Covenant University Ota, Nigeria

AFRICAN PRIVATE UNIVERSITY OF THE YEAR
African Leadership Magazine Group 2015

CU-ICADI

3RD
COVENANT UNIVERSITY INTERNATIONAL CONFERENCE ON AFRICAN DEVELOPMENT ISSUES (CU-ICADI)

THEME

DRIVING INCLUSIVE AND SUSTAINABLE DEVELOPMENT IN AFRICA: MODELS, METHODS AND POLICIES

Date: May 9-11, 2016   Time: 10.00am

Venue:
African Leadership Development Centre
Km. 10 Idiroko Road, Canaan Land, Ota, Ogun State, Nigeria

CONFERENCE PARTNERS

Cmfb   CAP plc   FIIRO   GOLDBRICK BUSINESS PALACE LIMITED   TOBADELI NIGERIA LIMITED

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CONTENTS

Covenant University: African Private University of the Year -(African Leadership Magazine Group 2015)

NATIONAL ANTHEM

1. Arise, O Compatriots
   Nigeria's Call Obey
   To Serve Our Fatherland
   With Love And Strength And Faith
   The Labour Of Our Heroes Past
   Shall Never Be In Vain
   To Serve With Heart And Might
   One Nation Bound In Freedom
   Peace And Unity

2. Oh God Of Creation
   Direct Our Noble Cause
   Guide Our Leaders Right
   Help Our Youth The Truth To Know
   In Love And Honesty To Grow
   And Live In Just And Truth
   Great Lofty Heights Attain
   To Build A Nation Where
   Peace And Justice Shall Reign

COVENANT UNIVERSITY ANTHEM

1. We're a covenant generation
   Pursuing excellence

   Redeemed to reign
   Learning to lead
   We are bound by an oath

   Obeying rules to rule
   Making Kings of youths
   Flying high on covenant wings

   Wisdom's call for change
   Inspired, on fire
   With courage
   Marching on in grace
   God's own arrow
   Shot for glory.

2. Covenant generation arise
   Light and knowledge to shine

   Glorious foundation stone
   Leadership skills to show

   Departing from knowledge
   To empowerment
   Legalism to realism

   Wisdom's call for change
   Inspired, on fire
   With courage marching on in grace
   God's own arrow
   Shot for glory.

COVENANT UNIVERSITY CONTEXT

VISION

To be a leading World-Class University, committed to raising a New Generation of Leaders in all fields of Human endeavour

MISSION STATEMENT

To create knowledge and restore the dignity of the black man via a Human Development Total Man Concept-driven curriculum employing innovative, leading-edge teaching and learning methods, research and professional services that promote integrated, Life-applicable, life-transforming education, relevant to the context of Science, Technology and Human Capacity Building

FOUNDING PHILOSOPHY

Covenant University is built on the philosophical platform espoused in the following aphorisms:

- A departure from *form* to *skill*
- A departure from *knowledge* to *empowerment*
- A departure from *figures* to *future building*
- A departure from *legalism* to *realism*
- A departure from *points* to *facts*
- A departure from *"mathe-matics"* to *"life-matics"*.

MANDATE

"Raising a new generation of leaders through a qualitative and life-applicable training system that focuses on value and skill development."
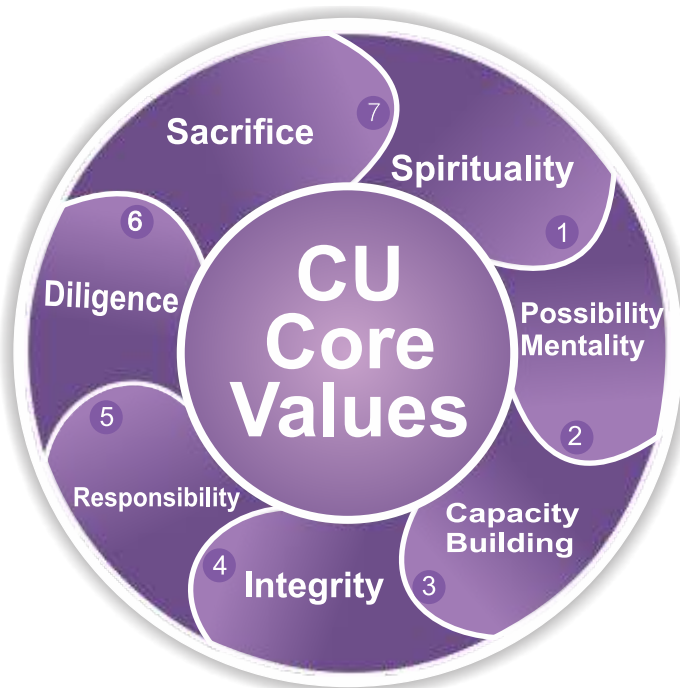
"Raising a new generation of leaders through a broad-based qualitative education built on sound biblical principles culminating in the birth of path-finders, pace-setters and trail-blazers."

"Raising a new generation of leaders who shall redeem the battered image of the black race and restore her lost glory as this trained army of reformers begin to build the old wastes, repair the wasted cities and raise the desolation of many generations."

CU Core Values

7 Sacrifice
1 Spirituality
6 Diligence
Possibility Mentality
5 Responsibility
2 Capacity Building
4 Integrity
3

CHANCELLOR'S WELCOME MESSAGE

I have the singular honour to welcome you to Covenant University, a visionary base for raising a new generation of leaders in all fields of human endeavours. Covenant University remains committed to maintaining its niche as a leading global centre for knowledge creation. Following the huge success of CU-ICADI 2014 and 2015 which had three distinguished Nobel Laureates, Professor Eric Maskin, Professor Thomas Sargent and Professor Alvin Roth as keynote speakers, Covenant University is keeping to its promise of making the CU-ICADI an annual event that attracts and engages the best brains known to humanity in proffering viable solutions to the diverse issues relating to Africa's development.

It is my delight to specially welcome the special guest of honour, an elder statesman of global acclaim and former President, Federal Republic of Nigeria, His Excellency, Chief Olusegun Obasanjo, GCFR. I also welcome the distinguished keynote speaker at this year's conference, Professor Joy Ogwu, Nigeria's Permanent Representative to the United Nations. May I also welcome all the eminent guest speakers who are notable intellectual icons in their various fields of human endeavour. I have no doubt in my mind that this carefully selected team of erudite scholars and technocrats will do justice to the central theme of CU-ICADI 2016, which is: Driving Inclusive and Sustainable Development in Africa: Models, Methods, and Policies. I do also expect that the inclusive and sustainable approach to this year's conference, as well as its expanded approach, will make the outcome of the conference much more beneficial to the development of the African continent.

Let us therefore keep ruminating over the issues that will be propounded on this conference platform as we seek to create sustainable development and the future we desire for the continent in our time and for the future generations yet unborn. Finally, I invite you to also spend some time to relax and enjoy the beautiful and research-friendly environment that Covenant University represents.

Once again, you are most welcome.

Dr. David O. Oyedepo
The Chancellor,
Covenant University

I am most delighted to welcome you to the 3rd International Conference on African Development Issues with the theme: Driving Inclusive and Sustainable Development in Africa: Models, Methods, and Policies.

This is an uncommon programme that is aimed at championing developmental issues in our continent. More than ever before, the socio-political and economic situations in Africa are getting more worrisome but definitely not beyond us if tackled headlong. It is the philosophy of our Chancellor, Dr. David Oyedepo that: "Universities on African soil must respond to the issues in the African Societies…".

ICADI is one of the strategic platforms targeted towards the actualization of Vision 10:2022 of the University, which is to get the University listed among the top 10 universities in the world by the year 2022. We are gradually approaching the end of the fourth year of the vision with proofs to show. Besides the giant strides made in the Webometrics ranking and the Presidential Special Scholarship Scheme for Innovation and Development, where the University has consistently remained tops, it is important to mention that in March 2016, Covenant University was awarded the African Private University of the Year (2015) by African Leadership Magazine Group (March 2016) and

Congressional Commendation of the State of Georgia US Legislative Black Caucus for pioneering excellence and innovation in tertiary education in Africa.

During the first and second ICADI, the University hosted three Nobel Laureates namely Professor Eric Maskin, Professor Thomas Sargent and Professor Alvin Roth. This is a feat of uncommon kind within the academic circle. Thanks to the Board of Regents of the University led by our Chancellor, Dr. David Oyedepo.

Ladies and gentlemen, nobody would be able to understand and solve the problems of Africa like Africans. Today, we are privileged to have illustrious sons and daughters of Africa present here to do justice to the topic of discussion.

Ladies and gentlemen, *Baba* is in the house. Therefore, I want to seize this opportunity to most respectfully recognize the presence of the former President and Head of State, His Excellency, Chief Olusegun Obasanjo (GCFR). Chief Obasanjo is a 2-time Head of

State of the Federal Republic of Nigeria: one as a Military Head of State and secondly as a Civilian President, the first of its kind in Nigeria.

President Obasanjo is a pan Africanist, an international figure of repute, a disciplined soldier cum administrator and a well-respected personality

PROFESSOR CHARLES K. AYO
Vice-Chancellor, Covenant University

worldwide. I will not fail to mention a few of his accomplishments in Nigeria that are still pivotal to the developmental discourse:
- He formed the Nigeria National Petroleum Corporation (NNPC).
- He established the "Green Revolution", an agrarian policy for Nigeria.
- He established the

Universal Primary Education (UPE), a scheme that is still being revisited today.

- How can we forget amongst other things, the debt pardon from the Paris and London Clubs amounting to $18bn. Suffice to say that he bailed Nigeria out of debt before leaving office in 2007.

Furthermore, I wish to recognize also, the keynote speaker of today, Prof. Joy Ogwu, a Professor of Political Science and International Relations. She was the first female Director General of the Nigerian Institute of International Affairs (NIIA). She was a Foreign Affairs Minister under President Olusegun Obasanjo. Ladies and gentlemen, her detailed citation will soon be presented to the house but my recognition will be grossly incomplete if I fail to mention that she is the first woman to hold the post of Nigeria's Permanent Representative to the United Nations and was the President of the UN Security Council in July, 2010, October 2011 and April 2014. I am sure you will all agree with me that this is the best choice of speakers ever made in the history of ICADI.

At this juncture, I wish to deeply appreciate our corporate partners who have contributed towards the successful hosting of this conference. I also acknowledge the tremendous efforts of members of the Conference Organizing Committee (COC) chaired by Professor Aaron Atayero, and other officers of the University for rising up to this task.

I recognize the contributions of the Covenant University Board of Regents towards building a great University that we are proud of. Their commitment to the actualization of Vision 10:2022 is unparalleled.

I wish to most respectfully acknowledge the support and contributions of the Vice-President (Education - LFCWW), Pst. Faith Oyedepo towards quality education delivery and character development expected of our Eagles, and the Chancellor, Covenant University, Dr. David Oyedepo, for his dedication to the actualization of the Vision of Covenant University, particularly Vision 10:2022. His passion and exemplary cum strategic leadership in carving out a niche that is fuelled by a visionary perspective of transformation and change is second to none. This has not only continued to inspire us, but also provide real impetus for us to continually strive to attain higher standards. We are privileged to have him as a worthy and notable leader indeed. Sir, Vision 10:2022 is a done deal in Jesus' Name.

I again welcome you to Covenant University. I wish you a successful and impactful deliberation, and I hope that the results of this conference will speak in years to come.

Thank you.

Professor Charles Korede Ayo
Vice-Chancellor

OUR BEGINNING, WHERE WE ARE AND OUR FUTURE

On October 21, 2002, the African educational landscape was radically altered by the formal entry of Covenant University (CU) into the Higher Education context. The University is located in Canaan Land, Ota, Ogun State, Nigeria, home of Faith Tabernacle, the largest Church Auditorium in the world. Covenant University is a fast growing, dynamic vision-birthed, vision driven University, founded on a Christian mission ethos and committed to pioneering excellence at the cutting edge of learning.

Covenant University was established by the World Mission Agency (an arm of the Living Faith Church) in the footsteps of world-renowned institutions like Harvard, Yale, Princeton and Duke. As a Christian mission University, her philosophy and pillars are deep-rooted in Biblical principles and are directed towards effecting a change that will advance humanity and restore the dignity of the Blackman. The University is driven by the compelling vision of raising a new generation of leaders in all fields of human endeavour.

Covenant University has stable academic calendar, a well-stocked library, state-of-the-art laboratories and an excellent road network. Our mandate is to pioneer excellence in teaching, research, community impact and scholarship. The University campus is an ultramodern campus and is fully residential for both staff and students with ample opportunities for informal interaction between faculty and students, thereby creating a special ambience of living and learning together. The University's home grown in-loco-parentis programme for mentoring students and addressing essential student issues, makes our university a home away from home for students, especially those who are leaving home for the first time.

The University is equipped with a network computer base enabled by wireless hot spots/Internet access, a wide range of lecture halls, theatres and laboratories equipped with high-tech electronic boards providing adequate facilities for teaching and research along the lines of the current 34 programmes with six options in the University's four Colleges of Business & Social Sciences, Leadership Development Studies, Engineering, and Science & Technology. All CU students are provided with first-of-its-kind mobile learning tablets loaded with courseware that engenders learning anywhere, anytime on campus via a special mobile platform.

All the University's academic programmes are accredited by the apex regulatory body for University education in Nigeria, the National Universities Commission (NUC), which rated the University as the overall best in

The Chancellor, Dr David Oyedepo at the historic commissioning ceremony of Covenant University on October 21, 2002

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the nationwide institutional accreditation exercise in 2005. Our professional programmes, such as, B.Sc /M.Sc Architecture; B.Sc Building Technology; B.Sc Estate Management; B.Sc Banking & Finance; B.Sc Accounting; B.Sc Marketing; B.Sc Mass Communication and B.Eng (Electrical & Electronic Engineering, Civil Engineering, Computer Engineering, Information & Communication Engineering, Mechanical Engineering, Petroleum Engineering, and Chemical Engineering) have been accredited by the relevant professional regulatory bodies.

The University also has a School of Postgraduate Studies. In 2009, approval was given by the NUC for the School to run postgraduate programmes for external candidates at the Masters and Ph.D. levels. The School has produced over 209 Ph.Ds and 514 Masters Degrees. The University's unique Total Man Concept and Entrepreneurial Development Studies driven curricula imbue in our students practical life skills and an entrepreneurial spirit, which has been acknowledged in the labour market. Our special graduation preparatory programmes, Towards A Total Graduate (TTG) and Leadership Certificate Course, are also designed to specially package the student for the world of work upon graduation, as an agent of change, set to take charge of his or her environment and break the

The University Students during a 3-week Summer cultural exchange programme to Lancaster, UK

barriers of limitation confronting our nation and continent at large. It should be noted that Covenant University pioneered the introduction of Entrepreneurial development studies, dress code (for purpose of grooming future leaders) and abolition of the award of pass degrees, in Nigeria and they have been adopted by the NUC.

Covenant University has robust international linkages and collaboration with top-ranked global Institutions. The University has signed Memorandum of Understanding with: Fayetteville State University, USA; University of Huddersfield, UK; Moscow Technical University of Communication and Informatics, Russia Federation; The University of West of England, Bristol, UK; University of Northumbria, UK; University of Florida, US; Lincoln University, UK; University of Durham, UK; The University of Nottingham, UK; University of Birmingham, UK; EISTI; German Development Institute/Deutshes Institute fur

Entwicklungspolitik (DIE) Bonn, Germany, among others.

These partnerships have afforded our students opportunities for short and long term exchange programmes abroad. Every summer, some of our students travel to the United States and the United Kingdom where they spend their holidays in some of their best Universities. We have also played host to faculty and students on exchange programmes from the United States. Also, the University has international visiting scholar programmes whereby academics of high repute from world-class Universities spend time in the University and contribute to her academic context.

Our students enjoy internship opportunities in the United Nations and other world-class Institutions. We are the only Private University (for eight years) in Nigeria approved by the United States and the

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Fulbright Commission to host and send Fulbright Scholars across the globe. Our students are uniquely packaged for the world of work. All students, irrespective of their course of study, are made to have at least two international ICT certifications at graduation. This has given our alumni competitive edge in the labour market as the demand for them continue to soar.

Reports reaching the University from the employers of our graduates have been very encouraging. Spread across the nation and overseas countries, the University's graduates have been performing extremely well in the banking sector, industries, politics, aviation and academic settings while some of them have become employers of labour, thus helping to address the unemployment challenges in our nation.

Our graduates are known for excellent performance in Nigeria, Africa and the rest of the world. For three years running, the First Class graduates of Covenant University have emerged tops in the Presidential Special Scholarship Scheme for Innovation and Development (PRESSID) (2013- 2015). A good number of alumni of the University, who joined the institution as graduate assistants have completed their Ph.D programmes. Some of them have equally served, with a touch of distinction, at high levels in the University administration. Also, a number of them are pursuing their postgraduate education in overseas countries, including University of Bolton, University of Stanford, Coventry University, University of Leeds, Baruch College, New York, College of New Caledonia, University of Greenwich, Kent

University, University of Bedfordshire, Birmingham City University, to mention but a few. Our graduates do not write intermediary exams for postgraduate admission in most reputable foreign universities – they are given preferential treatment and most of the time, their placement is certain. A Covenant University ICT Graduate Class of 2009 was awarded M.Sc Special Prize for Exceptional Performance by Kings College London, one of UK's leading Universities.

Covenant University is set to rewrite the history of higher education in Nigeria in the area of research, innovation and product development. In this regards, the University is in partnership with major organizations and industries in Nigeria under its industry partnership programme launched in 2015.

Trail blazing has been the hallmark of Covenant University since inception. Between 2014 and 2015, the University has played host to three Nobel Prize Winners in Economic Sciences, namely Professor Eric S. Maskin of Harvard University, Professor Thomas J. Sargent of New York University and Professor Alvin Roth of Stanford University as lead speakers at her International Conference on African Development Issues (CU-ICADI). CU-ICADI is an annual international

Members of CU Management with Award recipients at the Raw Materials Research and Development Council (RMFDC)/ Nigerian Universities Research and Development Fair (NURESDEF) Awards, where the university won numerous laurels

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conference that engenders innovative contributions towards value enhancement and sustainable development in Africa.

Covenant University has also hosted the Launch of UN Global Report on Human Settlement on two occasions (October 18, 2011 and September 25, 2014). This is a feat that no African University has achieved.

The University's unique vision is also being validated in the external context through awards and institutional recognitions. Some of the most recent include the following:

2002
o Federal Government approval of Covenant University's operational license was adjudged the fastest among the then 16 applications for establishment of private universities filed with the NUC and the University's assessment score was also the highest.
o First University in Nigeria to commence full academic and administrative activities at its permanent site with full scale functional infrastructure in place at resumption.

2005
o May 2005, NUC rated the University as the overall best in the nationwide accreditation exercise of that year.

o Best Private University in Nigeria.
o Most-preferred University among the private universities in the country by candidates seeking university admissions through the Joint Admissions and Matriculation Board (JAMB).

2006
o Best Vice-Chancellor of private universities in Nigeria for 2005 awarded to Prof. Aize Obayan.

2007
o Best ICT-driven University
o Private University with Most Improved ICT Programme and Facilities by the Commonwealth Scholarship Prize and Awards (CSPA 2007).
o 4 Summer Studies of the United States Institutes between 2007 – 2011.
o Covenant University won START/PACOM 2007 AWARD, by Global Change Systems for Analysis Research and Training.
o The Best at the Nigerian Model United Nations Society (NIGMUNS) Conference (2007).
o A 400-Level Electrical/Electronic student invented Portable Multimedia CD Player which won Medals during the International Exhibition

for Young Inventors (IEYI) in New-Delhi, India.
o A 300- level Accounting Student got the Goldman Sachs Africa Initiative (2007) award.

2008
o Fastest Growing Private University in Nigeria Award at the Education Time's Award of Excellence 2008.
o 6 United States Junior Fulbright Awards between 2008 and 2011.
o Best at the Nigerian Model United Nations Society (NIGMUNS) Conference (2008).

2009
o Best Private University.
o Best ICT Driven University of the Year 2009 at the National ICT Merit Awards.
o Two members of Faculty won the Ford Foundation Teaching Innovations Awards.

2010
o Rated "A" in the NUC's Pilot Institutional Accreditation
o A Covenant University Faculty member won a scholarship to attend the African School of Fundamental Physics & Its Application at the National Institute of Theoretical Physics,

Stellenbosch, South Africa.
o A Student in Business Administration won the Total Summer School Competition to represent Nigeria in Chantilly near Paris, France.
o A 400-Level Civil Engineering Student emerged 2nd Runner-up in the senior category of America National Day 2010 Art Competition by American Embassy in Lagos (2010).
o The Best ICT-Driven University in West Africa Award (2010).

2011
o First University in Africa to host the Launch of UN Global Report (October 2011).
o Best Marketing Students Award of the Year at the NIMN Award 2011.
o Ranked Number 1 Private University in Nigeria and among top 100 in Africa in World Universities Webometric Rankings.
o Hosted 4 Fulbright Scholars in Residence from the United States 2010 - 2011.
o Covenant University won the two (2) Gold Prizes at the Seoul International Invention Fair 2011(SIIF) for her inventions in "Radio Controlled Robotic Surveillance System and Hybrid Keyless Lock Based on SMS and Speech Recognition" organized by

the Korea Invention Promotion Association in Seoul KOREA.
o Covenant University also won the Bronze medal for the invention of School Management System Software at the same fair in Seoul, KOREA.
o A Faculty was awarded the United States Institute for Journalism and Media Study in 2011.
o Joint winner of the first edition of Unilever Idea Trophy.
o 6 Grantees of Third World Academy of Science (TWAS) Fellowship Awards (China, Italy, India, Malaysia, South Africa etc.).

2012
o Ranked Number 1 Private University in Nigeria and ranked in the top 100 in Africa in World Universities Webometric Rankings.
o Best Maintained Educational Institution in Nigeria at the Institutional Facility Management Award for 2012.
o 2nd and 5th positions in a Design Competition organized by Ife Architecture Students Association of the Obafemi Awolowo University, Ile-Ife held in December 2012.
o 1 Senior Fulbright Fellowship Award 2012.
o Covenant University got the Google-sponsored

Computer for High School (CS4HS) Initiative Awards 2012.
o Covenant University was the first University in Nigeria and one of the very few in Africa to start training SAP Consultants in collaboration with SAP University Alliances and SAP Education in 2012.
o Covenant University is the only University in Nigeria and one of the very few in Africa with both the Autodesk Authorised Training and Certification Centre in 2012.
o A Covenant University ICT Graduate, Class of 2009, was awarded the M.Sc Special Prize for Exceptional Performance by Kings College, London, one of UK's leading Universities.
o Covenant University emerged in the second position at the 2012 National Women History Art Competition organized by the Public Affairs Section of US Embassy.

2013
o Best Private University in Nigeria 2013 by Centre for Governance in Africa.
o Best at the 2013 Nigeria Software Competition, sponsored by Institute of Software Practitioners in Nigeria (ISPON).
o Ranked Number 1 Private

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University in Nigeria and ranked in the top 100 in Africa in World Universities Webometric Rankings.

o Best Performing Higher Institution of the Year Award.

o 19 First Class graduates of Covenant University emerged tops in the Presidential Special Scholarship Scheme for Innovation and Development (PRESSID).

o Covenant University made Top-Four at ARGUS Software International Competition 2013 organized by Argus Software Incorporated, Texas, USA.

2014

o Ranked Number 1 Private University in Nigeria in World Universities Webometric Rankings.

o First Class graduates of the University emerged tops in the Presidential Special Scholarship Scheme for Innovation and Development (PRESSID).

o Best Private University in Nigeria.

o Best Vice-Chancellor of Private University in Nigeria awarded to Professor Charles K. Ayo.

o The Centenary ICT-Driven University of the Year.

o The Best Private University in Nigeria by the United States based US Transparency International Standards (USTIS).

2015

o Grand Prize (Gold and Silver) at the UniAmerica Global Exhibition of Inventions for Creative, Happy Human and Smart Cities 2015 in Foz Do Iguacu, in Parana, Brazil (December 2015).

o Vice-Chancellor bagged Excellence and Leadership Award at the Nigerian Entrepreneurs Awards Night (November 2015).

o The University with highest listing of Google Scholars in 2015. CU produced 110 out of 797 Google Scholars listed in Nigeria.

o 1 Gold and 2 Silver Medals at the 67th IENA International Trade Fair for "Ideas, Inventions, New Products" 2015 in Nuremberg, Germany. (November 2015).

o Bronze Medal at the Seoul International Invention Fair 2015 in Seoul, Korea.

o No 1 Social-Media-Friendly University In Nigeria by Nigerian Tribune Newspapers (November 2015).

o Three Gold Medal Awards at the World Innovation and Invention Forum, Yancheng, China. The award was won on the innovation of Energy Retention Bags, Solar Powered Weather Station and Green Luminaire (September 2015).

o Vice-Chancellor, Professor Charles Ayo bagged the Excellence Leadership Award of the National Association of Nigerian Students (NANAS) (August, 2015).

o The Overall Best University in Nigeria and West Africa and number 15 in Africa on the Webometric Ranking.

o Ranked No1 in Web of Repositories in Nigeria and West Africa.

o The University with the highest listing of leading

Our three innovative products- Energy Retention Bag, Solar Powered Weather Station and Green Luminaire- won 3 Gold Medals at the World Invention and Innovation Forum 2015 in Yancheng, China and 1 Gold and 2 Silver Medals at the 67th IENA International Trade Fair for "Ideas, Inventions, New Products" 2015 in Nuremberg, Germany.

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LINKAGES AND COLLABORATIONS

Nigerian scientists. CU produced 78 out of the first 500 Nigerian Scientists listed by Cybermetrics.

o First Class graduates of the University emerged tops in the Presidential Special Scholarship Scheme for Innovation and Development (PRESSID).

2016

o Raw Materials Research and Development Council (RMFDC)/Nigerian Universities Research and Development Fair (NURESDEF) Awards (2016).

o African Private University of the Year (2015) by African Leadership Magazine Group (March 2016).

o No.1 Private University in Nigeria and Second Overall Best University in Nigeria on the Webometric Ranking of World Universities (February, 2016).

o Ranked No.1 in Web of Repositories in Nigeria and West Africa (February 2016)

LINKAGES AND COLLABORATIONS

The University signed MoU with the Universities and Institutions listed below:
1. Birmingham City University, UK
2. East Carolina University, USA
3. EISTI, France
4. Fayetteville State University, USA
5. Federal Polytechnic, Nassarawa
6. German Development Institute/Deutshes Institute Fur Entwicklungspolitik (Die) Bonn, Germany
7. Griffith College, Dublin, Ireland
8. Indiana University- Purdue University Fort Wayne (IPFW)
9. Landmark University
10. Moscow Technical University of Communication and Informatics, Russia Federation
11. North West University, South Africa
12. Oral Roberts University, USA
13. Otto-Von- Guericke-Universitat Magdeburg, Germany
14. Redeemer's University
15. Tavistock Institute, UK
16. Teesside University, UK
17. The School of Business, University of Ghana

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LINKAGES AND COLLABORATIONS

18. The University of Nottingham, UK
19. The University of West of England, Bristol, UK
20. Tuskegee University, USA
21. Universidad De Alcala, Spain
22. Universiti Kebangsaan Malaysia
23. University of Durham, UK
24. University of Florida, USA
25. University of Huddersfield, UK
26. University of Northumbria, UK
27. University of Petroleum and Energy Studies, India
28. University of Portsmouth, UK
29. University of Roehampton, London
30. University of Birmingham, UK
31. Investment One Financial Service Limited
32. Ado-Odo Ota Local Government Council
33. Un-Habitat
34. United Nations Humans Settlements Programme
35. Ads-Extraordinaire
36. Chams Plc
37. Biotechnology Society of Nigeria
38. IBM West Africa Ltd
39. System Maintenance Specialists Ltd
40. Health Peak Limited
41. Blood Bank Society of Nigeria, Lagos Chapter
42. Health Forever, Nigeria
43. Tecnik Specialist Services and Consultancy Ltd
44. Bel Papyrus Limited

45. Prison Fellowship Nigeria and The Prisons Services and The Small and Medium Enterprises
46. Goldtracks Business Palace Limited
47. Covenant University Microfinance Banks Ltd
48. Chartered Institute Of Personnel Management of Nigeria
49. Nigeria Air Force, Ministry of Defence on Research and Development
50. Viper Solutions and Resources Limited
51. Nigerian Foundaries Group
52. Songhai Regional Centre
53. Airtel Networks Ltd
54. Centre for Black and African

Arts and Civilization, Nigeria
55. Chartered Institute of Management Accountant
56. New Horizons System Solution
57. National Office for Technology Acquisition and Promotion
58. National Information Technology Development Agency (NITDA)
59. Association of Medical Laboratory Scientists of Nigeria (AMLSN)
60. African Clean Energy Summit (ACES)

German Agency for Research Official visit

Robert Gordon University Officials

Covenant University and KIA Motors Industrial Partnership

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ABOUT CU-ICADI 2016

The Covenant University International Conference on African Development Issues (CU-ICADI) series was established in 2014 as a unique platform for making innovative contributions towards value enhancement and capacity development of the African continent. The second edition built upon the success of the first featured the 2012 Nobel laureate in Economic Sciences as well as other renowned experts in development issues related to Biotechnology, ICT and climate change.

This third in the series of ICADI conferences aims at expanding the success of the previous two conferences by engaging participants on the Theme: Driving Inclusive and Sustainable Development in Africa: Models, Methods, and Policies. Accordingly, the third CU-ICADI is designed to cover a wide range of topics on the development of African nations vis-à-vis the humanities, social sciences and engineering, even as the foundation for the imminent African renaissance is laid. As is the custom at ICADI conferences, the 3rd CU-ICADI will feature a special keynote and guest lectures by renowned academics, seasoned administrators, legislators and industry experts.

In addition, there shall be dedicated fora and syndicate sessions that will provide opportunity for all participants to contribute to specific topics on sustainable and inclusive African development. This edition will feature scientific/technical paper presentations on a range of thematic areas from academic research and industry as well as syndicate sessions and product exhibitions. The conference will focus on specific areas of Inclusive and Sustainable Development in Africa as key drivers of a genuine economic prosperity and human capital development. Addressing these critical areas has enormous potentials to launch Africans into the league of developed nations of the world. The specific sub themes of the conference include:

- Good governance: Accountability and transparency for sustainable development in Africa
- Methods and concepts for enabling human capital development in Africa
- Entrepreneurial innovation as catalyst for development in Africa
- Developing the knowledge economy in Africa
- Sustainable infrastructure and technology for development in Africa
- Sustainable agriculture and food security in Africa
- Gender parity and sustainable development in Africa
- Health and environmental issues for sustainable development in Africa.

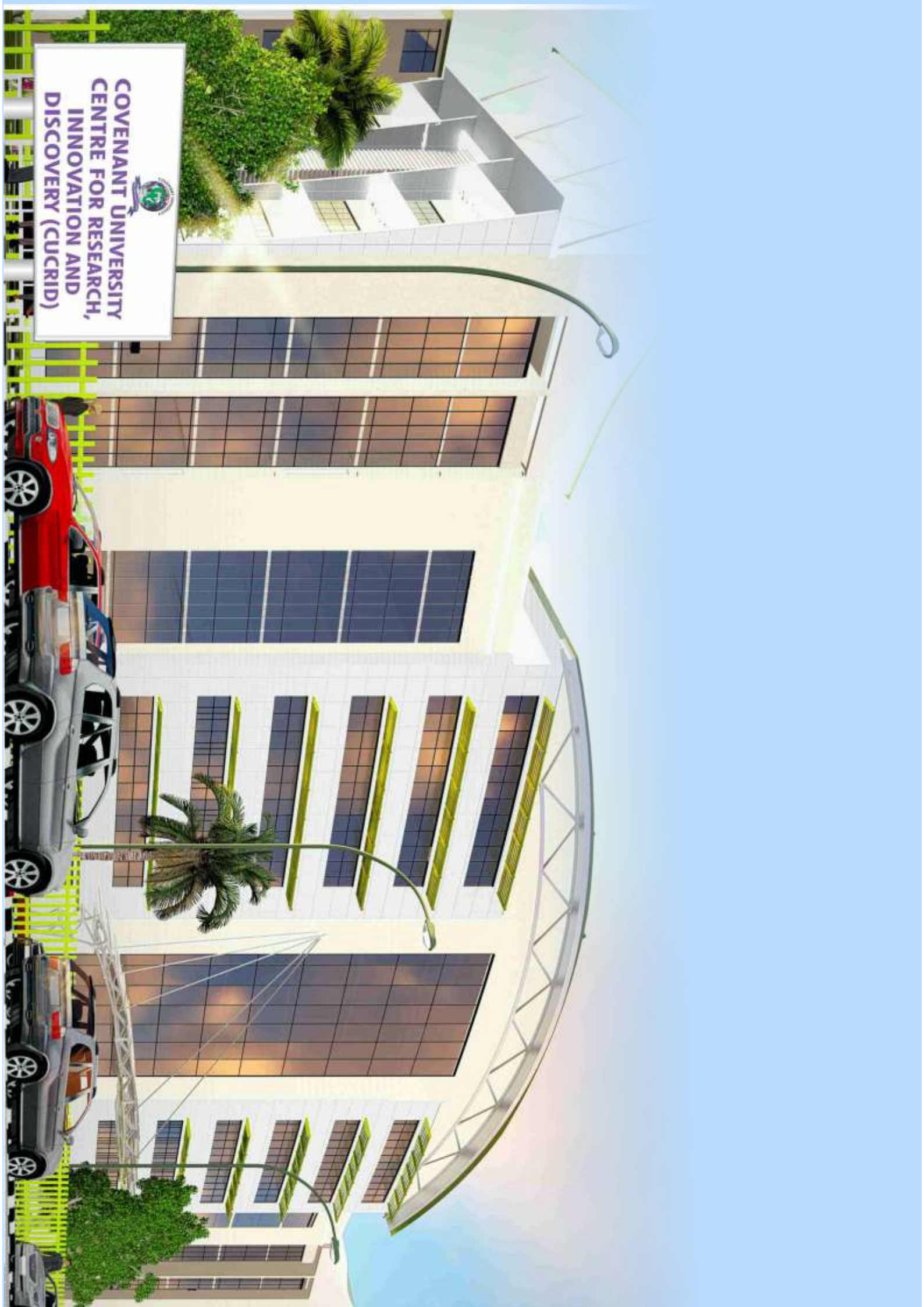Chancellor, Dr. David O. Oyedepo (centre) flanked by the Pro-Chancellor, Pastor Abraham Ojeme (left), the Vice-Chancellor, Prof Charles K. Ayo (right) and the Keynote Speaker and Noble Prize Winner in Economic Sciences, Prof Thomas Sergent at the opening ceremony of the first edition of CU-ICADI

Covenant University: African Private University of the Year -(African Leadership Magazine Group 2015)

WELCOME ADDRESS BY CHAIRMAN, COC

"It was the best of times, it was the worst of times".

The current socio-economic state of African nations, as is indeed of the world at large, is at best chaotic, at worst cataclysmic. But is it really? Gone are the days when stability was the natural consequence of systematic and conscientious efforts at national planning. Planned States are fast becoming failed States. Established democracies are declaring themselves bankrupt. Time-tested theories of old are fast tearing at the seams. Paradigm shift has become Paradigm skid. The societal variables are changing so fast, that the political theorists cannot keep the pace, causing many to lose the faith. In the current scenario of world events, the mind of the sage is enraged.

A Dame of The British Empire once said: "When nothing is sure, everything is possible." The world arguably has never been in a worse state of volatility, or in a better state for endless possibilities. A recurring theme in talks around the continent is the very endearing idea of African Renaissance. Since almost everything is conditioned by perspective, can we adopt the right perspective and by so doing make the best out of this worst of times? Is this a set up for those who can see beyond the immediate and recognise the bless in the mess? Is this the time for the "Dark Continent" to arise and shine albeit with minimal efforts as a direct consequence of the utter darkness around? These and many other questions as time will permit shall be pondered on during the three days of ICADI 2016.

In a bid to capture the zeitgeist of the African state at the moment, CU-ICADI 2016 departs from the tradition of the previous events by sourcing a worthy Daughter of Africa as Keynote Speaker. She will bring to bear her international

PROFESSOR AAA. ATAYERO
Chair, Conference Organising Committee (CU-ICADI) 2016

experience in diplomacy, while doing justice to the theme of the conference. As is the tradition at ICADI, the list of persons sourced as Guest Speakers for the sub-themes boasts of seasoned technocrats and practitioners who by virtue of their experiential base have a load to share.

By actively participating in the discussions that cannot but ensue after each thought-provoking keynote and technical presentation, you will benefit immensely in this process of charting a pathway for the long awaited African Renaissance.

Welcome.

Prof. AAA. Atayero
Conference Organising

COVENANT UNIVERSITY
CENTRE FOR RESEARCH,
INNOVATION AND
DISCOVERY (CUCRID)

3RD CU-ICADI PROGRAMME OF EVENTS (MAY 9-11, 2016)

DAY ONE: MONDAY, MAY 9, 2016

OPENING SESSION

Master of Event: Dr. Akan Williams

S/N	ACTIVITY	PRESENTER	TIME	VENUE
1	Arrival/Registration	All Participants, Delegates, Speakers and Exhibitors	08.00–09.30 am	ALDC Foyer
2	Pre-conference Networking/ Tea/Coffee	All Participants, Delegates, Speakers and Exhibitors	09.30–10.00 am	ALDC pavillion
3	Opening Prayer	The Chaplain, Covenant University	10.00–10.03 am	ALDC Main Auditorium
4	Conference Introduction	Chairman, Conference Organizing Committee	10.03–10.08 am	
5	Welcome Address	The Vice-Chancellor, Covenant University, Professor Charles K. Ayo	10.08–10.13 am	
6	Opening Remarks and Declaration of the Conference Open	The Chancellor, Covenant University, Dr. David O. Oyedepo	10.13–10.33 am	
7	Remarks by Special Guest of Honour	Former President, Federal Republic of Nigeria, His Excellency, Chief Olusegun Obasanjo, GCFR	10.33–11.03 am	
8	Citation of Keynote Speaker	The Deputy Vice-Chancellor, Covenant University, Professor Taiwo O. Abioye	11.03–11.08 am	
9	Keynote Speech	Nigeria's Permanent Representative to the United Nations, Professor Joy Ogwu	11.08–12.08 pm	
10	Panel Presentation	Discussants: a. Prof. Bonny Ibhawoh, Associate VP (Research), McMaster University, Canada b Mr. Timothy Oguntayo, GMD, Skye Bank	12.08–12.28 pm	
11	Goodwill Messages		12.28–12.38 pm	
12	Vote of Thanks	Registrar, Covenant University	12.38–12.43 pm	
13	Group Photographs	All Participants	12.43–12.48 pm	
14	Declaration of Exhibition Open/Exhibition	The Chancellor, Covenant University	12.48–01.05 pm	ALDC Foyer

3RD CU-ICADI PROGRAMME OF EVENTS (MAY 9-11, 2016)

15	Partners' Presentation	Partners	01.05–01.40 pm	ALDC Main Auditorium
16	Lunch Break	All Participants/Partners	01.40–02.20 pm	Café 2

SUB THEME PRESENTATIONS

Master of Event: Dr. Angela Eni

17	Presentation 1: Good governance: accountability and transparency for sustainable development in Africa	Presenter: Dr. Tunji Olaopa, Executive Vice Chairman, Ibadan School of Government and Public Policy	02.25 – 02.50 pm Reactions: 02.50–03.05 pm	
18	Presentation 2: Methods and concepts for enabling human capital development in Africa	Presenter: Dr. Nduka Okoisor, Head Talent Management, Forte Oil	03.10–03.35 pm Reactions: 03.35–03.50 pm	
19	Presentation 3: Entrepreneurial Innovation as catalyst for development in Africa	Presenter: Mr. Summy S. Francis, President Africa's Young Entrepreneurs	03.55–04.20 pm Reactions: 04.20–04.35 pm	ALDC Main Auditorium
20	Presentation 4: Developing the Knowledge Economy in Africa	Presenter: Senator Foster Ogola Chairman, Senate Committee on ICT	04.40–05.05 pm Reactions: 05.05–05.20 pm	
21	Presentation 5: Sustainable infrastructure and technology for development in Africa	Presenter: Dr. K.O. Olusola, Deputy Governor, Ekiti State	05.25–05.50 pm Reactions: 05.50–06.05 pm	
22	Announcement/Closing	Master of Event	06.05–6.10 pm	

3RD CU-ICADI PROGRAMME OF EVENTS (MAY 9-11, 2016)

DAY TWO: TUESDAY, MAY 10, 2016

Master of Event: Dr. Lanre Amodu

23	Registration/Networking	Participants	08.00–09.00 am	ALDC Foyer
24	Opening Prayer	The Chaplain, Covenant University	09.00–09.03 am	ALDC Main Auditorium
25	Welcome Address	Chairman, Conference Organizing Committee	09.03–09.08 am	

SUB THEME PRESENTATIONS				
26	Presentation 6:Sustainable agriculture and food security	Presenter: Prof. Emmanuel, Oladipo, Coordinator GEF, National Project on Sustainability and Resilience for Food Security.	09.10–09.35 am Reactions: 09.35–9.50 am	ALDC Main Auditorium
27	Presentation 7: Gender parity and sustainable development in Africa	Presenter: Dcns. Doyinsola Ogunbiyi President/CEO, Reach Out Integrated	09.55–10.20 am Reactions: 10.20–10.35 am	
28	Presentation 8: Health and environmental issues for sustainable development in Africa	Presenter: Dr. O. Kukoyi, MD/CEO Ace Medicare	10.40–11.05 am Reactions: 11.05–11.20 am	
29	Announcement:	a) Tea/Coffee Break b) Breakout Parallel Technical / Scientific Session	11.20 – 11.45 pm	ALDC Pavilion

3RD CU-ICADI PROGRAMME OF EVENTS (MAY 9-11, 2016)

TECHNICAL/SCIENTIFIC SESSIONS

30	Session 1 (Track 1A) Sustainable Infrastructure for development in Africa	Chairs: Prof. A. Adeboye Prof. O. Fagbenle Dr. D. Olukanni	11.45 - 2.00 pm	CEDS Hall 1
	Session 1 (Track 1B) Sustainable Technology for development in Africa	Chairs: Prof. S. Wara Prof. J. Omoleye Prof. S. John	11.45 - 2.00 pm	CEDS Hall 2
	Session 1 (Track 2A) Health & Environmental issues for sustainable development in Africa	Chairs: Prof. E. Iweala/ Dr. N. Benson/ Dr. G. Olasehinde	11.45 - 2.00 pm	CEDS Hall 3
	Session 1 (Track 3) Good Governance: Accountability & transparency for SD in Africa	Chairs: Prof. D. Gberevbie/ Dr. M. Egharevba	11.45 - 2.00 pm	CEDS Hall 4
	Session 1 (Track 4) Methods & concepts for enabling Human Capital Development in Africa	Chairs: Prof. J. Adeyeye/ Dr. C. Nkiko	11.45 -2.00 pm	CEDS Hall 5
	Session I (Track 5): Entrepreneurial Innovation as catalyst for development in Africa	Chair: Prof. I. Olurinola / Dr. O. Adegbuyi	11.45 – 2.00 pm	CEDS Hall 6
31	Lunch Break / Partners' Luncheon/ Exhibition	All Participants/Partners	2.00 – 2.40 pm 2.40 – 3. 10pm	Cafeteria 2
32	Session II (Track 1C): Sustainable Infrastructure for development in Africa	Chairs: Prof. A. Adeboye / Prof. O. Fagbenle / Dr. D. Olukanni	3.10 – 3. 25pm	CEDS Hall 1
	Session II (Track 6): Developing the Knowledge Economy in Africa	Chairs: Prof. S. Misra / Prof. P. Alege / Prof. C. Bolu	3.25 – 5. 55pm	CEDS Hall 2
	Session II (Track 7): Sustainable agriculture & food security in Africa	Chairs: Prof. E Maduagwu / Prof. K. Ajanaku / Dr. A. Eni	3.25 – 5. 55pm	CEDS Hall 3

3RD CU-ICADI PROGRAMME OF EVENTS (MAY 9-11, 2016)

	Session II (Track 2B): Health & Environmental issues for sustainable development in Africa	Chairs: Prof. E. Iweala / Dr. N. Benson / Dr. G Olasehinde	3.10 – 5.00 pm	CEDS Hall 4
33	Announcement/Closing			

3RD CU-ICADI PROGRAMME OF EVENTS (MAY 9-11, 2016)

	DAY THREE: WEDNESDAY, MAY 11, 2016			
	TECHNICAL/SCIENTIFIC SESSIONS			
34	Opening Prayer	Deputy Chaplain, Covenant University	8.00 - 8.03 am	ALDC Main Auditorium/ ALDC Pavilion
35	Welcome Message	Chairman, Conference Organizing Committee	8.03 - 8.05 am	
36	PechaKucha 20x20 Session	All Registered Participants Chair: Prof. S. N. Chinedu	8.05 - 11.00 am	
37	Tea/Coffee Break	All Registered Participants	11.00 - 11.30 am	
	BREAKOUT PARALLEL TECHNICAL / SCIENTIFIC SESSION			
38	Session III (track 1D)	Chairs: Prof. C. Awosope Prof. J. Odigure	11.30 -3.00 pm	CEDS Hall 1
	Session III (track 8)	Chairs: Prof. N. Derby Dr. N. Fayomi	11.30 -3.00 pm	CEDS Hall 2
	Session III (track 2C)		11.30 -3.00 pm	CEDS Hall 3
	WRAP UP/ CLOSING CEREMONIES			
39	Dinner/Closing Ceremony	All Registered Participants	3.00 -5.00pm	Cafeteria 2

POSTGRADUATE
HALLS OF RESIDENCE

BRIEF MILESTONES OF THE SPECIAL GUEST OF HONOUR

His Excellency,
CHIEF OLUSEGUN OBASANJO GCFR
Former President, Federal Republic of Nigeria

- Born March 5, 1937 in Ibogun, located in the present day Ifo Local Government Area of Ogun State, South-West Nigeria.

- In 1976, Chief Obasanjo was appointed as head of state by the Supreme Military Council following the death of Gen. Murtala Muhammed in an aborted coup.

- On 1 October 1979, Chief Obasanjo handed power to Shehu Shagari, a democratically elected civilian president, hence becoming the first military head of state to transfer power peacefully to a civilian regime in Nigeria.

- On 29 May 1999, Chief Obasanjo took office as the first elected and civilian head of state in Nigeria after 16 years of military rule. The day is now commemorated as Democracy Day, a public holiday in Nigeria.

- Before Chief Obasanjo's administration, Nigeria's GDP growth had been painfully slow since 1987, and only managed 3 per cent between 1999/2000. However, under Chief Obasanjo the growth rate doubled to 6 per cent until he left office, helped in part by higher oil prices. Nigeria's foreign reserves rose from $2 billion in 1999 to $43 billion on leaving office in 2007.

- Chief Obasanjo is a member of Club de Madrid, an independent non-profit organization created to promote democracy and change in the international community.

- Chief Obasanjo is a member of the Africa Progress Panel (APP), a group of ten distinguished individuals who advocate at the highest levels for equitable and sustainable development in Africa.

- Chief Obasanjo was recently appointed Special Envoy by UN Secretary General Ban Ki-Moon to the war-torn Democratic Republic of the Congo.

3RD
COVENANT UNIVERSITY
INTERNATIONAL CONFERENCE ON
AFRICAN DEVELOPMENT ISSUES (CU-ICADI)

CU-ICADI

THEME: DRIVING INCLUSIVE AND SUSTAINABLE DEVELOPMENT IN AFRICA: MODELS, METHODS AND POLICIES

PROFILE OF KEYNOTE SPEAKER

PROFESSOR JOY OGWU

Born on August 22, 1946, Professor Joy Uche Angela Ogwu is a former Foreign Affairs Minister of Nigeria and has been the Permanent Representative of Nigeria to the United Nations in New York since 2008.

Ogwu obtained her BA and MA in Political Science from Rutgers University. She later received her Ph.D. from the University of Lagos in Nigeria. While obtaining her Ph.D. in 1977, she joined the Institute of International Affairs at the University of Lagos.

A Professor of Political Science and International Relations, Ogwu started her career as an assistant lecturer at the Nigerian National War College and the Nigerian Institute for Policy and Strategic Studies (NIPSS). She subsequently joined the NIIA as a lecturer, obtaining a research fellowship during which she authored her first book, Nigerian Foreign Policy: Alternative Futures (Macmillan, 1986). She eventually headed the research department in International Politics, leading on to her role as the first female Director General.

Her participation in the government under the auspices of NIIA and the Presidential Advisory Council on International Relations enabled positive contribution to practical government policy such as the construct of the Nigeria-South America relationship on a macro level and the United Nations Educational Social and Cultural Organisation (UNESCO)

funded programme for teaching human rights in Nigerian Schools on a micro level.

Sequel to her appointment as Foreign Affairs Minister by President Olusegun Obasanjo on August 30, 2006, Ogwu, in 2008, became the first woman to hold the post of Permanent Representative to the United Nations in the history of Nigeria.

Professor Ogwu was the President of the UN Security Council in July 2010, October 2011 and April 2014.

Her career has been distinct in its additional focus on the developing countries of Latin America enabling an investigation into the possibilities of a proficient South-South relationship between Sub-Saharan Africa and Latin America, and she has published books promoting more African ties to Latin America.

As an expert on security issues, she serves on the United Nations Secretary General's Advisory Board on Disarmament Matters. In 2011, she was elected the First African President of the UN Programme of Action on Small Arms and Light Weapons.

Following numerous intensive consultations across the world, Ogwu led the 193 Member States of the UN in September 2012 to adopt a landmark consensus Outcome Document. This

momentous achievement has been widely acclaimed as a major diplomatic accomplishment for Nigeria, Africa and humanity.

Her continued role on the Nigerian National Delegation to UN General Assembly exhibits her contribution as an influential figure in the formation of Nigeria's relationship with the rest of the world.

Among her numerous honours, Professor Ogwu was conferred with an award of OFR – Officer of the Federal Republic; for exemplary contribution to Nigeria.

She is also a recipient of the 2002 Diplomatic Excellence Award presented by the Society of International Law and Diplomacy.

PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

Prof. Bonny Ibhawoh is a professor of Global Human Rights and Peace Studies at McMaster University, Canada. He is also currently the Associate Vice-President for Research at the University. He was previously the Director of the Centre for Peace Studies at McMaster University. He has taught in universities in Africa, the United Kingdom, the United States and Canada, including the University of North Carolina, USA and Brock University, Canada. He was previously a Human Rights Research Fellow at the Carnegie Council for Ethics and International Affairs, New York; a Research Fellow at the Danish

Prof. Bonny Ibhawoh
Professor of Global Human Rights and Peace Studies
Associate Vice-President (Research)
McMaster University, Canada

Institute for Human Rights, Copenhagen, Denmark and an Associate Member of the Centre for African Studies, School of Oriental and African Studies (SOAS), University of London, UK. He is the author of several books on human rights, peace and conflict studies. These include: Imperialism and Human Rights (SUNY Press) and Imperial Justice: Africans in Empire's Court (Oxford University Press). He has served as consultant to several governmental and non-governmental organizations on conflict resolution, human rights training, monitoring and evaluation. He writes a blog on "Global Human Rights, Social Justice and Peace."http://giazilo.blogspot.ca/

College of Science and Technology

PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

MR. TIMOTHY OGUNTAYO

Mr. Timothy Oguntayo was appointed to the Board of the Bank on August 18, 2009. He was the pioneer MD/CEO of Skye Financial Services Limited (the investment banking arm of Skye bank) before the Bank's divestment from it in 2012. He equally served on the

MR. Timothy Oguntayo
Group Managing Director/CEO, Skye Bank

Boards of Skye Stockbrokers Limited, Law Union & Rock Insurance Plc. and Kakawa Discount House Limited.

Following Mr. Kehinde Durosinmi-Etti's retirement from the Board on July 31, 2014, Timothy was appointed Acting GMD/CEO from April 15, 2014 and substantive GMD/CEO from August 1, 2014. Prior to this appointment as GMD/CEO, Timothy was the Bank's Executive Director responsible for the supervision of Corporate and Investment Banking Group, Commercial Banking in the South–West Region and all the international banking subsidiaries of the Bank.

Mr. Oguntayo has vast experience in financial advisory services and structuring of project finance across several sectors. He was part of the team that steered the successful merger of Prudent Bank with the other legacy institutions forming Skye bank, and has since been a core member of the executive team driving the growth of the Bank to its present height. Timothy's multi–disciplinary background adequately prepared him for the responsibilities of his new office. He is a known strategist with immense ability to innovate, and proffer solutions in sometimes complex situations. He is well respected in the financial circles both at home and abroad as a thorough bred manager and technocrat, and as a builder of relationships. It is, therefore, not surprising that under his leadership, the Bank successfully acquired Mainstreet bank and seamlessly integrated the products and services, processes, human capital and IT amongst others.

Mr. Timothy Oguntayo is an alumnus of the Prestigious INSEAD, Fontainebleau in France.

DR. TUNJI OLAOPA

Tunji Olaopa holds a doctorate degree in public administration, a

DR. TUNJI OLAOPA
Permanent Secretary, Federal Ministry of Communication Technology, Nigeria

culmination of two earlier degrees in political science and political theory from the University of Ibadan, Nigeria. From this intellectual background and management consulting practice, Dr. Olaopa joined the civil service as a Chief Research Officer in the Office of the President of Nigeria in 1988. He is currently the Permanent Secretary (Career Management Office) at the Office of the Head of the Civil Service of the Federation, Abuja. His areas of expertise ranges from public sector reform and restructuring, policy analysis and research designs, sector diagnosis and strategic planning, HRM to governance and institutional analysis/development.

PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

Dr. Olaopa has published severally and widely. Apart from several seminal articles in peer review journals and books, he is the author of six titles. These include: including Theory and Practice of Public Administration and Civil Service Reforms in Nigeria (2008), Innovation and Best Practices in Public Sector Reforms: Ideas, Strategies and Conditions (2009), and Public Sector Reforms in Africa (2010). He has led and participated in many initiatives like the Nigerian Education Sector Strategy and the National Public Service Reform Strategies Development (2000, 2003 and 2007) as well as a number of continental programmes of the African Union's Conference of African Ministers of Public Service (CAMPS).

He is a member of several professional bodies like the International Institute of Administrative Sciences, Nigeria Institute of Management Consultants, Commonwealth Association for Public Administration and Management (CAPAM), and guest lecturer at the Administrative Staff College of Nigeria, Centre for Management Development & Pan-African University in Lagos, amongst many others.

DR. NDUKA OKOISOR

Dr. Nduka is a Human Resources Professional, with over fourteen years' experience in Human Resources Management. He has a first degree in Dental Surgery, a Masters in Management Information System, and an Associate of the Chartered Institute of Personnel Management.

He started his career in Human Resources as a Business Analyst in Human Capital at Phillips Consulting, where he was involved in Recruitment, Training, Business process review and HR Strategy.

Over the years he has been involved in recruitment exercises from the entry to senior management levels, developed human resources strategy, competency frameworks as well as implementation of Performance Management Systems for leading companies in various sectors in Nigeria.

His experience covers a wide range of industries, including the financial services industry, manufacturing sector,

Dr. Nduka Okoisor
Head, Talent Management, Forte Oil Plc

telecommunications, and the oil and gas sectors.

Currently, He is the Head of Talent Management at Forte Oil Plc and he works in cooperation with key business & HR leaderships to co-create, execute, lead, and evaluate the impact of key talent processes for Forte Oil and its subsidiaries, including but not limited to talent acquisition, performance management, talent development, succession planning, and retention optimisation.

PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

SUMMY SMART FRANCIS

Summy Francis is the President and Founder of Africa's Young Entrepreneurs, an Organisation which is the largest entrepreneurship network in Africa with over 12 million members across the continent, Mr Francis

Summy Smart Francis
President Africa's Young Entrepreneurs South Africa

oversees its strategy and execution. Summy Francis started his first business venture at a young age of 14 where he worked at his Father's hotel in Lagos, Nigeria. At 17 the challenging task of managing one of the branches (Mullard Hotel) was handed down to him. From this early experiences he attained extensive business maturity and management skills,during his quest to becoming

a self-made successful entrepreneur, Mr. Francis experienced the challenges of limited capital and networks. In 2008 Mr. Francis formed Alien Rights Organization which advises and protects the rights of Aliens in foreign countries. He also works very closely with charity organizations that benefit the youth.

Mr. Francis is a persistent and determined entrepreneur and his extraordinary characteristics of self-confidence and creativity have given rise to his successful enterprises and also won him several awards which includes: 2011 Young CEO of the year in South Africa and 2015 Nigeria's Innovative personality of the year (INNOVATION AWARDS) . He is the Chairman and Chief Investor of SSF investments,Creative Director of Mega Minds, Chairperson of the Young Billionaires Club (Johannesburg) and he sits on the boards of several companies as a non-Executive Director. A visionary philanthropist and a writer, Mr. Francis holds a degree in Computer science, and a

SENATOR FOSTER OGOLA

Senator Foster Ogola who is popularly known with the title: Evangelist and Distinguished senator was born on February 5, 1954. He attended Esenaeb College Bomadi Delta State and Rivers State School of Basic Studies from 1975-1979. He obtained B.Sc Management from Nigerian College of Administration, Lagos; M.Sc Christian Leadership, Imo State University, Owerri and Ph.D Christian Leadership from GMF Christian University Lagos.

He also attended and obtained various qualifications from African Business School Abuja; Institute of Fraud Examiners, Abuja; UNOSAT Institute at the European Organization for Nuclear Research (CERN), Geneva, Switzerland.

Senator Ogola holds a Professional Associate - ACIA, Chartered Institute of Administration (CIA) of Nigeria; Associate Member, Chartered Institute of Arbitrators, Nigeria (ACIARB) and Doctorate Degree - Honouris - Causa: Doctor of Theology, Tam -Light Christian University, Port Harcourt, Nigeria. He was ordained a Christian Penticostal Evangelist in 1998.
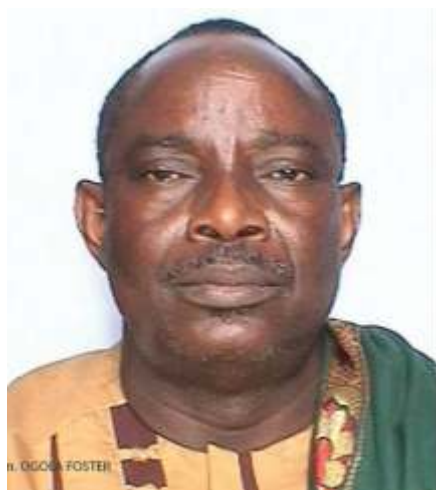
PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

Senator Foster Ogola has a rich political and business profile. He was a class teacher, Vice-principal, CEO Rivers State Government Development Projects

SEN. FOSTER OGOLA
Chairman, Senate Committee on ICT & Cyber Security

Implementation and Monitoring Committee (1980); Director General, Rivers State Works Directorate, Port-Harcourt (1981-1983); Chairman/CEO Bibowei Nigeria Limited, a personal business he incorporated in 1984; Special Adviser Political & Development Project to Governor Rufus Ada George, Governor of Rivers State (1992-1993); Chairman, OMPADEC

Establishment Committee in Rivers State (1992); Rivers State Secretary, National Republican Convention (NRC) Party (1993);

Senator Foster Ogola was elected as Delegate to the 1994 -1995 National Constitutional Conference - Abuja and he was the one who invented the lexicon " Resource Control' during the 1994/95 Constitutional Conference.

He was the head of the Movement for the Creation of Bayelsa State (1995-1996); Special Adviser and Chief Legislative Assistant to Senator Diffa in the Senate of Nigeria (1999- 2001); Special Adviser to the Bayelsa State Governor on Investment and Economic Development (2006- 2007).

Senator Ogola has headed several campaign committees that led to the emergence of several Governors and Senators in Rivers and Bayelsa States. He also served and still serves as chair and leader of several Christian groups.

Senator Foster Ogola is the Provost, United Nations

Institute for Training and Research (UNITAR), Yenagoa, Bayelsa State and Niger Delta Institute for Good Governance and Human Development, Sagbama, Bayelsa State 2008 till date. He was the Chairman, Bayelsa State Scholarship Board (2012 to 2014).

Foster Ogola was elected Senator of the Federal Republic of Nigeria on March 28, 2015 representing Bayelsa West Senatorial District.

He was also elected Member ECOWAS Parliament February 4, 2016

As a Senator, his legislative interests are on: NDDC, Upstream/ Downstream Petroleum, Defence, Works and Infrastructure, Housing FCT and Appropriation.

His target achievements are on: sponsorship of the best for the good governance of Nigeria, collaboration with fellow Senators to achieve their objectives and lobbying for developmental projects for Bayelsa State.

PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

DR. KOLAPO OLUSOLA

Dr. Kolapo Olubunmi Olusola was born on the 24th day in the month of May in the year 1968 at Ikere-Ekiti, Ekiti South Senatorial District, Ekiti State to the family of Elder Joshua Olusola Eleka. He attended St. Matthew Primary School and the famous Annunciation Secondary School (ANCO) both at Ikere-Ekiti before proceeding to bag a Bachelor of Science degree in Building at the Obafemi Awolowo University, Ile-Ife, Nigeria in 1989.

He also went ahead to earn a Master of Science degree in Construction Technology at the University of Lagos, Akoka, Nigeria in 1993 and later a Ph.D. in Building Structures again at OAU where he has worked as a senior lecturer. He has been a member of Nigerian Institute of Building since 1993 and a registered builder since 2005.

He is currently the Deputy Governor of Ekiti State.

PROF. EMMANUEL OLADIPO

Professor Emmanuel Olukayode Oladipo was born in 1951. His educational career has been glorious. He obtained Ph.D Geography, University of Toronto, Canada, 1983, M.Sc Geography, University of Toronto, Canada, 1977, BA Geography (First Class), Ahmadu Bello University, Nigeria, 1974. He was former Head of Geography Department, Deputy Dean, Faculty of Science, Ahmadu Bello University, Zaria.

Professor Oladipo is a Professor of Geography. He has served in and headed several national and international positions including: Regional Coordinator, GEF/UNEP Transboundary Project, Niger Republic (2006 – 2012); Head, Energy and Environment Unit, United Nations Development Programme (UNDP), Nigeria (2002 -2006; Sustainable Development Adviser, UNDP, Nigeria (1994- 2002).

Prof. Oladipo consults regularly for the Federal Ministry of Environment, UNDP Nigeria, Global Environment Facility (GEF), African Development Bank and the National Infrastructure Assistance Facility (NIAF) on policy and other sectoral issues of climate change, energy and food security. He has been leading the Nigerian delegation on adaptation to the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COPs) since 2009.

Prof. Oladipo is currently with the Department of Geography, University of Lagos to lead research on Energy and Climate Change. He is vastly published in national and international Journals in the area of climate change, drought and desertification.

PROFILE OF SPEAKERS, PANELISTS AND DISCUSSANTS

DCNS. DOYIN OGUNBIYI

Mrs. Doyin Ogunbiyi is a thoroughbred professional with rich background in the field of Communication and varied experience in Corporate Image and Reputation Management. She hails from from Ake and Oke-Ona Egba area of Abeokuta, the Ogun State capital.

Born in the mid-1950s to

seasoned educationists, Chief and Mrs. S. A. Adesina of blessed memories, Mrs. Ogunbiyi is a highly experienced, versatile and humble professional who has carved a niche for herself as a woman of great achievements by occupying leading positions, which are predominantly dominated by men.

Mrs. Ogunbiyi holds a Masters Degree in Communication Arts (MCA) and started her career in the media profession in 1974 when she joined the first WNTV/WNBS. She has since worked at and

headed several establishments.

A woman of distinction, Ogunbiyi, has recorded many firsts in various endeavours, which include being first Woman Chairman of the Ogun State Chapter of the Nigerian Institute of Public Relations (NIPR); first female Fellow of the Nigerian Institute of Public Relations, Ogun State; first woman in the National Council of NIPR (Representing Ogun State); first Commissioner for Women Affairs and Social Development in Ogun State; first woman to be the Commissioner for Works and Housing in Ogun State; first woman to be the Chairman, Board of Directors of Ogun State Television (OGTV); and first Chairman Ogun State Board of Technical and Vocational Education.

Presently the Chairman of the Ogun State Board of Technical and Vocational Education, Ogunbiyi is a woman who possesses multidisciplinary dimensions and capabilities. By virtue of many courses, seminars, and workshops in which she was either the organiser or presenter, she has presented many professional papers and made speeches too numerous to mention.

She is a Fellow/member of several professional bodies like the Nigerian Institute of Public Relations (NIPR), Nigerian Institute for Training and Development (NITAD), Nigerian Institute of Corporate Administration (NICA),

Institute of Entrepreneurs (IOE), Nigerian Institute of Management (NIM) and the Nigerian Union of Journalists (NUJ).

Also, Ogunbiyi has baggd several awards to her credit, among which are the Ogun State VIP Sport Personality Award; PSR Woman of Gold Award, the Amazon Distinguished Woman of Excellence Award, Ijamido Motherless Children's Home Selfless-Service Award, the National Association of Ogun State Student of Babcock University- Merit Award, the Nigerian Institute of Public Relations -Most Outstanding PR Professional of the Year Award and the Ogun State Government Meritorious Service Award in recognition of her sterling performance as Commissioner for Works and Housing.

Mrs. Ogubiyi, a Deaconess, who balances her rich professional career with service to God, also has a passion for Youths and Women, and gets twined up in anything that involves their lots and takes pleasure in Social Welfare activities. She is the initiator of the National Christian Youth Club (NCYC).

An attribute that compels attention, is her humanness, she shares your anxiety, sooths your agonies, and her charisma is a veritable balm in times of crisis, committed and compassionate.

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Preface

This volume contains the papers accepted for presentation at CU-ICADI 2016: 3rd Covenant University International Conference on African Development Issues held on May 9-11, 2016 in Ota. Over 300 papers and abstracts were submitted to CU-ICADI 2016, of which the Conference Programme Committee finally accepted 128 papers and 9 abstracts after rigorous double blind review.

The vision of Covenant University to become one of the top Ten University in the World in the next seven years (i.e. by 2022) is as laudable as it is divine. In pursuance of this most noble of goals, the Covenant University International Conference on African Development Issues (CU-ICADI) came into existence to create a uniquely conducive platform for promoting intellectual discourse on issues bordering on Africa development. CU-ICADI 2016 is aimed at creating a unique avenue for stimulating innovative contributions towards value enhancement and capacity development of the African continent from the perspective of the founding departure philosophy of Covenant University. This third in the CU-ICADI series of conferences will provide the ambience to network and collaborate with relevant stakeholders in the industry, policy makers, national and international development agencies, financial institutions, research bodies and the academia to engage themselves with varied issues concerning the development of the African continent.

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The Conference Organising Commitee appreciates the following persons and organisations for their role in ensuring that CU-ICADI 2016 is a success:

Dr. David Oyedepo, Chancellor and Chairman Board of Reagents of Covenant University, Ota.

Profesor Charles Ayo, Vice-Chancellor, Covenant University

Professor Taiwo Abioye, Deputy Vice-Chancellor, Covenant University

Pastor Olamide Olusegun, Registrar Covenant University

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Power Line Communications: A Platform for Sustainable Development

Matthew Kwatri Luka
Department of Electrical and Electronics Engineering
Modibbo Adama University of Technology, Yola
matthewkl@mautech.edu.ng

Felix Olowononi
Department of Electrical and Information Engineering
Covenant University, Ota
felix.olowononi@covenantuniversity.edu.ng

Joseph Stephen Soja
Department of Electrical and Computer Engineering
Ahmadu Bello University Zaria, Nigeria

sojasteve@gmail.com

*Abstract –***Electricity infrastructure together with information and communication technology (ICT) constitute a veritable platform for driving inclusive and sustainable development. However, last mile internet access in underdeveloped areas is limited by deficit telecommunications infrastructure. This is mainly due to the cost associated with deploying telecommunication distribution networks and the low returns on investments associated with underdeveloped areas. The availability of electric power grids which can be used as telecommunication distribution networks, makes the idea of using power line communication and wireless networks a realistic means of providing communications service to underdeveloped areas.On the other hand, electricity utilities needs an efficient and cost effective means of operating and managing the electric grid. This paper reviews different power line communications technologies that can used to achieve a smart grid model that provides a sustainable electricity and ICT infrastructure for development in Africa.**

Keywords—Narrowband Power Line Communications, Broadband PLC, Broadband Internet Access, Smart Metering, Electricity Theft Prevention.

I. INTRODUCTION

Modern power grids have evolved from a vertically integrated system to an unbundled system that introduces market activities at the generation and distribution ends. To this end, power utilities have been split into various independent entities of generation companies (GENCOs), transmission companies (TRANSCOs) and distribution companies (DISTCOs). This unbundling allows the integration of large scale sustainable and renewable energy sources and improved competition. However, the introduction of distributed energy sources can result in islanding due to power failure. It is thus necessary to incorporate robust communication technologies that ensures the security and stability of distributed utility system [1].At the distribution end of the power system, smart grid offers a platform for advanced metering infrastructure, demand response and demand side management. These applications enables DISTCOs to reduce both technical and non-technical losses as well as encourage active consumer participation in the management of the power system. Smart grid involves the use of various communication technologies to provide the needed monitoring, control protection.Generally, the communication system of a power system can comprise of satellite, the internet, fixed networks (e.g optical fiber) and wireless networks (e.g WiMAX and GSM).

These technologies are inadequate or in some cases unavailable in underdeveloped areas. Even where these communication infrastructures are available, the cost of renting is not justified. Another important parameter that influence the choice of smart grid technology is the wiring topology and power distribution infrastructure of an area or utility. Wireless technologies are better suited to electric distribution infrastructures that relies on small transformers to serve small number of homes [2]. On the other hand, technologies that allow aggregation of user information are more amenable to distribution infrastructures that utilize large secondary transformers to service a several homes. Power Line Communication (PLC) isa suitable and cost effective means of achieving smart grid in in underdeveloped areas where most conventional communication systems are not available. PLC is suitable for the wiring topology and power distribution infrastructure of most African countries where large secondary transformers which serves several homes are used. The use of fewer but large transformers minimizes attenuation of the PLC signal by transformers. A number of smart grid projects based on PLC have been implemented in Europe, where the power distribution topology is similar to that of most Africa countries [3], [4]. PLC technologies operating below a frequency range of 500 KHz are known as narrowband technologies. Narrowband technologies can be employed for various *energy-related* services such as automated meter reading, dynamic pricing, distribution system monitoring/maintenance, demand side management etc. Narrowband technologies are also used for automation of building systems and electric devices as well as implementing security task and sensor interconnections.

In addition to using PLC technologies for sustainable management of the electric grid, they can be used for providing telecommunication services. Telecommunication access networks are used for providing direct connection to subscribers. However, it is estimated that about 50% of all telecommunication investments is expended in the realization and management of access networks [5]. This impedes investment in access network infrastructure due to slow return on invested capital especially in rural/underdeveloped areas. Broadband PLC technologies can be used to realize a cost effective access network as it leverage the existing electric power distribution system.Broadband PLC technologies operate at frequencies above 1 MHzwhich can support broadband internet access, multimedia services and utility application with adequate quality of service (QoS). Broadband technologies can

also be used for In-home applications such as setting up a local area network (LAN) and home automation and security tasks. Connection to individual endpoints over the low voltage (LV) distribution network is known as Home Area Network (HAN). Neighborhood Area Networks (HANs) are implemented over the medium voltage (MV) segment of the distribution network to provide an interaction point between HAN and the utility's operations network. In NAN, data concentrators are used to aggregate information from various endpoints for transmission to utility database/information system. PLC technologies finds more extensive application over HAN and WAN, partly due to the distributed nature of modern communication system and the significantly high attenuation over the high voltage segment. Narrowband technologies cannot support the high data rate of aggregated user data over the WAN. On the other hand, broadband technologies cannot by-pass transformers due to the inductive nature of transformers and the increase in attenuation with frequency. Other communication technologies such as WiMAX, GSM, satellite and optical fiber networks offer better alternatives for implementing smart grid over the WAN. The cost of renting or installing conventional technologies for WAN is justified due to the large bandwidth of aggregated user information from the HAN/WAN. However, PLC technologies can be used over the HV segment to implement low data rate system wide monitoring, protection and control. Section II of this paper provides an overview of both narrowband and broadband PLC technologies. Grid management applications necessary to ensure a sustainable electricity infrastructure are highlighted in section III. Section IV provides disquisition on some ICT services that can be realized using PLC technologies.

II. PLC SMART GRID ACCESS SYTEM

The concept of PLC began with the deployment of carrier frequency systems (CFS) on HV line for voice communication and operations management. CFS operate in the 15 – 500 kHz frequency range and is capable of achieving a coverage distance of up to 500 km with an average transmission power of 10 W [6]. However, CFS was not amenable to LV and MV distribution networks due to different conductor types and the high number of inter-connections. Ultra narrowband (UNB) technologies such as the turtle system, ripple carrier signaling (RCS) and the two-way automatic communication system (TWACS) were developed for use on the LV and MV segments. These technologies operate between the super-low frequency band (30 – 300 Hz) and ultra-low frequency band (300 - 3000 Hz) and provide low data rates of few bps. The power requirements of UNB systems (between 10 kW – 1 MW for RCS) is asignificant cost factor. The need for higher data rate and low transmission power motivated the development of low data rate (LDR) narrowband technologies. The CENELEC EN 50065 (Comite European de Normalisation Electrotechnique) is a popular standard for LDR narrowband technologies. The percentage of bandwidth reserved for various application in the CENELEC standard is shown in Fig.1.

LDR narrowband technologies such as LonWorks (ISO/IEC 14908), KNX (ISO/1EC 14543-3-5), IEC 61334-3-1/IEC 61334-5 and CEBus (CEA-600.31) are based on single-carrier or spread spectrum transmission technologies. As depicted in Fig. 1, much of the bandwidth is reserved for energy related services, leaving only 38% for other smart grid applications. To provide more bandwidth for other smart grid applications high data rate (HDR) narrowband technologies with operating frequency of up to 500

kHz were developed. These technologies also employ the use of Orthogonal Frequency Division Multiplexing (OFDM) for improved resiliency against frequency selective fading and attenuation associated with the power line medium. Current OFDM based narrowband technologies include the ITU-T G.9902 (ITU-T G.hnem), ITU-T G.9903 (G3-PLC), ITU-T G.9904/PRIME Powerline Related Intelligent Metering Evolution) and IEEE P1901.2 standards [7]. As outlined in [2], the data requirement of smart grid applications ranges from few bytes to tens of kilobytes. However, modern smart grid applications such as advanced metering infrastructure (AMI) may comprise of millions of nodes. The sheer size of nodes may result in difficulties in real time data delivery, downstream data flow and realizing certain functions (such as firmware upgrade) that may require higher data rates. There are a number of broadband narrowband technologies such as IEEE 1901(HomePlugAV/HD-PLC), ISO IEC 12139-1, ITU-T G.hn, HomePlug AV2, HomePlug Green PHY, UPA Powermax, Gigle MediaXtreme and TIA- 113/ HomePlug 1.0 that can be used to implement high data rate smart grid and in-home applications with satisfactory QoS characteristics.
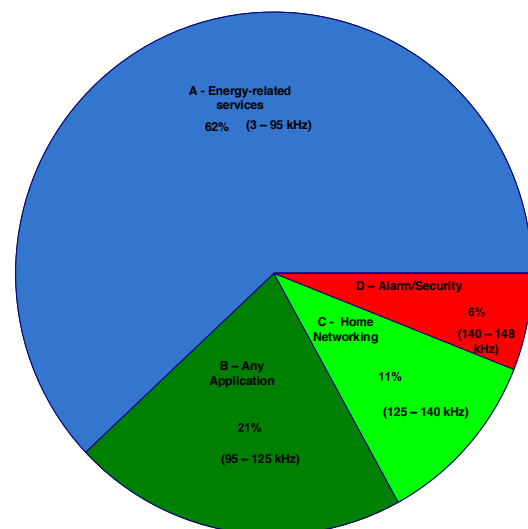
Fig. 1 CENELEC EN 50065 PLC Band plan

A. HDR Narrowband PLC Access Networks:Architecture and Topology

The HDR narrowband technologies can be used for both In-home network and as access network especially for utility metering infrastructure. The access network of the different technologies have a number of difference in network formation, security profiles, frequency bands of operation and routing techniques used.IEEE 1901.2 standard is based on an OFDM PHY and an IEEE 802.15.4 MAC layer. Although the standard was derived from the G3-PLC standard, it does not specify functionality for a number of higher layer processes such as routing, collision avoidance mechanism, bootstrapping techniqueetc.[1], rather support for these functionalities is supported through Adaptation layer Service Access Point (see annexes of [8] for implementation guidelines and examples) . An IEEE 1901.2 network is formed, maintained and controlled by a Personal Area Network (PAN) coordinator. Access to the power line media is controlled using unslotted CSMA/CA (collision sense multiple access with collision avoidance) for non-beacon PANs and slotted CSMA/CA for beacon PANs. An L2 or L3 routing algorithm can be used to create star, mesh or tree network topology; depending on the application. The 1901.2

standard supports indoor and outdoor communications for the following scenarios[9].

- Communication over low voltage line (less than 1000 V); the power line between meter and transformer
- Across a transformer low-voltage (1000 V) to a medium-voltage (72 KV) and vice versa in both urban and rural communications
- Lightening and solar panel PLC communications
- Home area networking, Electric Vehicle Charging and grid to utility meter communications etc.

The G3-PLC (ITU-T G.9903) was designed to provide a robust a robust OFDM based PHY for the hostile power line medium. The MAC layer is based on adaptation of the IEEE 802.15.4 MAC using 6LoWPAN (IPv6 over Low Power Wireless Personal Area Networks). A G3-PLC network is made up of one or more PANs (or domains), which is initialized and managed by a PAN coordinator. In addition to providing domain-wide management and control operations, the PAN coordinator also handles connectivity to other domains or the backhaul Wide Area Network (WAN) [10].Each registered node is identified by 16 bit ID short address and its domain ID. The 6LoWPAN adaptation layers defines bootstrapping protocol for devices to discover neighbors in a network. L2 routing based on LOADng routing algorithm, which is a robust technique that is capable or reporting a broken link, blacklisting of unicast neighbors and route cost calculation for efficient management of the routing table of each node. Mesh topology is used to supports hop-by-hop routing thereby ensuring self-healing capability;discovery of new link in case a link becomes unavailable. Only unslotted CSMA/CA for non-beacon supported PANs is used [11]. The Collison avoidance mechanism used is the Subsequent Segment Collision Avoidance (SSCA). A typical application of the G3-PLCis implementation of a PLC local area network (LAN) for use over the low voltage electrical network, to exchange commands and information between meters and concentrators for automated metering management (AMM) system[11].

The PRIME system was designed to support energy related services and is composed subnetworks defined with respect to transformer stations. A subnetwork is essentially a logical tree network made of up two types of nodes: the base (root) node and the service nodes. The base node acts as the master node and manages the subnetwork's resources and connections. Service nodes which are slave nodes follow a registration process described in Figure 2 to become part of the subnetwork. A service node is initially in the disconnected before it is registered as a terminal, where it is capable of communicating with other nodes in the network. In the Switch mode, a service node is capable of performing all the functions of a terminal as well as forwarding data from other nodes in a particular subnetwork.
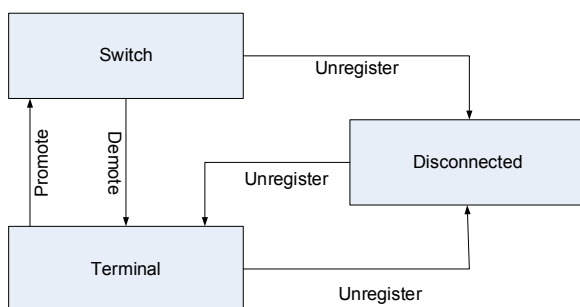
Fig. 2 Service Node States (source: [12])

Each node uses a 48-bit universal MAC address, called EUI-48

to uniquely identify itself during the registration process. The EUI-48 is also known as the subnetwork address (SNA). Each terminal node is assigned a 14-bit local node identifier (LNID) during the registration process and each switch node is assigned a unique 8-bit local switch identifier (LSID). The LNID and the LSID of the immediate switch to which a terminal is connected forms a 22-bit node identifier (NID), which is used to identify a single service node in a subnetwork. A device may have a number of simultaneous, connections each of which is identified by 9-bit local connection identifier (LCID)[12]. The PRIME network uses the CSMA/CA for access control to the transmission media.

The ITU-T G.hnem (ITU-T G.9902) standard specifies a standard that where the network is divided into a number of domains. Each domain consist of a domain master and a number of end-nodes. The domain master is responsible for a number of management functions such as[13]:

- Registration of new nodes into the domain
- Periodic communication of beacon to all nodes in the domain. Beacon frames information specific to domain operation such as domain name, domain ID, bandplan, spectral compatibility and security mode to be used.
- Gathering and maintenance of topology information from nodes of the domain
- Storage, processing and communication of statistics to the management centers.

Different domains of the same network may be managed by a global master (GM). Nodes of the same domain are identified by a node ID and can communicate to each other either directly or via relay nodes. Nodes of different domains in the same network can communicate using inter-domain bridges (IDB). Nodes of different networks can communicate over inter-network bridges (INB) which is a layer 3 bridging function. The G.9902 network can also communicate with alien networks via layer 3 bridges. The G.hnem network supports mesh topology which allows any network topology to be supported. A typical example of energy management application using the G.hnem network is illustrated in Fig. 3

In the tree-structured architectural model given in Fig. 3, the energy management HAN consist of utility-controlled and consumer-controlled appliances such as Programmable Smart Thermostats (PST) and Electric Vehicle Supply Equipment (EVSE) at the customer premises. Each HAN is a separate network, thus devices in each user premises connects to the utility access network (UAN) via the INB. The UAN could consist of a number of concentrator nodes for aggregating data from various HANs. The utility head-end unit acts as a global master of the UAN. Both Layer 2 and Layer 3 routing mechanisms are supported. The convergence layer is based on the use of 6LoWPAN to provide support for IPv6.In order to ensure the coexistence of the various narrowband PLC technologies, the use of preamble based mechanisms in addition to frequency separation and frequency notching were recommended in[14].
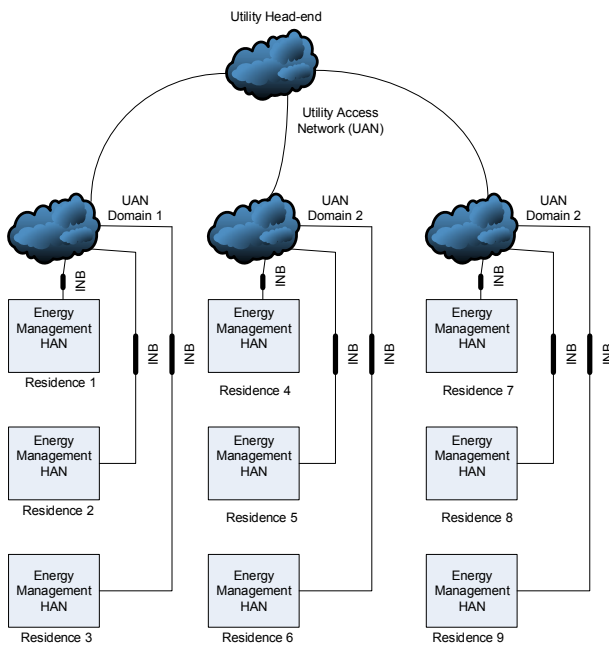
Fig.3 G.9902 Energy Management network Architecture

B. Broadband PLC Access Networks: Architecture and Topology

In addition to the use of broadband PLC technologies for in-home networking, these technologies can be used to provide utility smart grid and telecommunication services with higher data rate. The network architecture and topology for in-home networks are relatively simpler and smaller than that of access network. IEEE 1901 is based on two optional, disparate and non-interoperable physical layer technologies: the fast Fourier transform based FFT-OFDM PHY and the wavelet based W-OFDM PHY. An IEEE 1901 In-home network otherwise known as a Basic Service Set (BSS) consists of a BSS Manager (BM) and stations. Each stations can share information exclusively with other nodes of the same BSS. When a node is hidden from a BM, one of the stations can act as a proxy BM (PBM) as illustrated in Fig. 4.
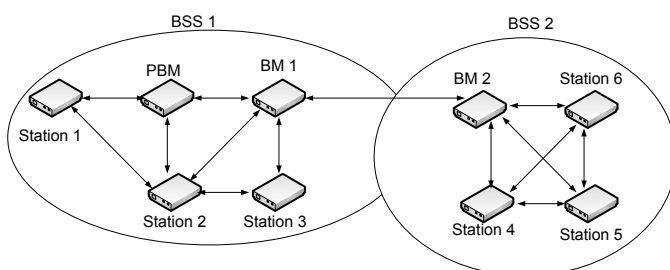
Fig.4 IEEE 1901 In-home network topology and components

A station can be chosen as the BM if it has the best connection to every station in the BSS or it has the best bandwidth management capability[15]. The BM can also be explicitly chosen by the user. All stations in a BSS share the same Network Membership Key (NMK), which is a 128-bit advanced encryption standard (AES) key that is provided for all the stations in a BSS. Each station in the BSS is assigned an 8-bit Terminal Equipment Identifier (TEI). The TEI is used for addressing in all frame control transmissions. Access to the power line transmission media is based on either CSMA/CA (CSMA/CA only mode) or a combination of CSMA/CA and Time Division Multiple Access (TDMA) for coordinated and uncoordinated modes. The topology and concept of the IEEE

1901 access network is significantly different from that of the In-home networks. The 1901 access network assumes a cell structure, which is built and managed by a cell manager [16]. An IEEE 1901 access network consists of the following types of stations:

- Head End (HE) station: this is the cell manager and connects the access network to the backbone or Wide Area Network (WAN) such as the internet.
- Repeater Stations (RP): these are stations that can repeat data from one station to another
- Network Termination Unit stations (NTU):provides gateway function between the access network and the customer premises equipment (CPE). The NTUs also bridges the access network to the customer in-home BPL network and other network technologies such as Ethernet, Wi-Fi and Coaxial cable networks.

The HE stations are assigned a short network identification (SNID), which uniquely identifies and logically separates the an access cell from its neighbors [16].Stations connect to a particular cell by association with the SNID of the HE of the cell. The HE allocates a 12-bit TEI to each station in the network. The combination of SNID and TEI is used for addressing to support functionalities such as routing, channel access, channel estimation and neighbor network detection. CSMA/CA is used as the default MAC protocol due to its suitability to the multi-hop and dynamic topology of the of the access network. However, a combination of TDMA and CSMA/CA is used to ensure deterministic media access for smart grid utility applications as well as to ensure deterministic quality of service for some real time applications such as video conferencing and Voice over Internet Protocol (VoIP).

The ITU-T G.hn is another standardized power line technology for broadband home networking over various types of wire media such as category 5 cable, coaxial cable and power line. In addition to use of OFDM in the physical layer, there are enhancements for supporting Multiple Input Multiple Output (MIMO) techniques as outlined in [17]. A G.hn network can have up to 16 domains each of which can include up to 250 nodes; one of which acts as the domain master (DM) [18]. Each endpoint node can support concurrent communication with at least 8 other nodes [19]. Fig. 5 illustrates the architecture of the G.hn network. The Global Master coordinates the resources and operations of the domains in a network. A nodes of the same domain can communicate with each other directly. Nodes of different domains communicate over the inter domain bridge (IDB). Connection to other in-home networks such as Wi-Fi, Zigbee and ITU-T G.hnem is realized over a network layer bridge. For smart grid applications, the ITU-T G.hn standard specifies a low complexity profile (LCP) that operates in the frequency range from 2 – 25 MHz. The ITU LCP is fully interoperable with the full ITU G.hn and is envisioned to reduce power consumption and component cost. Media Access Control is based on a MAC cycle which for the power line media is synchronized with the mains alternating current (AC) cycle (usually 2 AC cycles. The MAC cycle is synchronized with the AC cycle in order to mitigate the effect stochastic power line channel and noise. Each MAC cycle is divided into a number of time slots known as *transmission opportunities* (TxOPs), which is assigned to nodes in the domain for media access.
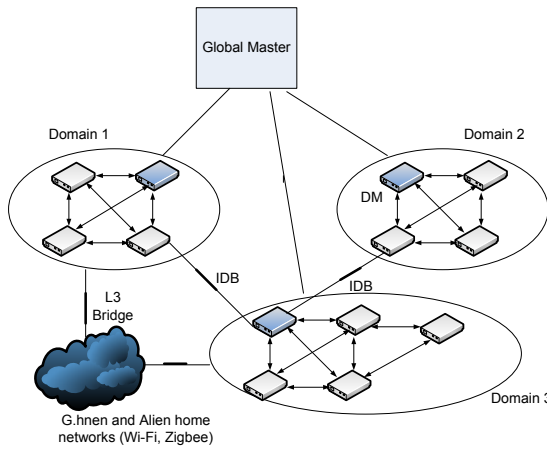
Fig.5 ITU T G.hn Network Architecture

III. GRID MANAGEMENT AND COMMUNICATION SERVICES

The electric power grid can be used to augment the telecommunication infrastructure deficit in developingcountries. This will significantly improve fixed broadband connectivity and last mile internet access. The statistics for the various telecommunication subscriptions for some African countries are outlined in Table 1. There are several applications of power line communications that ensures mutual benefits to both the telecommunication service provider and the utility company. These are applications are critical to ensuring the sustainable management of modern electric grids and accelerated mobile and telephony service access to developing economies.

Table 1: Statistics of Telecommunication Subscription[20]

Parameter	Nigeria	Kenya	South Africa	Ethiopia
Fixed-telephone subscriptions per 100 inhabitants	0.2	0.5	9.2	0.8
Mobile-cellular subscriptions per 100 inhabitants	73.3	70.6	147.5	27.3
Fixed (wired)-broadband subscriptions per 100 inhabitants	0	0.1	3.1	0.3
Mobile-broadband subscriptions per 100 inhabitants	10.1	3	25.2	4.8
Households with a computer (%)	8.4	10.8	25.8	2.1
Households with Internet access at home (%)	7.8	14.2	39.4	2.3
Individuals using the Internet (%)	38	39	48.9	1.9

A. Internet Access

One of the major drivers of the economic development of any nation is the level of broadband Internet penetration attainable therein. According to research results released by the World Bank, a 10% increase in broadband internet penetration in developing countries guarantees a 1.3% corresponding growth in Gross Domestic Product (GDP) [21]. The broadband supply chain comprises of the international connectivity, a national backbone network and the last mile access network. All across Africa, the international connectivity aspect received a lot of attention around 2010 resulting in a lot of investments by various consortia (see Fig.6) [22].

From Fig.6, Africa is undoubtedly the region with the largest

investment in new submarine fiber optic cables in the period under consideration. It is however quite unfortunate that the expected returns in investment in terms of an increase in broadband internet penetration is yet to be realized. In Nigeria for example, only about 10% of the total capacity of undersea cables in Nigeria is currently being utilized hence resulting in about 6% internet penetration due to a reliance on wireless access technologies. A key factor responsible for the low access to broadband internet in developing economies is the lack of adequate infrastructure for access by end users and customers. The access network derives its importance as a result of its proximity to the subscriber and comprises of the wired and wireless access technologies. The fixed broadband subscription for various regions illustrated in Fig. 7 shows that Africa has the lowest subscription.

Figure 6: Investment in New Submarine Fiber Optic Projects by Region: 2008 – 2012 [22]
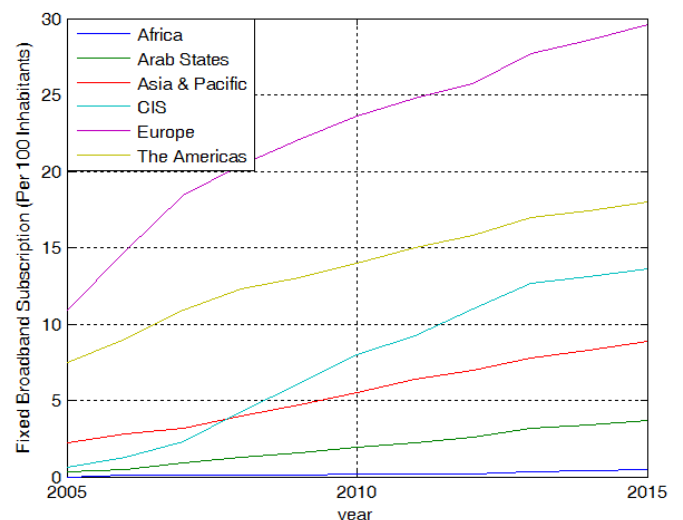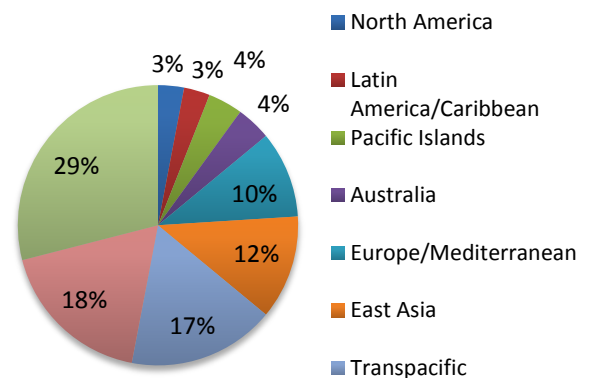
Fig. 7 Fixed Broadband Subscription for Different Region (source:[23])

The goal of achieving greater broadband penetration in developing nations can only be achieved by leveraging on a combination of various access technologies.The Broadband over Power Line (BPL) technology involves the transmission of information over conductors used for electric power transmission. International Organizations like the Organization for Economic Cooperation and Deployment (OECD) support the use of this technology due to its apparent ease of deployment and negligible environmental impact. The fact that previous rural electrification projects have been run before makes it possible to use such infrastructure to boost the last mile internet access.An

internet Service Provider (ISP) can rent the electric network of a power utility company to provide internet access to all customers that are connected to the electric power grid. This makes it possible to provide broadband internet connection to any point *where there is a power cable*. The sustainability of utility company is enhances as it ends up making money from the use of its network instead of renting for telecommunications service. A case study of this mutually beneficial synergy is in the agreement between Canal+ (an Internet Service Provider) and Beninese Electric Power Company (SBEE). In January 2016, Canal+ in Benin Republic entered an agreement with Beninese Electric Power Company (SBEE) to provide internet access services over the utility operator's network. The utility company will receive fees for the use of its infrastructure while leveraging the internet access for smart grid applications such as geo-referencing of its electricity poles and managing electricity consumers [24]. The PLC internet access platform can also be used to realize Advanced Metering Infrastructure (AMI). AMI is capable of providing consumer directed smart grid initiatives such as [18]:

- Two-way communication system
- Connects millions of nodes and reaches every consumer
- Highly secure communication systems for delivery of meter data to utility
- Service management such as disconnect and reconnect of customers and monitoring of meters for tampering.

B. Electricity Theft Prevention

Electricity theft is a major challenge to the sustainable and profitable operation of electricity utilities in developing countries, especially in remote areas[25]. Electricity theft takes many forms: from compromising or intimidating utility company workers to by-passing and tampering electricity meters. There are several engineered ways of tampering both electromechanical meters and smart meters. Tempering in electromechanical meter may involve taking connections directly from distribution lines, Grounding the neutral wire, Putting a magnet on electromechanical meter like neodymium, Inserting some disc to stop rotating of the coil, Hitting the meter to damage the rotating coil or Interchanging input output connections. But these tampering strategies can be drastically minimized by using smart meters with capability for real-time monitoring and anti-tampering circuitry[26]. Advanced Metering Infrastructure (AMI) has been used in developing countries to control electricity theft because it provides a new sensor based approach which are installed in the electrical equipment. Smart meters have the ability to record zero reading and it can alert the utility system by sending data through the PLC infrastructure.

C. Distribution Automation and Electric Vehicle Management

Electric Vehicles have often been suggested as a helpful solution to reduce fuel consumption and air pollutant emissions where concerns about its security, availability and its negative impact on the environmental are worrisome [27]. Electric vehicles play a crucial role in decarbonizing road transport and at the same time need careful management. EV charging is one of the fundamental schemes in the electric vehicles' applications. EVs can offer benefits due to their flexibility in charging and discharging time span and introduce a useful concept called "Vehicle-to-Grid" (V2G) capability.

Smart-grid technology can facilitate EV-charging (grid-to-vehicle, or G2V) load during off-peak periods [28]. This can be useful in reducing electricity system costs by providing a cost-effective means of providing regulation and monitoring services, recyclingreserves and reducing capacity. EV can act as a controllable load as well as a distributed storage device. When connected to the electricity network, the battery of an EV can supply power during peak load times and thus increase the reliability and availability of the grid. Different approaches have been proposed in literatures for integrating Large EV fleet into electric grid is in two folds, that is, the electric vehicle owner and utility entity. In [29], a distribution automation architecture which explicitly involves an EV aggregator was proposed. The aggregator coordinates all the required operational activities like communicating with the distribution system operator (DISTCOs), transmission system operator (TRANSCOs) and energy service providers. It maintains the link between energy market players and the electric vehicle owners.

D. E-Learning

Globally, there is a growing concern about the shortfall in the number of qualified teachers in the various institutions of learning. This trend is more prevalent in the developing and less developed nations than the advanced nations. In 2013, United Nations Educational and Scientific and Cultural Organization (UNESCO) estimated that by the year 2015, about 1.6 million more teachers would be needed globally to achieve the goal of Universal Primary Education [30], [31]. There is however an associated cost to this as countries that require additional teachers need to increase their overall budget for teacher's salaries. Sub-Saharan Africa has the greatest need for extra teachers and Nigeria alone accounts for two-fifth of the gap. For example, reports have shown that $4 billion is needed annually in Sub-Saharan Africa to pay the additional salaries of the additional primary school teachers required by 2020[32].

Just as the Information and Communication Technology has been used to solve many other challenges in government and financial institutions, it can also be leveraged upon to complement the efforts of the available qualified education personnel. At the level of higher institutions, Information technology in teaching and learning has created a reliable platform to change how university students learn by using more efficient,modern and cost effective alternative tools such as electronic learning (E-learning). E-learning is a learning method and a technique for the presentation of academic curricula and content through the internet or any other electronic communication media such as multimedia, compact discs, satellites, or other new education technologies[33], [34]. The Open and Distant Learning is a model of e-learning that can be used to drive sustainable development in the rural areas. This model of learning which has been in place before now has not achieved the desired aim due to challenges such as poor funding, poor power supply, poverty, poor ICT penetration and low tele-density. The use of Power Line Communication technologies will go a long way to address a number of the challenges already highlighted.

IV. CONCLUSION

Sustainability of an electric power system depends to a large extent on the ability of the operator to cost effectively manage the network as well as minimize both technical and non-technical losses. Moreover as indicated by statistic of mobile broadband subscription for various countries and regions, there

is a deficit of telecommunication infrastructure in developing economies. Standardized narrowband and broadband can be used address this challenges. Modern narrowband technologies can be used to provideenergy-related services such as smart metering, automation distribution, Electric Vehicles Charging, demand-side response etc. Broadband PLC technologies can also be used to provide energy-related services while simultaneously functioning as telecommunication access networks for providing broadband internet and voice services to remote/underdeveloped areas. Broadband technologies can also be used for implementing local area networks (LANs) and community networking. The use of PLC for telecommunication services is an 'infrastructural plus' that is capable of accelerating into human and economic development. The flexibility, low cost and support for high data rate features of broadband PLC opens up the opportunity for sustainable provision of diverse information and communications (ICT) services for accelerated development of underdeveloped areas. For example, a system of distance learning for primary and secondary school can be provided in rural areas where availability and quality of teachers is a serious challenge. Tertiary Institutions can also set up satellite campuses where video conferencing and video on demand services are used to provide cost effective educational services. Other ICT services include e-government, community networking, telemedicine and e-health.

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Digital Inclusion and Sustainable Development in Nigeria: The Role of Libraries

Goodluck Ifijeh, Juliana Iwu-James, Oyeronke Adebayo
Centre for Learning Resources
Covenant University,
Ota, Nigeria.
goodluck.ifijeh, juliana.james, oyeronke.adebayo{@covenantuniversity.edu.ng}

Abstract— **Sustainable development has been defined as the development that meets the social, economic and technological needs of the present without compromising the ability of future generations to meet their own needs. To attain sustainable development, the roles of information and digital literacy cannot be ignored. Unfortunately, according to the National Bureau of Statistics, adult illiteracy rate in Nigeria stands at 56.9%, while 95% of Nigerians do not own a personal computer (PC). Considering that opportunities and access to information and communication technologies (which are key drivers of sustainable development) are predicated on literacy, the Nigerian situation is very disturbing. In this paper, we examine the concept of digital inclusion and its role in sustainable development. An assessment of the situation in Nigeria reveals that libraries at different levels have critical roles to play in surmounting the challenges of digital inclusion in the country. The paper concludes with a way forward for libraries and key actors in the Nigerian polity.**

Keywords— *Sustainable Development, Digital Inclusion, Nigeria, Libraries, Digital Literacy.*

I. INTRODUCTION

Since the 1980s, the concept of sustainable development has been widely used. The term gained popularity when it became fashionable for experts to use it as a way of responding to global economic concerns, equity and distribution. In year 2000, 189 member countries of the United Nations adopted the Millennium Development Goals (MDGs) to address the issue of sustainability in development. In this regard, the United Nations outlined eight goals to be achieved in 2015.The motivations for the goals were to eradicate poverty and hunger; achieve

universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria and other diseases; ensure environmental sustainability and develop a global partnership for development. However, by 2015, many developing countries including Nigeria were far from achieving the MDGs. Coming to terms with the reality that the MDGs were far from being achieved in many developing countries, the United Nations member states at a summit in 2015 adopted a 2030 agenda for achievement of a set of 17 sustainable development goals to end poverty, fight inequality and injustice and tackle climate change.

Sustainable development maybe defined as development that meets the need of the present without hampering the ability of future generations to meet their needs. Sustainable development is efficient management of resources for human survival, taking into consideration both the present and future generations[1]. To achieve sustainable development, the world summit on sustainable development suggested that countries must ensure the full participation of their citizens in development programmes and strengthen the capacities of citizens to access and utilize timely information. The role of information and communication technologies (ICTs) in information generation, processing and use in the 21st century cannot be over emphasized. Global economy thrives on digital innovation which to a large extent leads to advancement in sustainable development. For instance, a former head of Nigerian Communications Commission was quoted as saying that 10 percent increase in broadband yields 1.13 percent to national gross domestic product[2]. Access to ICTs and digital literacy are very vital to knowledge empowerment and information generation and utilization. Thus, sustainable development remains a mirage in any country whose citizens cannot effectively and efficient deploy the use of ICTs to access and utilize quality information. It is in this regard that the concept of digital inclusion has evolved and the need for members of society to be 'digitally inclusive' has become a major discourse in literature. This paper examines the concept of digital inclusion in view of its role in sustainable development; it also discusses the challenges of digital inclusion in Nigeria and how libraries can help.

II. THE CONCEPT OF DIGITAL INCLUSION

A. Digital Divide

Undoubtedly, information and communication technology (ICT) has affected every area of human life. Consequently, the level of deployment of ICT in a country can determine its level of development and placement among the comity of nations. Unfortunately, ICT has become a basis for disparity among nations. This disparity has been termed as digital divide.

Digital divide is inequality in access, distribution and use of information, communication and technologies between two or more populations[3]. Digital divide may also be viewed as a gap that exists between those who have access to computers and the internet and those that do not have access[4]. The United Nations posits that though digital divide is mainly a result of income gap, Government, Institutions and individuals must do everything possible to bridge the divide as ICTs are important factors of sustainable human development[5]. Consequently, Agustin & Clavero[6] proposed a concept known as digital inclusion which goes beyond the quantitative and technological aspects of the concept of digital divide.

B. Digital Inclusion

Digital inclusion is a set of public policies that relates to the installation, administration, expansion, creation and development of content on wired or wireless public networks in countries, regions and communities. This includes privacy and security, training and incentives to develop new tools[7].

To attain sustainable development, it is very important to take digital inclusion into cognizance because it helps to create an informed society. This can be achieved by transforming members of the society from the 'digitally excluded' to the 'digitally included'. GOV.UK[8] opined that digital inclusion is a facet of social inclusion and it provides the right access to the digital world for intellectual development and promotes spaces for significant cultural practice that allows individuals to be digitally literate. It further stated that digital inclusion does not only imply being technically capable of acting in the cyber space, but being capable of creating and producing meanings and feelings to it. GOV.UK also viewed digital inclusion as the ability to access, adapt and create new knowledge using ICT. Digital inclusion implies possessing both technical and operational capacity to navigate the world of ICTs[9]. Digital inclusion revolves round four types of resources[10]:
- Physical (computers and connectivity)
- Digital (digital materials available online)
- Human (literacy and education)
- Social (communication institution and society structures.)

If these resources are well harmonized, then the implementation and reality of digital inclusion is not farfetched. Digital inclusion process emanates from four types of capital[11]:
- Social (their identity and political power)
- Intellectual (individual competence)
- Cultural (memory of a society)
- Technical (power of action and communication)

Microsoft[12] opined that technology is a tool and it is the focal point for education, economic development and social well being. Consequently, Microsoft posited that digital inclusion goes beyond being connected or disconnected; it involves formulating and implementing strategies that would culminate in full participation in a digital society. In resonance with Microsoft, Damodaran and Olphert[13] suggested a hierarchical framework for progress as far as digital inclusion is concerned. The frame work comprise of the following:

- Technical infrastructure as the essential and fundamental foundation for inclusion
- Digital awareness programs and campaigns
- The know-how, understanding basic IT skills
- Digital opportunity
- Digital empowerment

III. BENCHMARKING DIGITAL INCLUSION

It is important to make comparisons of progress achieved towards digital inclusion. An analysis of a digital inclusion research conducted in 2005 categorized African countries into four[14]:
- Digital leap-froggers- these are countries with below average level of internet users but are making progress in catching up
- Digital pacesetters- countries that are both average in levels of internet use and above average in growth level
- Slow starters- countries with below average levels of internet use and growth rates
- Successful but slow- countries with above average level of internet use and growing less than average rate.

IV. NIGERIA AND DIGITAL INCLUSION

Nigeria, made up of 36 states and 774 local government council areas, with about 150 million people has ICT facilities that are limited to urban areas at exorbitant rates, affordable by the middle and upper classes of society, thus making many of the rural and suburban areas unable to fully participate in the emerging information economy. Digital inclusion revolves round three sequential classifications of the digital divide - opportunity (encompassing accessibility and affordability), infrastructure (network indicators and indices) and utilization (ICT usage and quality). Nigeria falls within the countries with low digital opportunity index scores. The digital opportunity index scores released by International Telecommunication Union revealed that Nigeria was ranked 31 in the African continent with very low score of 0.41, 0.03 and 0.01 for opportunity, infrastructure and utilization respectively[15]. In terms of ownership and access to personal computers (PCs), the National Bureau of Statistics[16] reported that only 4.5% of the Nigerian population has access to personal computers. Access implies those who either own a pc or can derive benefits from it. According to the report, only 0.9% of the population can claim ownership of a pc. However, access and usage of the internet have greatly increased among Nigerians in recent times largely due to mobile telephony technology and social media. A published reported revealed that about 70% of the Nigerian population uses the internet[17]. The same report also indicated that more than 98% of internet users in Nigeria gain access to the internet through mobile telephone networks. However, internet access and usage may not necessarily imply digital literacy. About 56.9 percent of Nigerians are illiterates[18]. It is access to ICTs and ability to find and utilize information from the ICT platforms that constitute digital inclusion. Going by these reports, a greater percentage of Nigerians maybe classified as non digital inclusive.

V. CHALLENGES OF DIGITAL INCLUSION IN NIGERIA

A number of factors have been outlined by various interest groups as reasons for Nigeria's dismal performance in global ICT (by extension digital inclusion) rankings compared to countries in the developed world. Some of these reasons are outlined below.

A. Affordability

A survey by Research ICT Africa[19] disclosed that 70% of non-internet users in Nigeria say affordability is the main reason for not using the internet. Majority of internet users in Nigeria access it exclusively using mobile devices. Smart phones and tablets have become very popular in Nigeria. Nevertheless, a mobile broadband cost is high for most people in a country like Nigeria where low per capita incomes subsist. World Bank reported that around 80% of Nigerians earned $2 or less a day, or $730 per year[20]. The cost of ICT services is a major barrier to increased internet and broadband usage. Nigeria cannot boast of free Wi-Fi to enable internet access; and internet speeds are particularly slow.

For Nigerians with low per capita incomes, the price of a mobile phone can represent a consequential barrier to access and even regular usage of the internet[21]. When respondents to a Research ICT Africa survey who did not use the internet were asked why they did not, almost 70% reported that the services were too expensive[22]. From that Survey, only 3.4% of households, or 747,025, have a fixed internet connection, and 62% of internet users depended solely on their mobile phone for online access.

B. Illitracy / Language Barrier

As noted earlier, 56.9 percent of Nigerians are not literate. Though the Nigerian government has made efforts to bridge the literacy gap by embarking at one time or the other, on programmes with various captions such as Education for all, Mass Literacy Campaign (MIC), one-third of the adult population still lack basic literacy. Nigeria is a multi-lingua state; some of her citizens can only write and speak in local languages other than English. Most, if not, all of the ICT facilities imported into Nigeria are configured in English Language. Consequently, these people are digitally excluded[23]

C. Disparities Between Urban and Rural Areas

Rural areas in Nigeria constitute about sixty percent of the country's habitable land space[24]. These parts of the country are adjudged economically underdeveloped as they are plagued with poor infrastructure hence the continuous migration of persons in the productive age bracket from rural to urban areas in Nigeria[25].Considering the development advantages that ICT offers, those who are on the disadvantaged side of the digital divide will remain digitally excluded and underdeveloped.

The level of information and computer illiteracy in the rural areas is alarmingly high. Apart from illiteracy, most people in these communities are low income earners and as such, the provision of ICT facilities remains a luxury.

It is commonly reported that internet access in rural communities is poor and almost nonexistent[26]. From a general household survey of 2011, it was reported that "84% of urban dwellers have access to mobile phones while only 58.5% of rural dwellers have access to mobile phones"[27]. Most owners of mobile phones in rural areas use them for making calls, rather than for accessing the internet to interact and search for important information. Correa and Pavez[28] corroborated this when they observed that in the rural communities there is a lack of telecommunications infrastructure, a lack of electricity and a reluctance on the part of internet services providers (ISPS), cybercafé operators and other stakeholders to extend their internet services.

D. Lack of Digital Literacy

Virtually every area of our lives is increasingly dominated by the internet and digitized services; individuals unable to access, interact and use digitized services are gradually excluded from enjoying basic benefits in the society. "Just as providing books to people who cannot read does not solve functional illiteracy, simply offering access to technology does not bridge the digital divide"[29].

Lack of basic digital literacy skill is a major threat to digital inclusion. Conventional education i.e. learning to read, write and communicate; can never be downplayed. However, literacy in information and communication technology (ICT) is a non negotiable standard in the 21st century[30]. Digital literacy is the ability to identify, search and utilize required information in multiple formats from a wide range of sources presented through information and communication technologies. CILIP postulates that digital literacy is one of the core skills required for digital inclusion[31]. It enables one to find, critically appraise and manage information that is useful for every area of life.

E. Internet Crime / Computer Phobia

Internet scam coded as '419' is very popular in Nigeria and has made the internet to appear unsafe. Incidents of hacking into persons and organizations' important files and exposure of confidential documents have not helped matters. These have left people vulnerable to online threats including identity theft, cybercrime and exposure to hate sites. Consequently, many people have become apprehensive when it comes to computer/internet access and usage. They would rather not have anything to do with such ICT facilities.

VI. DIGITAL INCLUSION AND LIBRARIES: WHAT ROLE?

Libraries are agents of social communication. They help to bridge the awareness and information gap among members of the society. Libraries and librarians as information/specialists and brokers have roles to play in bridging the digital divide and improving on digital inclusion for their clienteles. Libraries and their sphere of influence are defined by the type of community/clienteles they serve. Thus, school and academic libraries cater for students, teachers/lecturers and researchers/scholars. As the name implies, public libraries cater for members of the public. Their roles in digital inclusion follow the same pattern.

A. School and Academic Libraries

School libraries are libraries established to cater for the information and academic needs of students and teachers in the lower levels of education – primary, secondary and technical schools. Academic libraries are established to meet the information, academic and research needs of students and faculty/staff in higher institutions of learning – Colleges of Education, Mono/Polytechnics and Universities. They could play intervention roles in digital inclusion in the following ways.

B. Acquisition and Provision of Acess to Digital Content

We are in the era of digital media and e-books distributed via the Internet. While maintaining their role in collection and provision of print materials, libraries all over the world must have renewed determination to support access to digital content, technology and services[32]. To provide access to digital content, libraries must go beyond the level of acquisition to information and digital literacy, dissemination of information resources through various ICT media and training for students, teachers/lecturers and other users of the library.

To this end, school and academic libraries should:

- ✓ Offer classes in general computer skills and technology training either online or within the library.
- ✓ Provide designated spaces, equipped with smart devices for tutorials within the library.
- ✓ Accelerate digitization of library resources.
- ✓ Help students to enjoy learning by introducing them to the use of open content. This implies editing and combining various digital resources (including pictures and sound) to make learning interesting.
- ✓ Ensure that digital content is discoverable via any interface.
- ✓ Ensure provision of digital content via mobile devices, social media, virtual research environments.
- ✓ Support and encourage open publishing platforms, wikis, blogs, social media, citation tools, instructional technologies, data visualization tools, etc.
- ✓ Teach students and teachers how to navigate library catalogues and databases in order to search and find information.
- ✓ Teach users how to search and locate required information from internet platforms like search engines and databases. Students need to learn about search engines and Boolean logic; the need to define concepts and keywords. Library users need to be able to critically evaluate resources relevant for them.
- ✓ Students should be introduced to different types of digital resources and content
- ✓ There is need to teach students how to engage the social media sites such as twitter both for research and to consider ways in which they can share, network and even crowd source for information.
- ✓ Students should be taught ways to be up to date with research findings in their field by using journal TOCs (table of contents) which alerts you when issues of your followed journals are published,
- ✓ Introduce students to the advantages of referencing software.
- ✓ Digital inclusion can be encouraged when students are taught the beauty of creating blogs to discuss their research findings. This will help them to build confidence and enhance their digital identities.

Librarians in school and academic libraries can collaborate with teachers, and other stakeholders to train students and equip them with the required skills needed to be digitally included. They should also be equipped with computer and digital literacy skills necessary to help them drive digital inclusion among library users.

C. Public Libraries

As the local gateway to knowledge, public libraries provide resources for lifelong learning, independent decision making and cultural development of the individual and social groups[33]. In rural areas, public libraries are designed to provide information on agriculture, building, trade, health care and other aspects of human activities which are required mostly by the rural dwellers because they lack access to other sources of assistance. Rural communities in Nigeria are faced with low literacy rate and absence of information and communication technologies. Perhaps, one of the most important role public libraries can play in digital inclusion is provision of internet services to their users. A recent study of libraries as internet providers showed that library users tend to access more information about health, government, language and culture than people who access the internet from other public locations. Public library users also report a higher positive impact of the internet on their lives in areas such as health, education, time savings, income and financial savings[34].

Public libraries can also play the following roles in digital inclusion:

- ✓ Offer free classes on general internet use, teach specific access skills which should impact the economic, social, and cultural lifestyle of the people.
- ✓ Teach basic computer skills.
- ✓ Participate in programmes to combat illiteracy.
- ✓ Provide information resources in various formats and teach the proper use of the information resources.
- ✓ Offer free or subsidized internet access alongside support and training for users.
- ✓ Be vital part of any Digital Inclusion initiative. Public libraries should champion programs aimed at equipping people with digital skills which would meet their information needs and increase their chances of enjoying sustainable development.

The public libraries should carry out awareness campaigns on the need for people to acquire basic digital literacy skills as more essential services are gradually going to be online. Applying for admission, obtaining and verifying validity of driver's license, checking pension details and other essential services are going online.

VII. THE WAY FORWARD

A. Examples and Lessons from Developed Countries

Proposals made in this paper on the roles Nigerian libraries could play in digital inclusion are not mere theoretical insinuations. They are practicable as seen in the examples of libraries in other countries:

- ✓ In Chile, the National Digital Literacy Campaign was launched with the goal of training 500,000 Chileans in ICT by 2005, largely via a network of over 300 public libraries. So far thousands of Chileans have benefited from the program. The free training has helped Chileans launch businesses, navigate market information and develop technology skills to improve their job competitiveness[35].
- ✓ In Poland, Polish public libraries are able to offer their users free internet access.
- ✓ In Uganda, Hoima Public Library provides free internet access and training for health workers and the general public.
- ✓ In the United States, U.S. public libraries are providing e-book content to borrowers to ensure that all Americans continue to have access to commercially produced content through their local public libraries. In 2012, public libraries reported that they were the sole provider of free public access to computers and the internet in 62.1% of communities in the United States.
- ✓ In Malaysia, public libraries provide electronic corners in its libraries. The electronic libraries serve as one-stop sources of information and even entertainment.
- ✓ In South Africa, public libraries provide space for information kiosks and tele-centres.
- ✓ In Estonia, open access internet points have been established in public libraries.
- ✓ In Sunderland, England, the public library provides free access to PCs (personal computers) alongside training for adults and children users.

B. Conclusion

A cursory review of library services delivery system in Nigeria reveals that citizens are not accessing library services adequately. The poor state of public libraries in Nigeria is an issue that has been over flogged in literature. The need to consciously develop our public libraries to embrace technology is of prime importance.

Librarians should be empowered with modern technological tools to support learning. Library staff must have access to ICT training. Libraries should participate in local and national initiatives and discussions on internet policies, digital inclusion, broadband access and open data. Governments should include libraries in plans for broadening ICT and broadband reach to rural areas as well as reducing the cost of access for the low income earners.

Assistive technology should be provided in public libraries to improve access for people with disabilities. These technologies are often costly for physically challenged people who are usually among the lower socio-economic groups. People need to develop interest in acquiring digital literacy skills tailored towards sustainable development. Universal access is going to take a combined effort of different types of libraries, IT companies, governments, NGOs, and the international community to create an enabling environment void of digital exclusion. The digital era is not going to disappear anytime soon and so there is need for education to respond to the growing digital tide which is rapidly increasing. Librarians have a vital role to play in spreading digital literacy across Nigeria. Libraries should step in to help the citizenry to acquire 21st century digital skills they need to attain sustainable development.

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Modifications of Richardson-Dushman thermionic emission current density equation for nano-materials

Dilip K. De*

Department of Physics,
Covenant University, Canaan Land,
Ota, Nigeria.
dilip.de@covenantuniversity.edu.ng

Olawole C. Olukunle

Department of Physics,
Covenant University, Canaan Land,
Ota, Nigeria
olukunle.olawole@covenantuniversity.edu.ng

Abstract— **The noble prize winning Richardson-Dushman equation (RDE) had been found to be quite applicable for thermionic emission from metals as far as temperature variation is concerned except the fact that the thermionic emission constant vary from metal to metal contrary to the original equation. We have derived expression for the temperature (T) dependence of work function (W) of a material considering thermal expansion and variation of the chemical potential with temperature. We find that the calculated dW/dT as well as the effective thermionic emission constant, A$_{eff}$ of metals are fairly in good agreement with experimental results of many metals. We then modify the RDE by using temperature dependent work function and report the excellent fitting of thermionic emission current density data from monolayer graphene with our modified equation. We discuss briefly the potential application of the modified Richardson Dushman equation for thermionic emission from nano-materials. The latter will appear in details in paper II.**

(*Abstract*)

Keywords— Work function, temperature dependent chemical potential, modification of Richardson Dushman equation, thermionic emission, thermal expansion coefficient, nano-materials, metals.

I. INTRODUCTION

In a metal the valence electrons of the atoms gets detached from the parent atoms when the atoms form the metal. These valence electrons can move freely within the body of the metal but are held by an electrostatic barrier that prevents them from flying out of the metal under normal circumstances (i.e, at room temperature, no external electric field etc.). As a result of the barrier an electron must have a minimum energy W in order to be able to escape out of the metal. This is called the work function W. However, when a metal is heated to high temperature (>700 C) there is a significant number of electrons in the Fermi energy distribution with energy greater than W. Such electrons usually get out of the metal surface in the form of an electron current. This phenomenon, where electrons are emitted from a hot metal surface has been termed as thermionic emission by Owen William Richardson [1,2] who, for his work was awarded Nobel prize[3]. Richardson[3] in his Nobel lecture predicted the form of the dependence of thermionic emission current density J on temperature T, as:

$$J = A_0 T^2 e^{-W/k_B T} \qquad (1)$$

Where k_B is the Boltzmann constant. A_0 is a constant with same value for all metals. This equation later became known as Richardson-Dushman (RD) equation[4]. Sommerfield later derived the equation based on free electron theory of metals[4] and showed that A_0 is given by

$$A_0 = \frac{4\pi emk_B^2}{h^3} = 1.2 \times 10^6 \text{ A/m}^2\text{K}^2 \qquad (2)$$

Even though the temperature (T) dependence on J in RD equation (1) was found to hold fairly well, the constant A_0 was found to vary from metal to metal [5, 6] and this variation has remained unexplained theoretically so far. Moreover, in Somerfield derivation as well as in the original work of Richardson, the work function W was assumed to be independent of temperature, contrary to experiments[7]. Metals have high number density of free electrons (n) and hence the Fermi energy at absolute zero temperature, (E_{F0}) is also high, usually of the order of a few eV [8a]. This can be understood from the relation

$$E_{F0} = \left[\frac{h^2}{8m}\right]\left(\frac{3n}{\pi}\right)^{\frac{2}{3}} = 3.65 \times 10^{-19}\text{n}^{2/3} \qquad (3)$$

In nano materials like graphene the surface density of free carriers has been estimated and experimentally determined to be within[8b,c] 10^{12} - 10^{13} /cm^2. Considering the diameter of carbon atom that makes graphene[9], this translates to a carrier density [10,11] of 1.6×10^{26} to 1.6×10^{27}/m^3. In the case of metals the free carrier density [8a] 1.15×10^{28} to 1.5×10^{29}/m^3. Free carrier density in carbon nano-tube[13] is 7×10^{24}/ m^3. Free carrier density [14a] in graphite is 7×10^{24}/ m^3. Maximum carrier density in carbon nano tube is calculated[14a] to be 9.9×10^{24}/ m^3. Thus nano materials are expected to have much

smaller (E_{F0}) than metals. As we shall see in later section the work function is expected to be temperature dependent in such materials. As a consequence the Richrdson-Dushman equation should break down in such materials as has been observed[14b]. Metals usually have a small temperature coefficient of work function which, as is shown later, nearly independent of temperature, due to high (E_{F0}). Where as in nano-materials dW/dT is expected to be temperature dependent as a result of low (E_{F0}). This calls for modification of Richardson-Dushman equation, specially, for thermionic emission from nano-materials.

II. RICHARDSON-DUSHMAN EQUATION (RDE) FOR THERMIONIC EMISSION FROM A METAL.

It is seen from Table 1 that the effective thermionic emission constant Ao (=A$_o$×b in Table 1) is quite less than the theoretical value of 1.20×10^6 Amp/m^{2}K^2 for most of the metals except cesium. In the derivation [4] of Eq. 2 it is assumed that the work function, W is independent of temperature, contrary to experimental observation[7,13]. In the next section we consider the temperature dependence of W and modify Eq.1.

III. VARIATION OF WORK FUNCTION (W) OF A METAL WITH TEMPERATURE

The relation of W with T of a pure metal depends primarily on the change of E_F with T and thermal expansion. To work out this change we rely on the fact that the total number of electrons N(T) in a given piece of metal at T = 0 K is the same as at T = T K. (It is assumed that during thermos electron emission in a thermionic energy converter (TEC), electrons will be replaced at the emitter through load current. The case where electron emission takes place without the electrons being replaced at the emitter will not be treated here). Now at

T = 0 K, $E_F = E_{Fo}$ and for E< E_{Fo} the Fermi function f(E) = 1 at

0 K.

Using the concept of density of state g(E)[8a] and E_{Fo}, the total number, N of free electrons in the metal are given by:

at temperature 0 K,

$$N(T = 0 \ (K)) = V_0 \int_0^{E_{Fo}} g(E) \, dE \qquad (5a)$$

at finite temperature T,

$$N(T) = V \int_0^{\infty} g(E) f(E) dE \qquad (5b)$$

Where

$$f(E) = \frac{1}{1 + \exp(E - E_F(T))/k_B(T)} \qquad (5c)$$

is the well-known Fermi-function. In Eq.5a the upper limit is E_{Fo}, because at 0 K free electrons fills the energy levels up to E_{Fo}. In Eq. 5b the upper limit is ∞ because at any finite

temperature above 0 K, there is a Fermi distribution with energy extending up to ∞.

Considering thermal expansion of the metal,

$$V = V_0(1 + 3\alpha T) \qquad (6)$$

Where α = Linear thermal expansion coefficient. Thermionic emission takes place at high temperature (>1000 K). Change of E_F with T will change the work function W with T [Eq. 4] and this in turn will affect the thermionic emission current density (J) from that given by RD Equation. This is going to play special role in nano-materials where E_F is much lower compared to metals [Eq.1], due to much lower concentration of carriers [see results and discussion] at ambient temperature. Our primary objective now is to obtain E_F and hence W, as a function of T from the equations (4) to (6) and compare with experimental results for metals (Paper I). The 2nd objective is to see how this affects the RD equation and how the modified RD equation fits the experimental results of graphene and carbon nano-tube and detailed comparison with regular (unmodified) RD equation (paper II).

Since N(T=0) = N(T) as discussed above, from eqns. 4 to 6

$$V_0 \int_0^{E_{Fo}} g(E) \, dE = V_0(1 + 3\alpha T) \int_0^{\infty} g(E) f(E) dE \qquad (7)$$

Now noting that $g(E) = 0$ for E< 0, the limits 0 to ∞ on the RHS of Eq.(7) can be replaced by $-\infty \ to \ \infty$. Then following Sommerfield's expansion method as explained in Ref.8a, we get from Eq.7,

$$E_F = \frac{E_{F0}^{3/2}}{E_F^{1/2}} - 3\alpha T E_F - (1 + 3\alpha T)[\frac{\pi^2}{12}\frac{(k_BT)^2}{E_F} + \frac{7\pi^4}{960}\frac{(k_BT)^4}{E_F^3}] \qquad (8)$$

The numerical coefficients for successive terms in (8) get smaller and smaller with higher power of T. For temperature T such that $K_BT < E_{F0}$, terms up to the fourth power of T are sufficient.

Eq.(8) is difficult to solve for E_F. As an approximation by replacing E_F by E_{Fo} [assumption valid $K_BT < E_F, E_{F0}$] on the RHS of Eq. (8) we get Eq.(9)

$$E_F = -E_{F0} = -3\alpha T E_{F0} - (1 + 3\alpha T)[\frac{\pi^2}{12}\frac{(k_BT)^2}{E_{F0}} + \frac{7\pi^4}{960}\frac{(k_BT)^4}{E_{F0}^3}] \qquad (9)$$

Using Eq.(4) we then obtain

$$W(T) = W_0 + 3\alpha T E_{F0} + (1 + 3\alpha T)[\frac{\pi^2}{12}\frac{(k_BT)^2}{E_{F0}} + \frac{7\pi^4}{960}\frac{(k_BT)^4}{E_{F0}^3}] \qquad (10)$$

W_0 is the work function of the material at T = 0 K. Eq. (10) gives us the temperature dependence of the work function of a metal. It is interesting to note that $W(T)$ for a given E_{F0} increases with T and one shall be able to tune $W(T)$ by tuning the carrier density in nano-materials, as E_{F0} depends on carrier density[Eq.1]. It also predicts that in materials with zero E_{Fo} , i.e., in insulator materials, W(T) is infinite, meaning that

thermoelectron emission is not possible in insulators. This is in line with experiment. Because of the quantities, α and E_{F0}, this dependence on T is metal specific. The positive temperature coefficients of W(T) from Eq.(10) is consistent with that of many metals [7,13]. We shall examine this in some details in latter section. For temperatures $T < E_{F0}/k$ but well below the melting point of the metal, the term with fourth power of T is sufficient. In general the relative contributions of the second, third and fourth terms depend on T and E_{F0}.

Eq.(10) is particularly important for estimation of J in materials like graphene, carbon nanotubes etc. with low E_{fo}(0 – 0.3 eV). This should also be important for computation of energy distribution[15] of emitted electrons from nano-materials. For metals where $E_{FO} >$ a few eVs, the work function, dW(T)/dT in [Eq. 10] is practically temperature independent for T~2000 K which means metals have almost a linear variation of W with T. In such cases the second term in Eq.10 dominates the third and the fourth terms. For greater accuracy in computation of W the eq. 7 needs to be solved numerically, which is quite tedious and not easily applicable for computation of thermionic emission current density.

IV. NEW MODIFIED RICHARDSON DUSHMAN EQUATION (MRDE)

Richardson Dushman equation for thermoelectron current density (emitted along z direction) is given by:

$$J = \int dnev_z = \iiint_{v_z=v_{z0};v_y=0;v_x=0;}^{v_z=\infty;v_y=\infty;v_x=\infty;} \left[2ev_z\left(\frac{m}{h}\right)^3 \exp\left(\frac{E_F}{k_BT}\right)\right]$$
$$\times \exp(-\frac{(m(v_x^2+v_y^2+v_z^2)}{2k_BT})dv_x dv_y dv_z \qquad (11)$$

where v_{z0} is the minimum velocity required for electron to get out of the metal in the z direction (direction of electron emission) and is given by:

$$v_{z0} = \sqrt{2\,(E_F + W(T))/m} \qquad (12)$$

From Eqs. (10) - (12) we finally get the modified Richardson-Dushman thermoelectronic emission equation (MRDE) for J as

$$J = A_0T^2 exp(-[W_0 + 3\alpha TE_{F0} + (1+3\alpha T)[\frac{\pi^2}{12}\frac{(k_BT)^2}{E_{F0}} + \frac{7\pi^4}{960}\frac{(k_BT)^4}{E_{F0}^3}]]/k_BT) \qquad (13)$$

Eq. 13 gives us new modified thermionic emission equation that must be applied for materials like graphene, carbon nanotubes which have low E_{Fo} and at temperatures comparable to E_{Fo}/k_B. For E_{Fo} of the order of 0.3 eV and for T within 2500 K, terms up to fourth order in Eq.13 is sufficient, since the contribution of the sixth power of T will be negligible. For metals with high E_{Fo} (a few eVs), at temperatures $k_BT < E_{Fo}$, Eq. 13 approximately gives the ordinary RD temperature dependence with an effective thermionic emission constant A_{eff} (Eq.14).

Eq. 13 gives us the modified thermionic emission equation with the constant Ao changed to a new constant Aeff

$$A_{eff} = A_0\exp(-\frac{3\alpha E_{F0}}{k_B}) \qquad (14)$$

Now in Eq. (14) the term E_{Fo}/kB is a constant of a given metal and is metal specific. E_{Fo} is given by Eq.3. The number density n can be calculated from, n = zNA ρ/M. z = valency; ρ = density; M = atomic mass. NA = Avogadro number. n can also be calculated from the following relation: n = xz/a3. Where x = number of atoms per unit cell of the metal crystal. z = valency of the metal. a = lattice constant of the metal. n of some metals calculated from the second relation is given in Table 1. E_{Fo} is then computed from Eq.(3). The nearly temperature independence of the thermal expansion coefficient α can be understood from the following considerations:

$$\alpha = \frac{\gamma(C_v^{ion}+C_v^{el})}{3B} \qquad (15)$$

Where γ is the overall Gruneisen parameter of the metal; this is primarily of the order of unity and temperature independent. B the bulk modulus. At temperatures above 300 K, C_v^{ion} assumes the value of 3R. C_v^{el} is usually much smaller than C_v^{ion}. The electronic contribution C_v^{el} is very negligible at high temperature. Thus α can be assumed to be fairly independent of temperature in a metal. For greater accuracy temperature dependence of α can be inserted in Eqs.7,10 & 13.

This new thermionic constant[14] A_{eff} is dependent on two quantities: α and E_{F0} which are both metal specific. It is to be noted that the Schottky effect (lowering of work function by the presence of electric field, E on to the metal surface) modification of the thermionic emission equation that is well-known is not added to eq.13. With Schottky- effect Wo is lowered to $W_0^/$ (Eq.16).

$$W_0^/ = W_0 - e(\frac{eE}{4\pi\epsilon_0})^{0.5} \qquad (16)$$

The final modified equation for thermionic equation is given by:

$$J = A_0T^2 exp(-[W_0^/ + 3\alpha TE_{F0} + (1+3\alpha T)[\frac{\pi^2}{12}\frac{(k_BT)^2}{E_{F0}} + \frac{7\pi^4}{960}\frac{(k_BT)^4}{E_{F0}^3}]]/k_BT) \qquad (17)$$

Eq. (17) can be said to be the final modified RD equation that takes care of Schottky effect, thermal expansion and change of chemical potential with temperature.

Because Fermi surface of a metal is not spherical in k-space. E_{F0} can depend on crystallographic orientation of the metal plates from which thermionic emission takes place and hence Aeff. In Eq. 10, for metals with E_{F0} of a few eVs, at temperatures up to 2500 K, dW/dT is primarily due to thermal expansion of metals. Since deviation of A_{eff} [Eq.14] from Ao is primarily due to thermal expansion of materials, A_{eff} and dW(T)/dT of a given metal can also depend on whether thermionic emission measurement is carried out on (i) thin wire; (ii) plate surface; (iii) spherical surface or cubical surfaces of the metal. At thermionic emission temperature of 900 K the de Broglie wavelength of electron is 41 Angstrom and it decreases with higher temperature. As long as the two dimensional plate thickness or the diameter of a long wire is significantly greater than 41 angstrom, three dimensional density of states and hence Eqs. (8 -14) will be valid for thermionic emission from plate surface and the cylindrical

surface of a wire. However, the effect of thermal expansion for three dimensional, two-dimensional (thin plate) and one dimensional (thin wire) emitters can be accounted by replacing 3α in Eqs. 10,13 and 17 by $r\alpha$ where r=1,2 and 3 for thermos electronic emitters in the shape of thin wire, a thin plate and a bulk cube or sphere..

III.3. Rate of change of work function and effective thermionic constants of metals:

With this idea A_{eff} and dW/dT for electron emissions from metal at temperatures $k_B T \ll E_{F0}$ can be given by:

$$A_{eff} = A_0 \exp(-r\alpha \frac{r\alpha E_{F0}}{k_B}) \qquad (18)$$

$$\frac{dW(T)}{dT} = r\alpha E_{F0} \qquad (19)$$

where r=1,2 and 3 for thermos electronic emitters in the shape of thin wire, a thin plate and a bulk cube or sphere respectively. Eq.(19) is valid for most metals as $E_{F0} > 2$ eVs.

$$a = \left(\frac{dW}{dT}\right)_{exp} \times 10^{-4} eV/K, \quad b = \left(\frac{dW}{dT}\right)_{th} \times 10^{-4} eV/K$$

TABLE I. WORK FUNCTIONS AND RICHARDSON'S CONSTANTS FOR VARIOUS MATERIALS IN UNITS OF A CM^{-2} K^{-2} OR 10^4 [5,6]

Metal	W (eV)	A× $b(Acm^{-2}K^{-2})$ B is material correction factor
Molybdenum	4.15	55
Nickel	4.61	30
Tantalum	4.12	60
Tungsten	4.54	60
Barium	2.11	60
Cesium	1.81	160
Iridum	5.40	170
Platinum	5.32	32
Rhenium	4.85	100
Thorium	3.38	70
Ba on W	1.56	1.5
Cs on W	1.36	3.2
Th on W	2.63	3.0
Thoria	2.54	3.0
BaO + SrO	0.95	~10^{-2}
Cs-oxide	0.75	~10^{-2}
TaC	3.14	0.3
LAB$_6$	2.70	29
Theoretical		120.2 (b=1)

TABLE II. TEMPERATURE COEFFICIENT OF WORK FUNCTION FOR SOLID P-BAND METALS [7].

Metal	W	a	b	Tm (K)	E_{Fo} (eV) *	$\alpha \times 10^{-6}/K$
Ga	4.07	7.40	7.3$^{!!!}$	303	10.4	23.5
In	3.90	4.3	4.36$^{!!}$	429	8.63	25.3 [a]
Sn	4.18	2.20	2.41$^{!}$	505	10.3	23.4
Bi	4.35	2.00	1.29$^{!}$	544	9.90	13
Tl	3.69	1.20	2.45$^{!}$	577	8.15	30
Pb	4.06	1.40	2.65$^{!}$	606.6	9.47	28

TABLE III. COMPARISON OF CALCULATED AND EXPERIMENTAL VALUES* OF THERMIONIC EMISSION CONSTANT A'

$$C = A_{eff(th)} \times 10^4 (Acm^{-2}K^{-2}) \text{ AND } d = A_{eff(exp)} \times 10^4 (Acm^{-2}K^{-2})$$

Metal	$\alpha \times 10^{-6}/C$		$n(10^{28}/m^3)$	E_{F0}(eV)	c		d	
					r=1	r=2		
Ca	22.5	[28]	4.60	4.69	35.3		60	[30]
Cr	6.2	[28]	8.37	7.05	72.3	43.5	48	[30]
Cs	97	[28]	0.90	1.59	20		162	[30]
Iron	11.7	[28]	16.92	11.2	26.3		26	[30]
Ta	6.5	[28]	11.03	8.38	63.8		60	[30]

CONCLUSION

Original Richardson-Dushman thermionic emission equation is based on temperature independent work function W which gives thermionic emission equation with emission constant A same for all metals. Experiments confirm that A varies from metal to metal and W varies with temperature. We have considered temperature variation of work function of metals taking into account thermal expansion and temperature variation of chemical potential to obtain theoretical expression for temperature dependent work function (Eq.10) and modified Richardson-Dushman equation (Eq. 13 or17). We have seen fairly good agreements for several metals on dW/dT and A_{eff} with not so good agreement for alkali metals. To our knowledge there is no unified single theory that explains the experimental observations of A_{eff} and dW/dT for all metals and the thermionic emission from nano-materials. This modified equation does not affect the temperature dependence of thermionic emission current density much from the original RD law for metals because metals have high E_{Fo} compared to

k_BT. It will however, significantly alter the temperature dependence for nano-materials which have low E_{Fo}. It is reported that the ordinary RD law cannot explain the experimental thermionic emission current data for graphene [22] and carbon nanotubes [14b]. We have verified that our model fits the data excellently well. We have seen that the values of thermal expansion coefficient and the carrier density derived from the fitting agree very well with independent experimental measurements. The excellent agreement of thermionic emission current density of monolayer graphene with our theory provides further validity of our theory-this aspect will be detailed in subsequent publications along with the detailed applications of the modified RD equation to nano-materials. The equation is expected to be important also in the studies of the energy distribution of thermally electrons from nano-materials [15] and for correct evaluation of performance of the energy converter for solar thermionic power conversion using nano materials.

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RADIOACTIVITY RISK OF DUMP-SITE EXPOSURE TO STUDENTS AT DANIEL HALL IN COVENANT UNIVERSITY.

Omeje Maxwell.
Department of Physics, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria.
maxwell.omeje@covenantuniversity.edu.ng

George Akuroma
Department of Physics, College of Science and Technology, Covenant University, Ota, Ogun State Nigeria.
akuroma.george@stu.cu.edu.ng

Joel Emmanuel
Department of Physics, College of Science and Technology Covenant University, Ota, Ogun State, Nigeria.
emmanuel.joel@covenantuniversity.edu.ng

Amaremo,E.O
Department of Physics, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria.

Abstract— **A radiometric assessment of the activity concentrations of ^{238}U, ^{235}Th and ^{40}K was conducted in Covenant University dump site located about 200-400 meters behind Daniel hall. For this study the RS-125 Super Spec hand held radiation detector was used alongside a GPS to take down location coordinates. Fifteen stations were measured, in the dump site, some meters away from the dumpsite, by the sides and in front of Daniel hall. The activity concentration of radionuclides varies from 11.42 ± 0.3 to 44.76 ± 0.2 Bqkg^{-1} with a mean value of 27.31 Bqkg^{-1} for ^{238}U, 33.29 ± 0.8 to 213.96 ± 0.4 Bqkg^{-1} with a mean value of 69.14 Bqkg-1 for ^{252}Th and 31.3 ± 0.2 to 1017.25 ± 0.6 Bqkg^{-1} with a mean value of 275.96 Bqkg^{-1}for ^{40}K. The absorbed gamma dose rates exposed to students around the area varies from 81.56 to 442.31 ± 2.2 nGry^{-1} with a mean value of 152.25 ± 2.2 nGry^{-1}.The annual outdoor and indoor effective dose equivalent was 0.18 mSv and 0.274 mSv respectively. Comparing the radiological health risks from the present study with the average world standard by ICRP (International Commission on Radiological Protection) and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR,2000) recommended standard values of 1 mSv, it is within the range. This study revealed that the risk exposure to the students at Daniel Hall may not be from the dump-site, rather, the granitic crushed rocks used for constructions near Daniel Hall may be the risk implication.**

Keywords— Dump-site, Activity concentration, Radiological assessment, Radionuclides

I INTRODUCTION

The presence of ionizing radiation in natural Environment was noted in 1899 and was assumed to originate from radioactivity in environmental materials like rivers, groundwater, soils and rocks. Ionizing radiation is an inseparable part of the living environment.

Naturally occurring radioactive materials (NORM) are found throughout the earth's crust, and they form part of the natural background radiation to which all humans are exposed. Natural radiation is of two origins extraterrestrial and terrestrial.

Extraterrestrial radiation originates from outer space as primary cosmic rays. Their interactions with earth's atmosphere give rise to secondary cosmic rays to which living beings on earth are exposed to. The dose rate from cosmic rays varies with latitude and altitude. There is little that can be done about exposure to cosmic rays since it readily penetrates ordinary buildings.

Terrestrial radiation is emitted from radioactive nuclides present in varying amounts of all soils, rocks, the atmosphere and the hydrosphere and from radionuclides that are transferred to man through food chains or by inhalation and deposited in his tissues. Terrestrial radiation leads to internal and external radiation. The presence of these (NORM) in soil, rocks, water, and air, along with cosmic radiation result in continuous and unavoidable internal and external radiation exposures of all human [7]

More than 200 types of atomic nuclei that are radioactive and are sources of alpha, beta and gamma radiation are known in nature. The most important elements contained in rocks that cause gamma radiation are uranium, thorium and potassium which concentrate in the near-surface layer 150 mm thick. These radiations are exposed to inhabitants of Earth which requires immediate attention [2].

In groundwater, uranium and other toxic elements are present in particulate and dissolved form due to certain minerals such as uranite, pitchblende and conalite or as secondary mineral in form of complex oxide of silicate, phosphate, validates lignite and monazite sands.

Human activities such as industrialization is the main cause of man's exposure to radiation cosmic ray contribute just a little. The global average annual effective dose arising from natural source of radiation is 2.4mSv [7].Studies on radiation level

and radionuclide distribution in the environment provide vital radiological baseline information on human exposure to NORM which may be relevant to radiation protection. X-rays used in hospitals are the most recognized source of artificial radioactivity. A chest x-ray for instance would a dose equivalent to the lungs of about 0.1 mSv. Radionuclides are also administered to patients for diagnostic and therapeutic purposes such as treatment of cancer.

Radiation exposure can also be as a result of large scale production of electric power by nuclear fission. The nuclear fuel cycle includes mining and production of the uranium ore, fuel fabrication and enrichment, power production in the reactors and finally the reprocessing of the spent fuel. Self-luminous wrist watches and color televisions also emit radionuclides as they x-rays.

II GEOLOGY AND GEOGRAPHIC LOCATION OF THE STUDY AREA

Covenant University is in Ota, Ogun State, which falls within the Eastern Dahomey (Benin) Basin of south-western Nigerian that stretches along the continental margin of the Gulf of Guinea. Rocks in the Dahomey basin are Late Cretaceous to Early Tertiary in age [3]. The stratigraphy of the basin has been classified into Abeokuta Group, Imo Group, Oshoshun, Ilaro and Benin Formations. The Cretaceous Abeokuta Group consist of Ise, Afowo and Araromi Formations consisting of poorly sorted ferruginized grit, siltstone and mudstone with shale-clay layers.
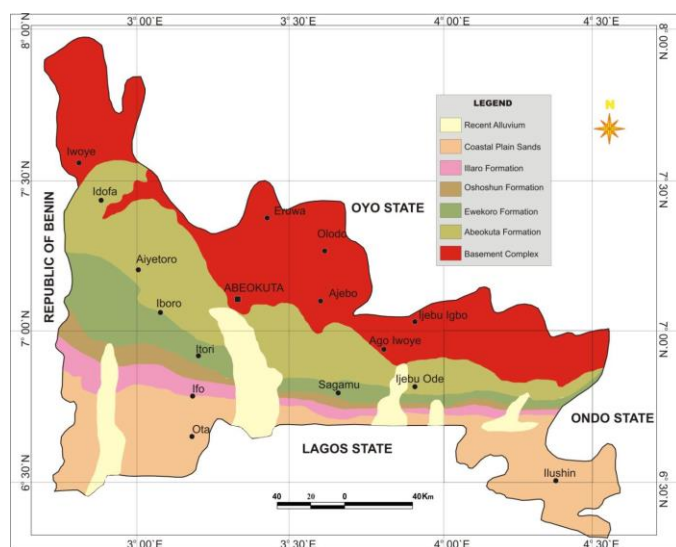
Figure 1 shows Geological Map of Ogun State Gotten from Geological Survey Agency Abuja.

III   MATERIALS AND METHODS

Gamma radiation (GR) dose rates were measured 1 m above the soil from various locations at the dump-site. The measurement points were chosen based on the level of waste deposits and the Students Hostel which is the target of assessment of the area avoiding cliff and non-arable land. The

GR dose rates were measured at each point using a gamma-ray detector, and the coordinates (latitude and longitude) of each surveying point were recorded with a Global Positioning System made of (Garmin :GPSmap 72H) .An average value was recorded from four measurements around each point. The detector used was model (Super SPEC RS-125), manufactured by Canadian Geophysical Institute. It has high accuracy with probable measurement errors of about 5%. It offers an integrated design with a large detector, direct assay readout, data storage and high sensitivity. The assay mode of RS-125 Super SPEC provides sample concentration analysis with direct data display of K (%), U (ppm) and Th (ppm). It uses sodium iodide (NaI) crystal doped with thallium [Tl] as activator. The approximate linear energy of the detector falls between 0.80 and 1.2 MeV, this range covers the majority of significant gamma-ray emissions from terrestrial sources. The detection of gamma-rays from cosmic rays is negligible due to the detector's low response to high-energy gamma radiation (6, 5). The instruments reading was in parts per million (ppm), the mean results were obtained and then converted to Becquerel per kilogram (Bqkg-1) with the conversion factor by (2). Microsoft excel software was used for the conversion analysis. The RS-125 spectrometer is calibrated on 1m X 1m test pads manufactured by Dr. R. L. Grasty et al, fully described in Geological Survey of Canada (1991) Report No.90-23. The calibration process utilizes 5 minutes spectra accumulation on K, U, Th pads and 10 min accumulation on the Background (BG) pad according to Canadian Geophysical Institute.

I Calculating the Radiation hazard indices

The radiation hazard indices obtained in this study includes:
(i) The annual effective dose outdoors (AEDEout), which took into account the conversion coefficient (0.7 Sv Gy−1) from the absorbed dose in air to effective dose, and the outdoor occupancy factor (∼ 20 %) was calculated using Equation (1) according to [7] :

$$\text{AEDEout (mSv)} = D(nGy\ h{-}1) \times 8760\ (h) \times 0.2 \times 0.7\ (Sv\ Gy{-}1) \qquad (1)$$

(ii) The radium equivalent activity (Raeq) which assesses the gamma radiation hazards associated with materials that contain 238U, 232Th and 40K was calculated using Equation (2) according to [7]:

$$Raeq = (AK \times 0.077) + ARa + (ATh \times 1.43) \qquad (2)$$

where ARa, ATh and AK are specific activity concentrations of 238U, 232Th and 40K, respectively, in Bq kg−1. The recommended level of Raeq is 370 Bq kg−1.

(iii) The external hazard index or outdoor radiation hazard index denoted by Hex was calculated using Equation (3) according to [7]:

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$$= \qquad \leq \ 1mSvy^{-1} \qquad (3)$$

Where Cu, CTh and CK are the specific activity concentrations of 238U, 232Th and 40K in dump-site and Daniel Hall, respectively, in Bq kg−1. The value of this index should be less than 1, for the radiation hazard to be considered acceptable to the public [7].

IV RESULTS AND DISCUSSION

I Activity Concentrations of ^{238}U, ^{232}Th and ^{40}K in the Study Area

Table 1 below presents the activity concentrations of naturally occurring radionuclides of varying concentrations. Considering the activity levels of radionuclides (238U, 232Th and 40K) in the study area, it varies from 11.42 ± 0.3 to 44.76 ± 0.2 Bqkg-1 with a mean value of 27.31 Bqkg-1 for 238U, 33.29 ± 0.8 to 213.96 ± 0.4 Bqkg-1 with a mean value of 69.14 Bqkg-1 for 252Th and 31.3 ± 0.2 to 1017.25 ± 0.6 Bqkg-1 with a mean value of 275.96 Bqkg-1 for 40K. The highest activity level of all the nuclides were found at station 13 with values of 37.67 ± 0.03 Bqkg-1 , 213.96± 1.05 Bqkg-1 and 1017.25 ± 6.5 Bqkg-1 for 238U, 232Th and 40K, respectively. This effect of higher values found outside the dump-site nearer Daniel Hall may be attributed to the imported building materials used for fillings and granites used for the construction of car packs. It can be observed that the major radionuclide that is most abundant in the area is 40K whereas the lowest in abundance is 238U. It may be that 40K contributed the highest exposure to the surrounding considering how richly found at the site of study. 238U and 232Th have lower radiation effects to the environment when compared to their 40K counterpart.

Table 1 Activity concentrations of naturally occurring radionuclides of varying concentrations.

Stations	U(Bq.kg^-1)	Th(Bq.kg^-1)	K(Bq.kg^-1)
1	23.77 ± 0.02	48.72 ± 0.24	54.78 ± 0.35
2	23.77 ± 0.02	48.42 ± 0.24	31.30 ±0.20
3	27.48 ± 0.02	44.96 ± 0.22	46.95 ±0.30
4	24.08 ± 0.02	39.89 ± 0.12	62.60 ±0.40
5	27.17 ± 0.02	34.92 ± 0.17	93.90 ±0.60
6	26.24 ± 0.02	35.63 ± 0.18	86.08 ±0.55
7	23.77 ± 0.02	33.29 ± 0.16	101.73 ±0.65
8	23.16 ± 0.02	38.47 ± 0.19	31.30 ±0.20
9	15.13 ± 0.01	49.63± 0.25	281.70 ±1.80
10	40.45 ± 0.03	120.48 ± 0.59	469.50 ±3.00
11	44.77 ± 0.04	108.81 ± 0.54	555.58 ±3.55
12	37.67 ± 0.03	112.67 ± 0.56	563.40 ±3.60
13	37.67 ± 0.03	213.96± 1.05	1017.25 ± 6.5
14	11.42 ±0.01	46.49 ± 0.23	367.78 ± 2.35
15	23.16 ± 0.02	60.90 ± 0.30	375.60 ± 2.40

II External Gamma Radiation (Gr) Dose Rates Assessments

Total number of fifteen (15) stations of external gamma dose rates were measured 1 m above the ground in the study area, with 10 stations within the dump site and 5 stations outside the dump site (Daniel hall) . The external gamma dose varies from 81.56 ± 2.25 to 442.31 ± 2.2 nGry-1 with a mean value of 152.25 ± 2.2 nGry-1. Comparing the mean value of gamma dose rate obtained in this present study with the world average value, it is approximately three times the world average value of 59 nGy h−1. The highest value of 442.31 ± 3.67 nGy h−1 was noted close to the hostel, about 58 m away (station 13), which is approximately eight times the world average standard but noticed that the effect of higher such value was from crushed granites composed of igneous rocks that have crystallized from molten magma, which usually results in higher gamma dose rate values [4, 6], used for road and car park constructions at the Daniel Hall. Table2 shows the mean values of GR dose rates for each sample station.

Table2 Mean values of GR dose rates for each sample station

Stations	Dose rate nGry^-1
1	99.16 ± 4.53
2	96.63 ± 2.77
3	95.92 ± 2.99
4	86.95 ± 4.36
5	82.72 ± 3.70
6	88.99 ± 1.63
7	81.56 ± 2.25
8	85.58 ± 1.88
9	102.2 ± 1.63
10	258.0 ± 13.3
12	252.45 ± 5.34
13	442.31 ± 3.67
14	112.58 ± 3.67
15	145.31± 2.92

The GR dose rate in the study area was plotted against station points as shown in Figure 2 below, for easy location peak level that poses higher exposure value to the environment. It can be noted that station 13 has the highest GR dose rate exposure to the students at Daniel Hall which was attributed to the granitic materials imported for building/construction purposes at the car park. The least value was observed at the entrance of the dump-site (station 1).

3 | P a g e

http://cu-icadi.covenantuniversity.edu.ng
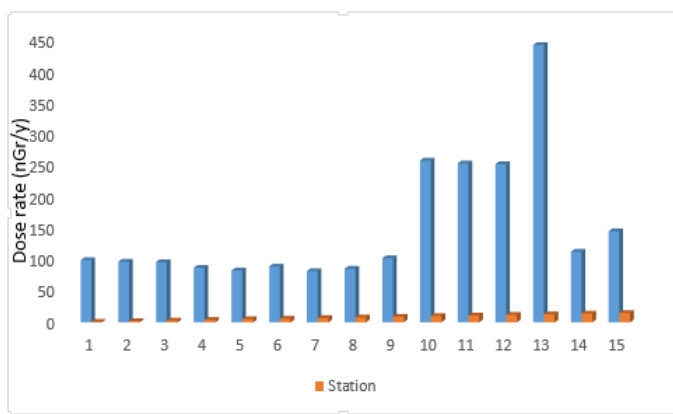
Figure 2 : Graph of Gamma Dose Rate against Stations in the Study Area.

II Calculation Of Radiological Effects

Radium Equivalent Uranium (Req)

From the results obtained in activity concentration of 238U, 232Th and 40K, radiation hazard indices associated with this study for radium equivalent uranium using Equation (2) was 147.45 ± 0.6 Bqkg-1 . This result when compared with the International standard value of 370 Bq kg^{-1}, it was lower by a factor of 2.5.

III   External Hazard Index (Hex)
External hazard index was determined from the Radiation exposure due to 238U, 232Th and 40K according to Beretka and Matthew 1985. For calculating external hazard index, the formula below was used. In the study area, the value obtained for the external hazard index is 0.39. Comparing the present work with the international standard value of 1 and the considered acceptable level to the general public [1, 3 7], it can be noted that the present work is below with a factor of 2.5. The external hazard index may not have any health risk to the students in Daniel Hall

IV Annual Effective Dose Equivalent (AEDE)

The AEDE was calculated using the dose conversion factor of 0.7 Sv/Gy for the absorbed dose in air [7], the world average occupancy factor for outdoor is 0.8 and 0.2 respectively [7]. Daniel hall boys spend almost six (6) hours outdoors and eighteen (18) hours indoors. AEDE is determined using the following equations (1). The AEDE for outdoor obtained in this present study is 0.18 mSv. Comparing this value with the International Reference Standard value of 0.07 mSv according to [7], it can be observed from Figure 2 below that this present work is twice higher than the standard value.
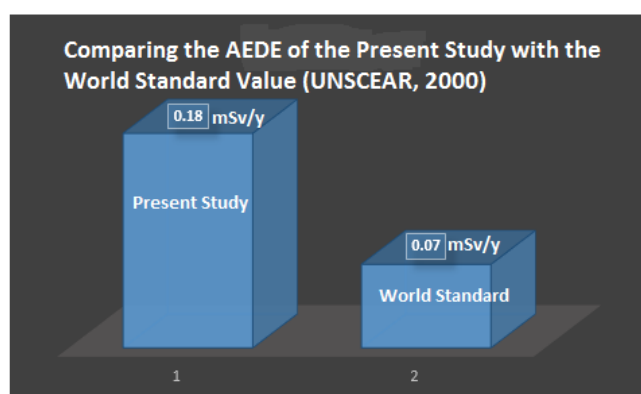
Figure 2. Comparison of the AEDE of the Present Study with the
International Standard Value [7]

V CONCLUSION

The natural radioactivity from the waste materials at the dump-site and the related radiological health implication in the environmental of Daniel Hall were obtained. The mean gamma dose rate was found to be 152.25 ± 2.2 nGry-1, which gives the AEDE outdoors of 0.18 mSvy-1 was measured. These values are three times more than the world average values of 59 nGy h−1 and 0.07 mSv, respectively. Few areas of enhanced activity were noted in the Dump-site and Car park in front of Daniel Hall. These areas at the Daniel Hall are predominantly covered with granitic crushed materials used for constructions. These areas have the highest values for activity concentrations of radionuclides. The radium equivalent activities (Req) and external hazard index (Hex) were below the recommended values of 370 Bq kg^{-1} and 1, respectively according to [7]. Further research on soil geochemistry and indoor gamma dose rate and radon assessment in Daniel Hall is highly recommended so as to draw a conclusion on the cancer fatal risks level.

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Use of Agricultural Wastes and Limestone for the Removal of Iron from Drinking Water

Ajayi, O.O.; Omole, D.O.; Emenike, C.P.
Department of Civil Engineering,
Covenant University,
Ota, Nigeria.
david.omole@covenantuniversity.edu

Abstract - In this study, adsorption method was employed in the treatment of iron in drinking water. Groundwater samples were obtained from Ota environs and tested for Iron impurity using Plainest 8000 photometer. Adsorbents such as rice husk, plantain peel, and limestone were used in the treatment of the water samples. All three adsorbents were washed with distilled water and oven dried at 100°C for 24 hours. The dried plantain peel was ground to powder using pestle. Both the rice husk and limestone occurred naturally in granular states. The density of rice husk, plantain peel and limestone were found to be 0.332 kg/l, 0.6 kg/l and 2.614 kg/l respectively. Subsequently, all three materials were heated to 200°C in an oven for 6 hours. They were, thereafter, sieved using 425 MIC sieve. Batched experiments on the efficiency of iron removal were conducted by measuring 10 ml of each adsorbent and adding it to 100 ml of water samples in turn. The mixture was stirred using a magnetic stirrer and the contact time during stirring was varied for 5, 10, 15 and 20 minutes in order to compare treatment efficiency. Results indicate that all three materials removed iron from the water samples. However, only limestone showed a consistent reduction in iron concentration with respect to time while the agricultural wastes (rice husk and plantain peel) had fluctuations in iron concentration with respect to time. Limestone, rice husk and plantain peel had ultimate removal efficiencies of 56.7%, 79% and 83.3% at 20, 20 and 15 minutes respectively. Further experiments were recommended in other to determine optimum iron removal conditions.

Keywords: water treatment, adsorption, adsorbent, iron, drinking water.

I. INTRODUCTION

Heavy metal contamination of water is a global problem that has been a subject of research for decades [1-4]. While metal contamination in water may occur naturally, evidence abounds that anthropogenic causes are more widespread [5]. These anthropogenic causes include pesticide and fungicide applications in agriculture, metallurgical industries, battery manufacture, paint manufacture, mining activities etc [6]. The adverse effects of high concentrations of heavy metals on public health is devastating, especially in children [7]. Common adverse health effects of metals include breakdown of vital organs such as kidneys, liver and cerebral system [1,8]. Specifically, iron is a metal that is useful in the human body [8]. Iron is a common element found in lateritic soils [4] and lateritic soil features commonly in Ota. Excessive iron metal in water, however, leads to problems such as stained teeth, brown colour stained toilet wares (Figure 1) and formation of free radicals in the human body [8]. Several methods of heavy metal removal from water or wastewater such as precipitation, electroplating, chemical coagulation, ion-exchange, membrane separation, and electrokinetics have been used successfully in the past [6,9]. However, adsorption method was consistently found to be economical and suitable for developing countries because of its treatment and cost efficiency [6]. In the current study, locally available materials such as rice husk, plantain peel and limestone were used to treat iron contaminant in water. While rice husk and plantain peels are agricultural wastes, limestone, on the other hand is a soil material that is commonly found in many parts of Nigeria. The three materials were used with the aim of determining their rate of removal of iron.

II. METHOD AND MATERIALS

A. Study Area

This study was conducted in Ota, Ogun State Nigeria. Drinking water samples were obtained from borehole sources located in Iyana Iyesi, Bells University and Covenant University, all in Ota, Ogun State.

Fig. 1: Iron stained wash hand basin in a covenant university residence

All borehole water samples were subsequently mixed together in equal ratios to obtain a single sample of drinking water. The Rice husk was obtained from a rice mill at Sihun village near Owode-Egba, Ofada, Ogun State. The plantain peels were collected from a plantain chips factory at Ketu, Lagos while crushed limestone was bought from Adenuga feeds, Sabo market, Ikorodu, Lagos.

B. Experimental Procedure

The three adsorbents (rice husk, plantain peel and limestone) were washed with distilled water and oven-dried at 100°C for 24 hours. The plantain peels were grounded using a milling machine, as the other two materials were already in powdered form. Each of the adsorptive materials was weighed and the density of rice husk, banana peel and limestone were found to be 0.332 kg/l, 0.6 kg/l and 2.614 kg/l respectively. The three materials were carbonized in the Model SDO/225 oven at 200°C temperature for 2 hours. After removing them from the oven, they were sieved with 425 MIC sieve but the plantain peel was pounded before sieving due to its adhesive state, which caused the granules to pack together in balls. Subsequently, equal volumes of each adsorptive material (10 ml) was applied to the water samples (500 ml) and stirred using an electronic stirrer under room temperature (27.4^{o}C) for varying durations (5 mins, 10 mins, 15 mins, and 20 mins). Each sample was allowed to settle for 30 mins before sieving out the adsorptive material with sieve 45 MIC. The obtained treated water was then poured into plastic bottles. The samples were left undisturbed for 48 hours to allow further settling. Thereafter, the water samples were filtered again and taken for metal analysis using Plainest 8000 photometer.

III. RESULTS AND DISCUSSION

As shown in Figure 2, the initial concentration level of iron in the raw water sample was 0.3 mg/l. The iron concentration level, however, reduced consistently following contact with limestone at stirring time of 5, 10, 15 and 20 minutes to 0.206, 0.18, 0.157 and 0.134 mg/l respectively. This translates to 56.7% rate of removal of iron from the water sample. Similarly, following the same procedure as limestone, rice husk had a 79% rate of removal of iron (Fig. 2). Finally, plantain peel reduced iron concentration to 0.05 mg/l (83.3%) at optimum treatment time of 15 minutes. The Standards Organization of Nigeria [10] recommended maximum contaminant limit for Iron in drinking water is 0.3 mg/l. Although the mean value of iron in the raw water sample is 0.3 mg/l, all three adsorbents were able to further reduce iron contaminant from the water samples at different rates.

Fig.2: plot of iron concentration level and time of treatment using rice husk, plantain peel and limestone
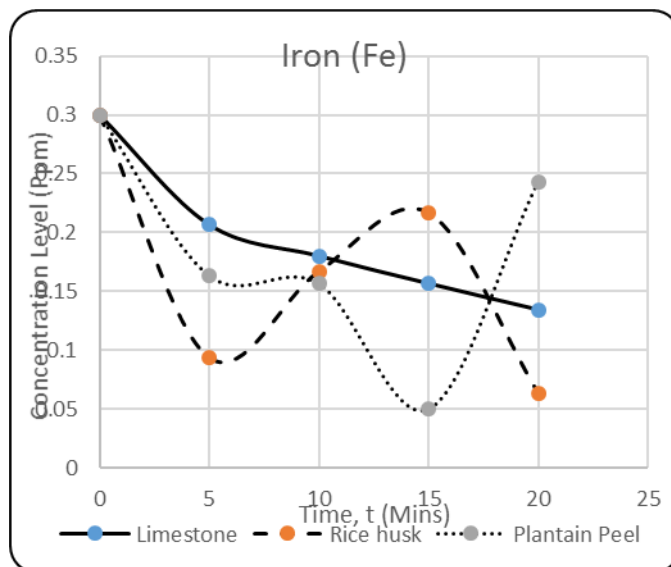
With a removal rate of 83.3%, plantain peel gave the highest treatment efficiency. However, the plantain peel treated water was aesthetically unattractive as the treated water sample had a dark coloration (even after 48 hours settling time) (Fig. 3). This phenomenon is probably caused by the leaching of soluble organic compounds into the water sample as observed by Nguyen, Ngo, Guo, Zhang, Liang, Yue, Li, and Nguyen [11].

Fig. 3: samples of water treated with plantain peel

Rice husk and Limestone which had removal rates of 79% and 56.7% respectively, however, had clearer water samples after treatment (Fig. 4).

IV. CONCLUSION

This research has shown that iron contaminant can be removed from drinking water samples using rice husk, plantain peel and limestone, with plantain peel showing the highest iron removal rate. However, due to the dissolution of organic compounds in plantain peel into the water, which gave the treated water sample a dark colouration, it is recommended that chemical pre-treatment should be given to plantain peel in future experiments to prevent unpleasant coloration after treatment (Nguyen et al., 2013). Also, further experimental studies detailing optimum treatment conditions such as temperature, stirring speed, adsorbent surface morphology and desorption studies of the adsorptive materials should be embarked upon. This solution has the potential to provide sustainable and economical heavy metal removal from water to people living in developing countries. In addition, rice husks and plantain peel which are agricultural wastes under normal conditions could now find usefulness as raw materials for the treatment of metals in drinking water.

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Causative Factors of Indoor Air Pollution in Nigerian Households

Omole, D.O. ; Azubuike, T.U.; Ogbiye, A.S.; Ede, A.N.; Ajayi, O.O.
Department of Civil Engineering,
Covenant University,
Ota, Nigeria.
david.omole@covenantuniversity.edu.ng

Abstract - **Air pollution is one of the leading causes of human mortality in the world. Within a space of one year, 396,000 deaths arising from indoor air pollution (IAP) in sub-Sahara Africa was reported in 2006. Besides the loss of human lives, public health challenges such as pneumonia in children, asthma, tuberculosis, upper airway cancer and cataract are caused or aggravated by IAP. A study was conducted among households in Lagos and Ogun States in order to determine risk patterns of IAP among residents through the distribution of questionnaires to 2000 households. Random sampling was adopted in the distribution of the questionnaires. A total of 1,616 responses (81% return rate) was achieved. Questions addressed include type of building, smoking habits of residents, use and location of electricity generating sets, location of cooking, cooking methods and use of alternative lighting system in the event of power failure. Results indicate that 62.2% of the residents lived in buildings where some form of commercial activities are taking place. Also, 6.4% of the residents admitted to smoking within living quarters, 9.2% used electricity generators within the building confines; about 35.2% used kerosene stoves for cooking; and 4% of the respondents cooked in kitchens where there was no proper ventilation. 18.3% of the respondents used candle for lighting in closed rooms while 14.4% used palm oil lit lamps. It was concluded that the use of IAP enhancing methods of illumination and cooking within the households were informed by poverty, poor ventilation within households, security related issues. The enforcement of building codes and environmental regulations could forestall avoidable deaths in future.**

Keywords: Air, pollution, environment, building, sampling, public health.

I. INTRODUCTION

Air pollution can be classified into two categories: outdoor air pollution (OAP) and indoor air pollution (IAP) [1]. Global data, however, shows that IAP is far more lethal than OAP [2]. While less than 300 deaths per million people arising from OAP was reported in 2004, approximately 2,200 deaths per million people arising from IAP was reported in the same year [1-2]. World Health Organization, [3] using data gathered from around the world, also reported that 1.6 million people died from cooking stove fumes. Of the 1.6 million deaths,

396,000 deaths occurred in sub-Sahara Africa, with highest incidents occurring in Nigeria [4]. Another WHO report posited that 78% of African population used biomass burning to cook and that a third of infant deaths associated with IAP occurred in Africa [5]. Health complications arising from IAP include pneumonia in children, asthma, tuberculosis, upper airway cancer and cataract [2]. Aside cooking sources, other common sources of IAP include mosquito repellant fumes, electricity generator fumes, and cigarettes [2, 4-5]. The main casualties of IAP are always children. Sofoluwe [6] visited the homes of nearly 100 children who were his patients and were suffering from bronchiolitis and pneumonia. He observed that all the visited homes had high concentrations of carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and bezene which were responsible for the sickness in the children. In particular, CO is a very dangerous, colourless and odourless gas that arise from incomplete combustion of fuel in electricity generators and cars as well as wood fires. Health challenges that may arise from CO poisoning include vision and hearing impairment, cerebral congestion, fainting, headache, dizziness, asphyxia, edema and death [7-8]. Considering the seriousness of IAP in Africa and Nigeria in particular, the current study embarked on an investigation of domestic practices that may jeopardize public health. The study aims to proffer solutions that would reduce and possibly eliminate the risks of IAP by studying the underlying causes of IAP in Southern parts of Nigeria.

II. METHOD AND MATERIALS

A. Study Area

The study areas for this research was Lagos and Ogun States. These two states are situated in the south-western parts of Nigeria (Fig. 1).

Lagos State has a population of over 21 million people living in a 3,577 km^2 area [2,9]. This gives a population density of 5,870 persons/km^2. This high population density suggests the possibility of congestions in households. Ogun State, on the other hand, has a current estimated population of 5, 010, 251 (using a 3% growth rate and the 2006 census figures) [10]. Ogun State land mass is 16,720 km^2 [9] thereby giving a

population density of approximately 300 persons/km^2. The State, however, has a high industrial presence, especially in Ota [11]. Most of these industries also generate air pollution, some of which may contribute to air pollution problems in the environment.
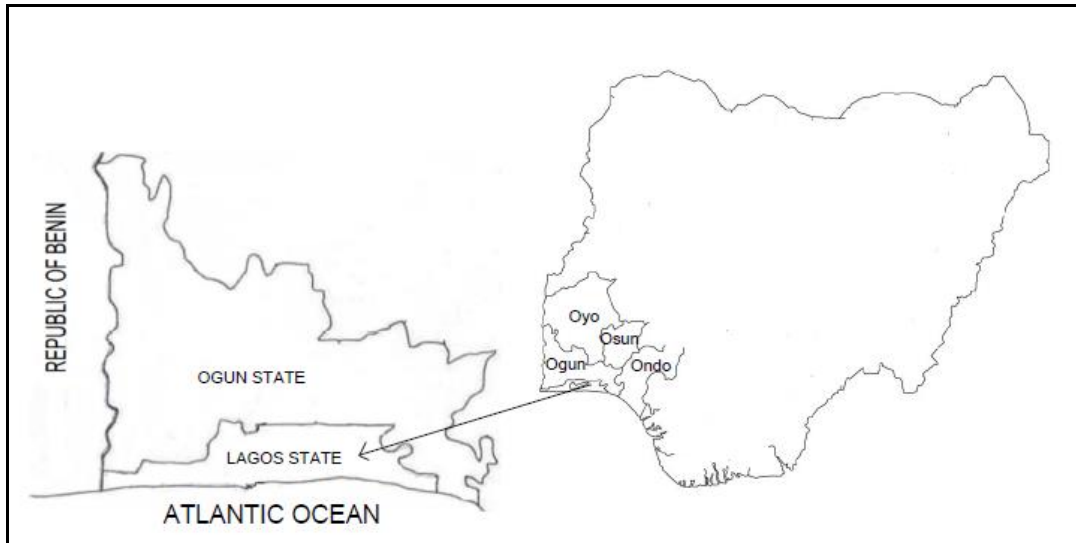
Fig. 1: Map of Ogun and Lagos States in South-west Nigeria

B. Data Collection

Data was collected through the administration of structured questionnaires which were distributed randomly within Lagos and Ogun States. In Lagos State, the questionnaires were distributed in Ikeja, Illupeju and Oshodi while in Ogun State, the questionnaires were distributed in Ota and Ewekoro. The choice of locations was informed by the relatively high population distribution in the respective locations, as well as the presence of industries which are likely to release gaseous and particulate emissions into the environment. Industrialized areas tend to serve as havens for job seekers. Thus, such areas have high population densities with many living in sub-human conditions [12]. A total of 2,000 questionnaires were distributed to the same number of households. However, only 1,616 completed questionnaires were retrieved, thus giving a return rate of 81%. Questions addressed in the questionnaires included type of building, smoking habits of residents, use and location of electricity generating sets, location of kitchen, cooking methods and use of alternative lighting system in the event of power failure. In the course of distributing the questionnaires, oral interviews were also conducted while visual observations of the state of ventilation in the households were also made.

III.   RESULTS AND DISCUSSION

A. Types of Buildings

The respondents lived in different types of environments. While 89.4% lived in proper residences, 3.6% lived and worked within private school premises, 1.5% lived and worked within church buildings, 1% lived in industrial premises, 3.2 % lived in commercial/shopping complexes, and 1.2% lived in buildings designed for than one purpose (Fig. 1). This distribution shows that some people live in buildings meant for purposes other than residential.

B. Commercial activities in the Households

When asked if the buildings accommodated any form of commercial activities, 62.2 % of the respondents answered in the affirmative while 36.9% denied that any form of commercial activity took place in their households (Fig. 2). The significance of this question has to do with the fact that
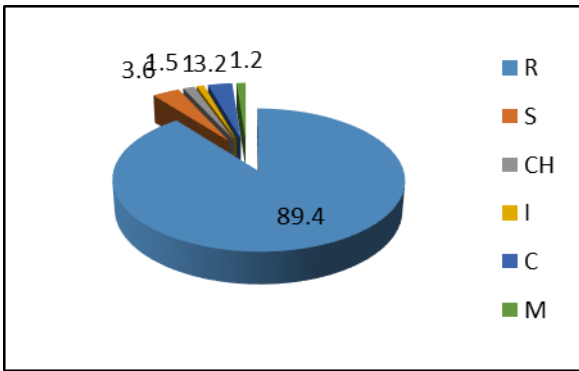
Fig. 2: Building type

commercial activities often require electricity supply which is in short supply in Nigeria. This often results in the use of electricity generating sets. Residents tend to simultaneously use multiple generating sets which result in both noise and air pollution in cramped spaces. When further asked why they indulge in this practice, respondents indicated that cost saving was the primary reason. The cost of paying separately for a shop and the cost of travelling to the workplace was saved when the commercial activity is accommodated in the residence. The opportunity cost of this practice, however, may result in adverse effects on public health.
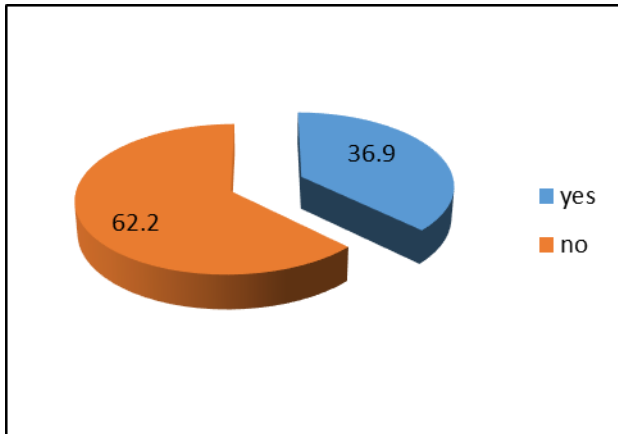
Fig. 2: Proportion of households with commercial activities in the building

C. Ownership of Electricity Generating Sets

In response to the question on ownership and operation of electricity generating sets in the households, 95.7% of the respondents responded in the affirmative (Fig. 3). Furthermore, 77.6% of the respondents indicated that the generators were kept outside the building while 9.2% kept the generators within the building while in operation. The reasons given for keeping an operational generating set in closed living quarters included protection of the generator from theft and from the elements such as rain or extreme heat.
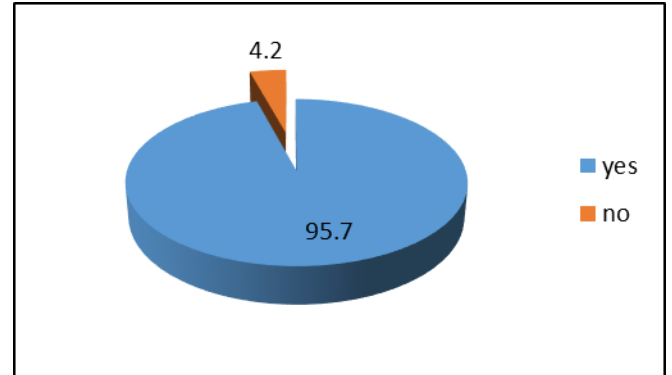
Fig. 3: Proportion of respondents that own electricity generating sets

D. Indoor cigarette Smoking

When asked if any of the respondents smoked in the home, 93.3% responded in the negative while 6.4% responded in the affirmative (Fig. 4). Most of the respondents also indicated their awareness of the carcinogenic effects of cigarette smoke, thus explaining the low population of indoor smokers in this research.
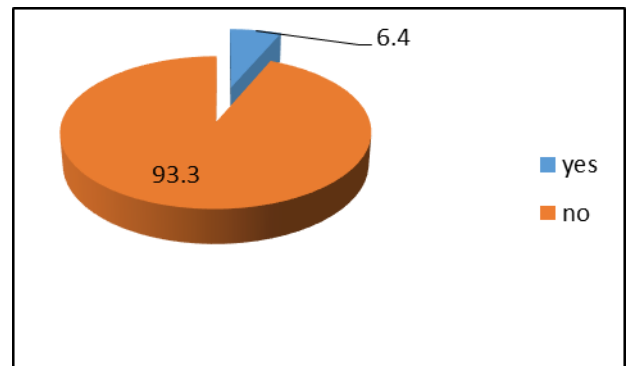
Fig. 4: proportion of respondents that smoke cigarette in the living quarters

E. Energy sources for Cooking

The distribution of the respondents according to energy sources for cooking are as follows: 18% used electricity, 17.7% used gas, 35.2% used kerosene, while 30% used other energy sources which include sawdust, biomass, and biogas.

F. Kitchen location

The proportion of respondents whose kitchens were indoors were 87.4%, while 12.6% situated their kitchens outdoors. 96 % of the respondents believe that their kitchens are well aerated while 4% admitted that their kitchens are not ventilated enough.

G. Alternative lighting in the homes

A major source of IAP in the homes is the alternative lighting sources when there is power cut. Many residents said they keep their windows locked when going to bed while also keeping their lighting on. Rechargeable lanterns were used by 49.4% of the respondents, 18.3% used candles, 14.4% used palm oil lit lanterns, 17.7% used kerosene lit lanterns, while 0.2% did not indicate their alternative lighting sources (Fig. 5). Of this proportion, 69.6% admitted that their left their lighting on while asleep while 30.4% turn off their alternative lighting when going to sleep. Leaving the light on can be dangerous, especially when the alternative lighting source is a candle, palm oil lantern or kerosene lantern. Moreover, candles and kerosene produce fumes that that may adversely impact on human health.
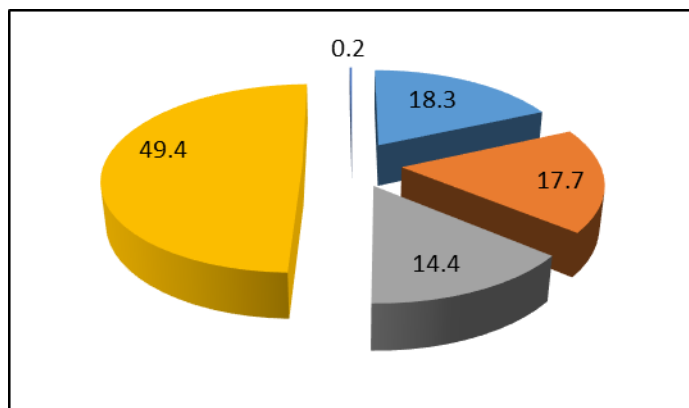
Fig.5: Distribution of respondents according to alternative lighting sources

IV. CONCLUSION

This study showed that many Nigerians are exposed to air pollution arising from generator fumes, residing in non-residential buildings, sleeping with actively burning candle/kerosene lamps in a locked room, and cooking in poorly ventilated kitchens. In order to save costs, some residents lived in their work places while many operated commercial activities in their homes. Many of such commercial activities required electricity generating sets which impact adversely on the standard of living through the release of carbon monoxide and noise pollution. It is therefore recommended that town planning officials should enforce strict compliance with building codes and the uses to which such building are put. Commercial activities should be restricted to commercial buildings while residential areas should be kept free of any unnecessary noise and air pollution that may arise from commercial activities. All buildings that fail to meet standards regarding kitchen sizes, and proper ventilation should not be approved for construction. Moreover, routine inspections should be carried out on such buildings to ensure continual compliance. Furthermore, advocacy programs should be carried by non-governmental organizations, schools, religious organizations and govern agencies to educate the general population on the dangers of IAP, in order to forestall preventable mortalities, especially among children.

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Gender-Based Violence and Pregnancy Outcomes among Couples and Cohabiting Partners in Nigeria.

Adebanke Olawole-Isaac
Dept. of Economics and Development Studies
Covenant University, Canaanland,
Ota, Ogun State, Nigeria
adebanke.olawole-isaac@covenantuniversity.edu.ng

Gbolahan Oni, PhD
Dept. of Economics and Development Studies
Covenant University, Canaanland,
Ota, Ogun State, Nigeria
gbolahan.oni@covenantuniversity.edu.ng

Muyiwa Oladosun, PhD
Dept. of Economics and Development Studies
Covenant University, Canaanland,
Ota, Ogun State, Nigeria
muyiwa.oladosun@covenantuniversity.edu.ng

Adeleke Yewande
Dept. of Demography and Social Sttistics
Obafemi Awolowo University,
Ile-Ife, Osun State, Nigeria

Abstract- **over the last two decades, the international community has expressed concerns on the increasing occurrence of gender-based violence and related consequences, particularly in African and many low-and middle-income countries. The 2006 United Nations General Assembly declaration on elimination of violence against women has been applauded across many settings. Intimate partner violence is a typical example of gender-based violence that occurs among males and females who have intimate relationships either as husbands and wives, or are in cohabiting relationship. This paper examines factors likely to influence gender-based violence and effects on pregnancy outcomes in Nigeria. The study used the 2013 Nigeria Demographic and Health Survey (NDHS) couple data set of 8658 couples aged 15-49 for women and 15-59 for men. 6,961 were interviewed for domestic violence. Analysis employed univariate, bivariate and multivariate techniques i.e. binary logistic regression. Pregnancy outcome, measured as either live birth or stillbirth is the ultimate dependent variable. Explanatory factors are of two types (1) intervening factors are, physical, and emotional violence, and (2) background factors including age, residence, education, employment status, and religion among others. The results showed that residence, employment status, religion and partner's age were significant factors explaining emotional, and physical violence among couples (p<0.05) While physical violence and emotional violence were significant associated with pregnancy outcome of either a live birth or still birth (P<0.05). The study also showed that respondents whose husband takes alcohol have a higher odds of experiencing violence while those who are working and educated beyond primary school also have higher odds of experiencing violence. These findings have significant implications for policy and programmes geared to improve on gender equity, and reproductive health of women in Nigeria.**
Keywords- **Gender-based violence; pregnancy outcome; couples**

INTRODUCTION

Gender-based violence (GBV) is a continuing and international abuse of somebody in the home in such a way that causes pain, distress or injury. It can also be referred to as any treatment of a member of a family by another member that violates the law of human rights. The World Health Organisation [15] defined violence as "various

sexual, psychological and physical acts used against women by a current or former partner". Since 1993, violence against women has emerged as a focus of global attention and concern, when the declaration on the elimination of violence against women was passed by the United Nation General Assembly and the first official definition of such violence against women were offered [4].

REVIEW OF LITERATURE

A study conducted by [8] on violence against women estimated that almost 30% of women in developed countries and over 67% of those in developing countries have experienced one form of physical abuse. Intimate partner violence as a type of domestic violence is a gender-based violence that usually occur between those who are intimately close like husband and wife or cohabiting partners. It is a serious public problem that cuts across nations, cultures, religion and class. Globally, in every three women, at least one has been abused in her lifetime, and mostly, their abusers are members of their own family in which the most common forms of violence against women is abuse by their husband or other intimate male partner [4]. Similarly, [5] opinined that, there is complex relationship between intimate partner violence and health, the aftermath might be immediate and direct (such as injury or death), longer term or direct (such as disability), indirect or psychosomatic (such as gastrointestinal disorder) or all inclusive. The effects of intimate partner violence are numerous. It is associated with post traumatic stress disorder (PTSD) and depression[7,9] somatic symptoms and other psychiatric morbidity. A study by [16] showed that there is a relationship between intimate partner violence and high chances of memory loss, pains, suicidal thoughts and injuries.

Globally, the lifetime prevalence of IPV among ever exposed women ranges from 15% to 71%, and studies indicate that nearly one out of every three women has experienced physical aggression, sexual coercion, or emotional abuse in an intimate relationship [6]. According to a World Health Organization inter-country study on women's health and violence against women, 6%-49% of women age 15-49 reported sexual violence by a partner at some point in life (WHO 2010). In Zambia, evidence shows that 43% of women age 15-49 have experienced physical violence and that 37% experienced physical violence in the 12 months preceding the 2013-2014 Zambia Demographic and Health Survey (ZDHS) (CSO 2014).

Many studies have examined factors or predictors of intimate partner violence in different parts of the world. The documented factors of GBV operate on different levels, ranging from individual socio-demographic characteristics to culturally related factors, particularly in the African context. Commonly reported socio-demographic factors that are positively associated with GBV include the woman's age [6,12] childhood experience of domestic violence ([16] having a low level of education, being unemployed, financial dependence on the partner [3], using drugs or drinking alcohol [6,7], and having more surviving children [5].

In Nigeria [9] also found a significant association between IPV and maternal health care services. This study revealed that women who had ever experienced physical or emotional violence were significantly more likely not to use adequate anti-natal care services and delivery assistance by a skilled health care provider. Cultural factors in Africa can be explained by institutionalized gender inequalities that privilege men with power over women in decision-making [8,5,11,10]. This cultural inequality relegates women to subordinate positions, thereby exacerbating their vulnerability to domestic violence.

In a study by Gazmararian (1995), women who had unwanted pregnancy were four times more likely to had experience physical violence by a partner compared with those who intentionally got pregnant. The majority of women asking for abortion were more likely those who had reported cases of intimate partner violence (IPV) compared with the general population[6,14,8]. In a similar study it was found that 39.5% of women seeking abortion had history of abuse. In this same study, it was shown that women with an abuse history were more likely not to inform their partners about the

pregnancy which may lead to not having the support of the partner in the abortion decision; they were also likely to report the relationship (violence) as the primary reason for aborting the pregnancy. Among women obtaining abortion, 46.3% were not using any form of birth control in the month they conceived .

In Nigera, as in many other African countries, the beating of wives and children is widely sanctioned as a form of discipline [3]. Beating of children is seen as a way of instilling discipline in them, likewise husbands beating their wives for disciplinary purpose. Also, Project alert (2001), in their survey on violence against women interviewed market women and other professions and ladies in secondary schools and higher institutions, in Lagos state, Nigeria. About six out of every ten women interviewed in the work place said they had been beaten by a partner (boyfriend or husband), 56.6% of 48 interviewed market women had experiencend such violence. In a study carried out on the factors related with domestic violence, in South East, Nigeria, 70% of respondents reported to have witnessed abuse in their family with 92% of the victims being female partners and the remaining 8% being male.

In a study carried out in Abuja, Nigeria, [1] revealed the experience of a mother of one in the hands of her husband who constantly was abusing

Definition of variables

Dependent Variable: the dependent variable for this study is pregnancy outcome. This is defined as ever experience a life birth or a still birth as a result of GBV

Independent Variables: There are three sets of independent variables in this study. The variables were chosen on account of their relevance, to the mainstream discus in the literature, on gender based violence. The first set considers violence as the dependent variable and women socio-demographic characteristics as independent variables. Socio-demographic characteristics

her physically whenever he was drunk, and she lost two pregnancies as a result of his brutality. Also, this study had a reported case of 34 years old housewife, Mrs Fatima Bankole, who had her face stitched, after she got battered by her spouse, for taking a piece of fish from the pot to break her fast. The CLEEN Foundation National Crime Victimization Survey, 2013, reported that one in every three respondents admitted to being a victim of domestic violence. The survey also found a national increase of 9% in domestic violence from 21 percent in 2011 to 30 percent in 2013.

Methodology

This study used the 2013 Nigeria Demographic and Health Survey (1). The survey is nationally representative and was organized under the auspices of the National Population Commission and ICF International. The data collected through the survey include background characteristics, marriage and sexual activity, fertility, family planning, maternal health, nutrition, HIV/AIDS, and domestic violence. The study made use of the couple's recode, out of 8658 respondents in the couple data set 6,961were interviewed on the survey module on domestic violence (weighted=6,485) couples and cohabiting partners aged women 15-49 and men 15-59.

(current age, marital status, wealth index, educational attainment, employment, area of residence and religion. Socio-demographic characteristics also include partner age, education, occupation, and alcohol consumption. Key intervening variables include; experience of violence either physical or emotional., alcohol consumption, experience of violence. The dependent variable are pregnancy outcome resulting from physical and emotional violence.

Variable	Operational definition

Dependent variables	
Pregnancy outcome	0=still birth, 1=life birth
Independent variables	
Area of residence	1=urban, 2=rural
Educational attainment	0= no education, 1=primary, 2= secondary 3=higher
Religion	1=Christian, 2=Muslim, 3=Traditional/Others
Household wealth	1=Low, 2=Medium, 3=High
Age	1=15–24, 2=25–39 3=40 or more
Type of union	1= polygamy, 2=Monogamy
occupation	0=not employed, 1=employed
Partners education	0= no education, 1=primary, 2= secondary 3=higher
Partners occupation	0=not employed, 1=employed
Alcohol consumption	0=no, 1=yes
Physical violence	0=no physical violence, 1= experience physical violence
Emotional violence	0=no emotional violence, 1= experience emotional violence

STATISTICAL ANALYSIS

We used STATA 12 to conduct our analysis. The analysis began with a univariate analysis, where descriptive statistics of socio-demographic characteristics of the respondents were obtained. Frequency distributions and proportions of each independent variable against the dependent variables were determined, followed by ascertaining associations between each intervening variable against dependent variables, using chi-square. To obtain and ascertain the strength of associations, logistic regression models with 95% odds ratio confidence intervals were used. One regression models was run. The model had violence as the dependent variable and socio-demographic and partner characteristics as independent variables. To address the issue of disproportionate sampling and non-response, the domestic violence sample weight d005/1000000 was applied in the analysis.

BACKGROUND CHARACTERISTICS OF THE RESPONDENT

This table below shows the distribution of respondent's background characteristics of the study population. Almost two-third of the women (65%) resided in rural areas and almost half (48%) have no education. Most of the women (60%) were age 25-39 and were working (67%) and also belong to the Muslim religion (63%) and in every ten respondent two (18%) had experience emotional violence

Two out of every five (42%) respondent's husband were in the age range of 31-40, one out of every three of their husbands had secondary level of education (30%) and almost all of them were working (96%), while (15%) of them were into alcohol consumption and almost half (46%) of couple belong to the low wealth index and (29%) belong to the polygamy union. Also the prevalence of physical and emotional violence was (12%) and (18%) respectively.

RESULT
Table 2: Background Characteristics of the Respondent

Variable	Frequency (N= 6,485)	Percentage (%)	Variable	Frequency (N=6,485)	Percentage (%)
Respondent Age			**Wealth Index**		
<25	2010	31.0	Low	2982	45.9
25-39	3916	60.4	Medium	1094	16.9
40 or more	559	8.6	High	2410	37.2
Work Status			**Alcohol Intake**		
Not working	2156	33.4	No	5479	84.6
Working	4300	66.6	Yes	1000	15.4

Educational level					
No education	3149	48.5	**Physical Violence**		
Primary	1222	18.9	No	5732	88.4
Secondary	1685	26.0	Yes	751	11.6
Tertiary	429	6.6			
Religion			**Emotional violence**		
Christian	2304	35.5	No	5349	82.5
Muslim	4076	62.9	Yes	1130	17.5
Others	106	1.6			
Residence			**Type of Union**		
Urban	2234	34.5	Monogamy	4621	71.3
Rural	4251	65.5	Polygamy	1864	28.7
Partners age			**Partner's Education**		
<=30	1679	25.9	No education	2255	34.8
31-40	2713	41.8	Primary	1384	21.3
41 or more	2093	32.3	Secondary	1969	30.4
			Tertiary	887	13.5
Partner's Work			**Pregnancy Outcome**		
Not working	278	4.3	Life birth	5694	87.9
Working	6195	95.7	Still birth	784	12.1

(p=0.00) and (p=0.01) respectively have a higher odds

Logistic regression analysis of Violence and Socio-demographic Characteristics

The logistic regression analysis revealed a number of significant relationships between Socio-demographic characteristics and their experience of GBV Table 3 shows that women aged 25-39 (p=0.00) have a higher odds of reporting violence compare to those in the other age categories. Women working (p=0.00) have significantly higher odds of experiencing GBV than those not working. The study further revealed that primary and secondary educational attainment of respondent of experiencing violence. Also, women who belong to the other religion and from the polygamy union (p0=0.01) have higher odds of reporting ever experiencing violence. Concerning husband characteristics, the findings indicate that middle wealth index (p=0.00) and those who are rich (p=0.00) have lower odds of reporting violence. Partners who consume alcohol (p=0.00) have strongly odds of experiencing violence.

Table 3: Logistic regression analysis of Violence and Socio-demographic Characteristics

Variable	Odds	95% CI	Variable	Odds	95% CI
Respondent Age					
<25 (ref)			**Wealth Index**		
25-39	1.48	(1.21-1.80)***	Low (ref)		
40 or more	1.64	(1.21-1.23)**	Medium	0.70	(0.55-0.88)**
			High	0.58	(0.45-0.75)***
Work Status			**Alcohol Intake**		
Not working (ref)			No (ref)		
Working	1.24	(1.03-1.51)*	Yes	2.72	(2.27-3.25)***
Educational level					
No education (ref)					
Primary	1.55	(1.20-2.00)**	**Type of Union**		
Secondary	1.41	(1.06-1.88)*	Monogamy (ref)		
Tertiary	0.54	(0.34-0.87)*	Polygamy	1.25	(1.04-1.55)*
Religion			**Partner's Education**		
Christian (ref)			No education (ref)		
Muslim	0.60	(0.50-0.72)***	Primary		

Others	1.07	(0.68-1.72)	Secondary	1.41	(1.07-1.85)*
			Tertiary	1.40	(1.05-1.86)*
				1.25	(0.88-1.78)
Residence			**Partner's Work**		
Urban (ref)			Not working (ref)		
Rural	0.84	(0.71-0.99)*	Working	0.85	(0.53-1.17)

*p<0.05, **p<0.01, ***p<0.001

Violence and Pregnancy Outcome

The table below shows that there is a significant relationship between gender-based violence and pregnancy outcome. The table further shows that two out every ten respondents who reported to have experience one form of physical violence had a still birth (p=0.000) while the respondent who reported emotional violence one out of every five of them reported a pregnancy that did not result in a life birth (p= 0.000).

Table 4 Violence and Pregnancy Outcome

Variable	Pregnancy outcome		Chi-square	p-value
	Life birth	Still birth		
Physical violence				
Yes	702(82%)	152(18%)		
No	5387(88%)	710(12%)	26.1105	0.000
Emotional violence				
Yes	1047(82%)	230(18%)		
No	5038(89%)	632(11%)	45.1888	0.000

DISCUSSION AND CONCLUSION

The study was to establish the relationship between gender-based violence and socio-demographic characteristics, on one hand, and how violence is associated with pregnancy outcome, on the other hand. Background characteristics that were significantly associated with reporting violence in the study include women's age, age at marriage, household wealth, education, type of union and place of residence [3,9,7,2] These findings are in some respects consistent with previous studies, and contrasting in others. It is commonplace for previous studies in developing countries to report a positive relationship between household wealth and experiencing violence. The finding that violence victims often justify wife beating reflects both the persistence of cultural norms that privileged men with power hold over women [12,10,2] and also the lack of progress in the fight against gender inequality in the Nigerian society.

Men's alcohol consumption are common predictors of intimate partner violence against women and pregnancy outcome in Africa[1,9,10] However, the causal direction between consuming alcohol and perpetrating IPV is confounding.

In sum this study found that in Nigeria the socio-demographic characteristics of couple that are associated with women experiencing violence include Age education, household wealth, occupational status, education, and type of residence. Partner characteristics include alcohol consumption and education. The study also discovered that violence is strongly associated with pregnancy outcome at a bivariate level. These findings reflect the importance of addressing issues of gender equality and problematic cultural norms

embedded in our society that make women vulnerable violence.

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EXCHANGE RATE PASS-THROUGH, EXCHANGE RATE VOLATILITY AND INFLATION RATE IN NIGERIA

Ekene Obiekwe

Department of Economics & Development Studies,
Covenant University, Ota, Nigeria
ekeneobiekwe@yahoo.com

Evans Osabuohien

Department of Economics & Development Studies,
Covenant University, Ota, Nigeria
evans.osabuohien@cu.edu.ng

Abstract—Recently, the Nigerian economy has been experiencing significant exchange rate fluctuations, particularly depreciations in the foreign exchange market which has been accompanied with inflation. Given this background, This paper investigates the degree of pass-through of the official and parallel exchange rates to inflation as well as the relationship between exchange rate volatility and inflation in Nigeria based on monthly time series data (January 2006 to December 2015). It employs, among others, The Generalized Auto Regressive Conditional Heteroskedasticity (GARCH), technique in achieving its objectives. The results suggest that the parallel exchange rate passes through to inflation in the short run while the official exchange rate passes through to inflation in the long run exclusively. It also found out that exchange rate volatility has a positive and significant effect on inflation in the long run.

Index Terms— Exchange rate, Pass-through, Volatility, Inflation, GARCH models

I. INTRODUCTION

Macroeconomic performance is determined by the unemployment rate, inflation rate, and the growth rate of output of an economy [1]. It is no wonder then that the issue of price stability, in addition to being the main aim of fiscal and monetary policy in both developed and developing countries, has also gained a huge amount of attention from economists and policy makers around the world.

Inflation can be defined as the persistent rise in the prices of goods and services. It has positive as well as negative implications. Inflation might be emphatically correspond with growth at some low levels, but at higher levels inflation is is liable to be unfavorable for growth [6]. The Central Bank of Nigeria (CBN) targets about 2 percent rate of inflation which shows that inflation can be a serious advantage to the economy especially during periods of economic stagnation. Inflation helps in debt settlement, creates employment and boost growth. On the other hand, the negative effects of high inflation cannot be overemphasized. Examining countries such as Germany in the early 1920s, Hungary in mid 1940s and Zimbabwe in late 2000s, further strengthens this fact [3]. Rising level of Inflation reduces the value of a currency which further erodes the purchasing power of money. It is usually associated with higher interest rates which results in low savings and discourages investment and long term growth. It also erodes export competitiveness and leads to balance of payment deficits.

Since 1980, inflation in the developing countries has doubled that of developed countries [4]. Average inflation rates in more advanced countries have taken various patterns in recent years, trending downwards after 2012 in developed countries, while remaining constant or expanding further in developing countries [5]. The trend of inflation in Nigeria have been characteristically positive ranging from creeping to running inflation. [2], discovered that inflation is inimical to growth when it approaches 10.5 to 12 per cent in Nigeria. According to Central Bank Statistical Bulletin (2005) high inflation was recorded in the early 1970's from 13.8 percent in 1971 to 16.0 percent in 1972 which could be explained by the oil boom period and the economic controls and measures that were introduced after the Biafra (civil war) of 1967 to 1970.

The oil glut of the early 1980's which led to high prices of oil in the domestic market marked another period of inflation in Nigeria which recorded 23.2 percent in 1983 and 39.6 in 1984. This led to the Structural Adjustment Programme (SAP) in 1986 which presented another inflation period in the late 1980's. According to [6], one major problem in the post SAP era was exchange rate instability which led to high output volatility, higher cost of foodstuffs, lower wages and salaries and high unemployment thereby creating burden on the poor. The early 1990's (1992-96) also recorded high inflation at an average of 57 percent and in 1995 inflation was seen to be as high as 72.8 percent. Inflation rate in Nigeria from 1996 to 2015 is averaged at 12.2 percent and in January 1996 inflation rate was as high as 47.56 percent. Inflation at 8.70 percent in September 2015. Nigeria has recorded high volatility in inflation rates and these fluctuations should therefore be a concern and should be checked by the monetary authorities.

The increasing over dependence of the Nigerian economy on imports necessitates the need to continually check the extent to which exchange rate fluctuations transmits to consumer prices [7]. Exchange rate is a standout amongst the most imperative macroeconomic variables in the developing and emerging nations as it influences inflation, exports, imports and monetary action [8]. Exchange rate is the rate at which one currency is traded for one another currency. The modelling of exchange rate volatility has noteworthy ramifications for some monetary and budgetary matters. Exchange rate volatility alludes to swings or vacillations in exchange rates over a timeframe (Mordi, 1993). It is seen as the risk connected with sudden and unpredictable movements in the exchange rate [6].

There are a number of reasons why we need to study the relationship between exchange rate volatility and inflation. First and foremost, both exchange rate and inflation are important for the macroeconomic goal of price stabilization. Secondly, when exchange rate changes, particularly a depreciation, passes through to consumer prices resulting in inflation, our exports no longer become competitive due to high prices [9]. This is due to the fact that the high inflation cancels out the export competitiveness that would have resulted from exchange rate depreciation, therefore exchange rate becomes an ineffective in correcting balance of payment deficits and relieving debt burden. [7] gave four main reasons why we should study exchange rate volatility in Nigeria: Firstly, Nigeria's economy is driven by her external sector, secondly, there is the need for a stable and strong currency, thirdly, the inflation in Nigeria has become endemic and so there is need to check the extent to which exchange rate volatility contributes to it, and lastly but not least is the need to make the external sector competitive.

Prior to 1986, Nigeria Nigeria had embraced the fixed exchange rate regime which was upheld by trade control regulations that incited disequilibrium in the economy preceding the presentation of Structural Adjustment Program (SAP) [6]. The exchange rate had been relatively stable during this period. The SAP programme then introduced a second tier foreign exchange market that allowed for the determination of exchange rate by forces of demand and supply thereby introducing a flexible exchange rate regime which also created uncertainty in the foreign exchange market. Since then, Nigeria has been experiencing significant exchange rate depreciations till date. However from 1993 to 1998 exchange rate was fixed at 21.886 while inflation rose from 13.8 in 1991 to 72.8 9 (its highest) in 1995. In 1999 exchange rate was allowed to float and so it depreciated to 92.7, more than 3 times its value in 1998. Inflation however fell to 6.6 but continued increasing as the exchange rate continued depreciating. On 19th February 2015, the exchange rate was devalued from 168 to 199 Naira per dollar while the Naira exchange rate reached 213.2 from 196.13 Naira per dollar in the parallel market. Since March the CBN rate has remained almost fixed at about 197 Naira per dollar while creating a huge gap and severe exchange rate volatility in the parallel market due to dollar scarcity. Inflation during this period however increased gradually from 8.1 in February to 9.01 in December (Source: CBN website). These significant exchange rate depreciations coupled with speculations about 2015 general elections alongside dwindling oil prices and fuel scarcity adversely affected the economy, businesses and investments and led to an endemic inflation in the economy.

Thus, this study differs from other studies by separating the pass-through effects of the official and parallel exchange rates and establishing the effects of their volatility on inflation based on monthly time series data. The study is divided into five sections. Section one is the introduction, while section two provides some insights from the relevant literature. In section three, the empirical model used in the study is presented. Section four encapsulates the presentation of results from the estimation techniques and discussion while the last section concludes with some recommendations for policy and further research.

II. SOME INSIGHTS FROM EXTANT LITERATURE

The need for adjustments to structural disequilibria in developed countries resulting after the Great Depression led to development of vast researches on exchange rate pass-through in order to determine a nominal anchor for inflation [10]. However, although many authors highlight the relation between exchange rate volatility and exchange rate pass-through, the literature on the impact of exchange rate volatility is not as comprehensive as the one available on exchange rate pass-through [11].

Some authors have found out that pass-through rates have been declining over time. [12], investigated the reason why the prices of non-tradable goods and services responded by so little after large devaluations motivated by the devaluations in the U.K. (1992), Korea (1997) and Uruguay (2002). The author found that in Korea, inflation stayed stable after the devaluation. On the other hand, inflation climbed considerably in Uruguay after the devaluation. The devaluation in UK was was generally little and was trailed by a gentle expansion and stable inflation. The model attributed this result to two situations: First, is sticky non tradable goods prices and second, is the effect of real shocks connected with large devaluations which prompted a decrease in the price of non-tradable goods relative to traded goods. [13] investigated declining pass-through rates over-time in twenty industrial countries and found out that exchange rate pass-through to consumer prices has been declining since the 1980s and asserted the monetary policy may be the reason for the declining rate of exchange rate pass-through.

[14] investigated slow pass-through in 76 countries using VAR analysis and found out that low pass-through rates were no longer unique to advanced countries as conventionally perceived as developing countries have recently been experiencing rapid downward trends in the degree of short-run pass-through, and in the speed of adjustment. [15] also discovered that levels of pass-through are largely

uncorrelated with country size, among others based on 25 OECD countries. They also found that across the OECD countries, exchange rate pass-through is incomplete in the short-run, however over the long run, pass-through is common for many types of imported goods.

[11] in order to establish the relationship between exchange rate volatility and inflation in Brazil from 1999 found out that the relationship between exchange rate volatility and inflation is semi concave. Using bivariate GARCH model his results revealed that when volatility is very high, inflation response is low and the impacts are little, and therefore assumed that firms adopted a "wait and see" strategy when volatility is high in the short run. This also aligns with the findings of [16] and [17] in Nigeria. On the contrary, [18] investigated this relationship and found positive and significant relationship between exchange rate volatility and inflation in Nigeria from 1986 – 2012 using the Vector Error Correction Mechanism (VECM).

Another line of reasoning stems from the fact that in order to achieve a stable output, low inflation and exchange rate stability would be traded off. This is consistent with the findings of [4] conducted tests on a sample of eighty developing countries from 1980 to 1989 found out that there is a trade-off in the choice of exchange-rate regime between inflation or exchange rate volatility and output volatility and that inflation tends to be 10 percent higher in a country that adopts floating exchange rate regime than a country that adopts fixed exchange rate regime. However, [19] used a two-sector dependent-economy model to compare the properties of a series of different monetary rules and argued that the trade-off differs according to regime and that a flexible exchange rate policy that stabilizes output can do so without high inflation and exchange rate volatility.

III. THEORETICAL FRAMEWORK AND EMPIRICAL MODEL

Theoretical Framework

The theoretical backing establishing the relationship between exchange rate and inflation is the Purchasing Power Parity (PPP) doctrine. According to [20], PPP asserts that the exchange rate change between two currencies over any period of time is determined by the change in the relative price level the two countries. He also stated that the theory has also been referred to as the "Inflation Theory of Exchange Rates" as the theory asserts that the price level between two countries mainly determines exchange rate movements. It is now an established wisdom that the exchange rate parity does not hold across countries at every instant [21]. This is due to the fact that pass-through tends to be incomplete and prices sticky in the domestic country. [19] also found out that local currency pricing induces exchange rate volatility which in turn leads to deviations from purchasing power parity. Although according to [22], the relationship between exchange rate pass-through and law of one price is unclear and maintained that partial exchange rate pass-through is not necessarily an evidence against market integration, that is, law of one price.

However, [23] tested PPP in 31 developing countries and found out relative PPP holds almost exactly in the long-run. The result is also consistent with [24] interpretation of the consensus view of the PPP debate; that in the short-run PPP due to incomplete pass-through, does not hold while in the long-run PPP may hold due to the reversion of the real exchange rate to its mean. The Purchasing Power Parity theory would be adopted in this study. [25] analysed the consistency, persistency and severity of volatile exchange rate in Nigeria from 1986 to 2008 using the Purchasing Power Parity (PPP) model to analyse consistency and ARCH and GARCH models to analyse the severity of exchange rate volatility. The result indicated the existence of extreme volatility shocks and that both the real and nominal exchange rate are not consistent with the traditional long run PPP model in Nigeria.

Empirical Model and Sources of Data

The model adopted in this study are in two strands namely; The Generalised Auto Regressive Conditional Heteroscedasitic (GARCH 1,1) Model and the Vector Auto Regressive (VAR) Model.

The GARCH model is used for the estimation of exchange rate The GARCH model is preferred over the standard deviation because it is sensitive to outliers and volatility clusters. It consists of a mean equation and a variance equation. The mean equation is specified as follows:

$$INFL_t = \pi_0 + \pi_1 EXOF_{t-1} + \pi_2 EXPARL_{t-1} + \mu t \qquad (1)$$

Where: $INFL_{t-1}$, $EXOF_{t-1}$ and $EXPARL_{t-1}$ are the current inflation rate, previous session of the official and parallel exchange rate respectively. π_1 is the coefficient of exchange rate while μt is the stochastic term of the model. The a priori expectation sign is $\pi_1 > 0$ and $\pi_2 > 0$.

The GARCH model allows the conditional variance to depend on its pervious lags, therefore the conditional variance in this case is:

$$\delta^2_t = \alpha_1 + \alpha_2 \mu^2_{t-1} + \lambda_1 \delta^2_{t-1} \qquad (2)$$

Where: α_1 is the log run average variance which is constant, μ^2_{t-1} is the information about volatility observed in the previous period (ARCH term), δ^2_{t-1} is the lagged variance of exchange rate (GARCH term), $\delta^2 t$ is known as the conditional variance (i.e the variance of the error term derived from equation 1). It is one–period ahead forecast variance based on past information and is also known as the exchange rate volatility which would be plugged into VAR model.

Following this model, the econometric model for this study follows insights from [26] but with slight modifications. The model consists of two equations in order to analyse the effects of the official and parallel exchange rates separately which is specified as:

$$INFL = f (ERV, MSP, INTR, OILP, EXOF, EXPARL) \qquad (3)$$

The explicit form of equation 3 is represented as follows:

$INFL_t = \beta_0 + \beta_1 ERV + \beta_2 MSP + \beta_3 INTR + \beta_4 OILP + \beta_5 EXOF + U_t$ (4)

$INFL_t = \beta_0 + \beta_1 ERV + \beta_2 MSP + \beta_3 INTR + \beta_4 OILP + \beta_5 EXPARL + U_t$ (5)

From equation 4 and 5 , the VAR model can be expressed as:

$$INFL_t = \beta_0 + \beta_1 ERV_{t-1} + \beta_2 MSP_{t-1} + \beta_3 INTR_{t-1} + \beta_4 OILP_{t-i} + \beta_5 EXOF_{t-i} + U_t.$$ (6)

$$INFL_t = \beta_0 + \beta_1 ERV_{t-1} + \beta_2 MSP_{t-1} + \beta_3 INTR_{t-1} + \beta_4 OILP_{t-i} + \beta_5 EXPARL_{t-i} + U_t.$$ (7)

Where $INFL_t$ = Inflation Rate at time t, ERV_t = Exchange Rate Volatility at time t, MSP_t = Broad money supply at time t $INTR_t$ = Interest rate at time t, $OILP_t$ = Oil price at time t, $EXOF_t$ = Official exchange rate at time t, $EXPARL_t$ = Parallel exchange rate at time t and U_t = error term. The apriori expectation is such that $\beta_0 > 0$, $\beta_1 > < 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$, $\beta_5 > 0$.

The dependent variable, Inflation (*INFL*), is measured by the percentage change in the Consumer Price Index (*CPI*). *INFL* is brought about by the other variables specified in the model while the error term (U_t) that covers the variables not included in the equation that might affect inflation.

The key explanatory variables in the study are brought in based on the various theories of inflation. The quantity theory of money and demand pull inflation recognises the role of money supply and interest rates in determining inflation, cost push inflation recognises the role of oil price and PPP recognises the role of exchange rates in determining inflation.

Exchange rate:- is domestic price of a foreign currency. The official (*EXOF)* exchange rate is controlled by the government while the parallel (*EXPARL*) is not controlled by the government and reflects the true value of a currency. Exchange rate volatility (*ERV*) is estimated from the GARCH model using monthly exchange rate data. It is the risk associated with fluctuations in exchange rate.
Money supply:- Broad money supply (M2) consists of currency notes in circulation and check deposits as well as quasi money which includes savings and time deposits and money market mutual funds.
Interest rate:- Deposit interest rate is the amount paid to individuals who have deposit accounts in financial institutions.
Oil price:- Crude oil price measures the spot price of barrels of oil in the world market which is usually determined by the Organisation of Petroleum Exporting Countries (OPEC).

To test the empirical evidence, the Johansen Co-integration technique would be used to determine the long run relationships among the variables. Co-integration ensures that the linear combination of variables are stationary while regression analysis using ordinary least squares (OLS) based on time series data discretely assumes all values to be stationary which may not always be the case. The regression

of a non-stationary time series data will lead to spurious (nonsense) regression thereby leading to misleading results. The restricted VAR (also VECM) would also be used to determine the short run relationships among the variables. However, the coefficients from VAR are often difficult to interprete and so further interpreted with estimates from impulse response function (IRF) [27]. Therefore, the Impulse Response Function and Variance Decomposition Analysis would be used to further specify interrelationships among the variables for this study. As similar approach was done by [28].

The econometric software which would be used for this study is E-views 7. Monthly data spanning from January 2006 to December 2012 in Nigeria would be analysed for the purpose of this study. The data used in the estimation process are sourced from the Central Bank of Nigeria.

IV. EMPIRICAL RESULTS AND DISCUSSIONS

Results from Econometric Estimation
The Estimation Of GARCH Model
The GARCH model was used in testing for the effect of exchange rate volatility on Inflation from 2006M1 to 2015M12 and the results as reported in Table 2 shows that both the volatility of the official and parallel exchange rates have negative effects on inflation in the short run. However the relationship between the parallel exchange rate volatility and inflation is significant at 5% level while the official exchange rate volatility is not significant in determining inflation judging by the probability value of 0.9309. This implies that a 1% increase in the parallel exchange rate volatility or official exchange rate volatility would lead to a less proportionate decrease in inflation by about 0.003 %.

TABLE 1. GARCH RESULT

Mean Equation				
Variable	Coefficient	Std. Error	z-Stat	Prob.
DLEXPARL	0.114	0.065	1.751	0.080
DLEXOF	-0.046	0.048	-0.970	0.332
C	-0.003	0.002	-1.196	0.232
Variance Equation				
C	0.000	0.000	1.556	0.120
RESID(-1)^2	0.735	0.221	3.325	0.001
GARCH(-1)	0.067	0.256	0.261	0.794
DLEXPARL	-0.003	0.0014	-2.444	0.0145
DLEXOF	-0.003	0.0036	-0.087	0.9309
R-squared	0.2279	Mean var		-0.006
Adjusted R2	0.0059	S.D. var		0.0412

Note:Dependent Variable: DLINFL
GARCH=C(4)+C(5)*RESID(-1)^2+C(6)*GARCH(-1)+C(7)*DLEXPARL +C(8)*DLEXOFF
Source: *Computed by researcher using E-views7*

The mean equation shows a positive significant relationship between the parallel exchange rate and inflation in Nigeria at the 10% level however the co-efficient shows that pass-through is low and inelastic in the short run. It also reveals a negative but not significant relationship between official exchange rate and inflation which means the official

exchange rate does not passthrough to inflation that in the short run. The summation of the ARCH and GARCH components (0.73 and 0.067) is less than one; therefore we can conclude that volatility is not persistent.

Johansen Maximum Likelihood Co-integration
Based on unit root test, all variables were found to be integrated of order one I(1), therefore we can then proceed to co-integration. Johansen maximum likelihood co-integration is used to determine the co-integrating rank and number of common stochastic trends in the system. The variables are presented in their log-linear form because they reduce the problem of heteroscedasticity and are useful in showing rates of changes [29].The co-integration test would be carried out to determine the nature of the long run relationship between exchange rate volatility based on the objective of the study.

TABLE 2. UNRESTRICTED CO-INTEGRATING TEST

Trace Statistic

No. of CE(s)	Eigenvalue	Trace Stat	C. V.	Prob.**
None *	0.389	119.219	95.75	0.0005
At most 1	0.199	61.5144	69.82	0.1918
At most 2	0.153	35.5317	47.86	0.4203
At most 3	0.085	16.0826	29.8	0.7064
At most 4	0.043	5.657	15.49	0.7356
At most 5	0.004	0.509	3.842	0.4756

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Maximum Eigenvalue

No. of CE(s)	Eigenvalue	Max-Eigen Statistic	C.V	Prob.**
None *	0.389	57.7047	40.08	0.0002
At most 1	0.199	25.9828	33.88	0.3218
At most 2	0.153	19.449	27.58	0.3806
At most 3	0.085	10.4256	21.13	0.704
At most 4	0.043	5.148	14.26	0.723
At most 5	0.004	0.509	3.842	0.4756

Max-eigen test indicates 1 cointegrating eqn(s) at 0.05 level

Source: Authors' *Computation using E-views 7*

The result of the co-integration rank test presented below reveal that there is one co-integration equation for both the Trace and the Max-Eigen statistic at the 5% level. These results suggest that the VECM is appropriate model to use for this specification.

The results from the Johansen cointegration test are displayed below in Table 4. The T-statistics is used to show the significance of the independent variable in the long run. If the T-statistics is approximately equal to 2 or greater than 2, the variable is statistically significant but however, if the T-statistics is less than 2, the variable is not statistically significant.

Based on the result above, it can be concluded that there is a positive and significant relationship between exchange rate volatility and inflation rate in the long run. A 1% increase in exchange rate volatility leads to a more than proportionate

increase in inflation by about 2%. This means that a stable exchange rate is necessary to curb inflation in Nigeria.

TABLE 3. CO-INTEGRATION RESULT

Normalized co-integrating coefficients			T- statistic [ ]		
LINFL	LERV	LINTR	LMSP	LOILP	LEXOF
1	-1.9852	0.0634	-3.1374	0.6036	-3.8314
	[-7.4208]	[0.0990]	[-2.76]	[0.5776]	[-0.9513]
LINFL	LERV	LINTR	LMSP	LOILP	LEXPARL
1	-2.2124	0.6020	-8.0564	5.1675	8.597
	-[6.3079]	[0.7282]	[-6.46]	[3.8243]	[2.2644]

Source: Authors' *Computation using E-views 7*

The result shows that there is a negative relationship between interest rate and inflation. A 1% increase in interest rate would lead to about 0.06% and 0.6% less proportionate decrease in inflation for model 1 and 2 respectively and vice versa. This is theoretically expected as increased interest rates increases savings rate and decreases current consumption. However, this relationship is insignificant judging by the t-stat of 0.0990 and 0.7282, respectively.

There is also a positive and significant relationship between money supply and inflation in the long run based on the result. This is expected based on the quantity theory of money. A 1% increase in money supply will lead to a more than proportionate increase in inflation by about 3% for the official exchange rate equation and 6% for the parallel exchange rate equation and vice versa.

The result however reveals a negative relationship between oil price and inflation. A 1% decrease in oil price would increase inflation less proportionately by about 0.6% and more than proportionately by 5% for model 1 and 2 respectively and vice versa. This is not theoretically expected but could be attributed to the structure of the Nigerian economy during this period. Since, the Nigerian economy depends mostly on oil for her exports, a decrease in oil price worsens the terms of trade balance and depreciates the exchange rate, thereby making imports more expensive and making consumer prices rise. This relationship however is insignificant for the official exchange rate equation but significant for the the parallel exchange rate equation.

Also, in the long run, a 1% increase in the parallel exchange rate would lead to a more than proportionate decrease in inflation by about 9% which is significant while a 1% increase in the official exchange rate would lead to more than proportionate increase in inflation by about 4% but is insignificant. This shows that in the long run, the official exchange rate passes through to inflation while the parallel exchange rate does not.

Vector Error Correction Model
The presence of co-integration relationship between the variables means that the restricted VAR (VECM) should be used for the estimation. The VECM restricts the log run behavior of endogenous variables to incorporate short run disequilibria. The short run deviations are corrected through

series of adjustments. To satisfy the stability condition the VECM should have a negative sign, lie between 0 and 1 and be statistically significant.

The co-efficient of the error term has a negative sign and is statistically significant for both models. This shows that there a long run convergence between inflation and the independent variables. The co-efficient shows that for model 1 and 2 about 0.46% and 0.3% of errors in the current period will be corrected in the subsequent period respectively which implies a slow speed of adjustment. This slow speed could be attributed to sticky prices i.e. prices take time to adjust downwards and so when there is short disequilibrium, it takes a long time before it converges to its long run equilibrium.

TABLE 4. VECTOR ERROR CORRECTION RESULTS

Model 1		Model 2	
Dependent	D(LINFL)	Dependent	D(LINFL
ECM	-0.0046	ECM	-0.003
	[-3.9814]		[-3.5014]
D(LINFL(-1))	0.8621	D(LINFL(-1))	0.825
	[20.5290]		[18.1068]
D(LERV(-1))	-0.0064	D(LERV(-1))	-0.0048
	[-2.5331]		[-1.9846]
D(LINTR(-1))	-0.02786	D(LINTR(-1))	-0.0216
	[-1.4436]		[-1.1072]
D(LMSP(-1))	-0.00486	D(LMSP(-1))	-0.0158
	[-0.1188]		[-0.3857]
D(LOILP(-1))	0.0329	D(LOILP(-1))	0.0393
	[1.6813]		[1.8678]
D(LEXOF(-1))	-0.03628	D(LEXPARL(-1))	0.0067
	[-0.4574]		[0.1112]
C	-0.00018	C	-0.0003
	[-0.10044]		[-0.1815]
R-squared	0.8273	R-squared	0.823
Adj.Rsquared	0.8162	Adj. R-squared	0.8116
F-statistic	74.581	F-statistic	72.386

Source: Authors' *Computation using E-views 7*

The result of the estimation for the official exchange rate equation shows that the explanatory variables account for about 83% of the variations in inflation and 82% for the parallel exchange rate equation. The results of the estimation give the short run relationships among the variables. The result reveals that exchange rate volatility is the only significant variable and has a negative relationship with inflation in the short run. The results of the estimation of the remaining variables follow a priori expectations apart from money supply. The negative relationship between money supply and inflation could be due to the fact that broad money supply includes time and savings deposits which are not yet in circulation and do not contribute to inflation in the short run.

Impulse Response Analysis
The impulse response function shows the accumulated response of inflation to one standard deviation shock to each of the variables.

TABLE 5. ACCUMULATED RESPONSE OF INFLATION

Period	LINFL	LERV	LEXOF	LEXPARL	LINTR	LMSP	LOILP
1	0.02	0.000	0.0000	0.0000	0.0000	0.000	0.000
2	0.05	0.001	-0.0006	-0.0001	-0.002	0.000	0.002
3	0.10	0.010	-0.0013	-0.0008	-0.006	0.0007	0.007
4	0.15	0.020	-0.0015	-0.0023	-0.012	0.0024	0.014
5	0.21	0.040	-0.0008	-0.0047	-0.018	0.005	0.021
6	0.28	0.070	0.001	-0.008	-0.026	0.0087	0.029
7	0.36	0.100	0.0039	-0.0122	-0.034	0.0133	0.038
8	0.44	0.140	0.0079	-0.0173	-0.042	0.0189	0.046
9	0.52	0.190	0.0129	-0.0231	-0.051	0.0254	0.054
10	0.61	0.250	0.0188	-0.0296	-0.06	0.0326	0.062

Source: Authors' *Computation using E-views 7*

From the plot below there is clear evidence of the effect of exchange rate volatility on inflation over the 10 period interval. According to the table the immediate effect of a shock to LERV at say period 9 is about 24% increase in inflation. The full effect of this shock would be realized as the period increases.
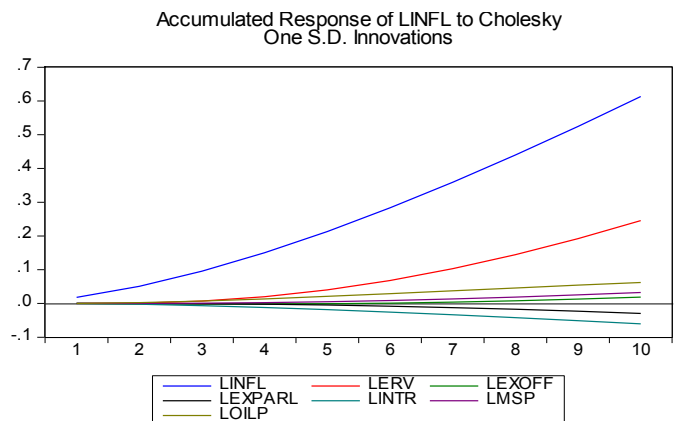
Fig 1. Accumulated Response of Inflation
Source: Authors' *Computation using E-views 7*

The diagram above shows no relatioship between inflation and shocks to the variables throughout the 1st period. However from the 2nd to the 10th period inflation showed a postive reponse to shocks from exchange rate volatility and oil price throughout, while the postive response started from the 3rd period for money supply shocks and 6th period for the official exchange rate. The accumlated response of inflation to the parallel exchange rate and interest rate is negative throughout the period.

Variance Decomposition Analysis
Variance decomposition analysis shows the relative contributions of shocks in the independent variables to inflation variance (i.e changes in inflation).

The variance decomposition of inflation has shown that in the first period none of the independent variables could explain changes in inflation. While exchange rate volatility caused significantly large changes in inflation, other variables caused relatively smaller changes in inflation. For instance, in the 7th period, exchange rate volatility, interest rate, money supply and oil price account for about 10uints,

0.87unit, 0.19unit. and 1unit changes in inflation respectively.

TABLE 6. VARIANCE DECOMPOSITION

Period	LINFL	LERV	LEXOF	LEXPARL	LINT	LMSP	LOILP
1	100.0	0.000	0.0000	0.0000	0.0000	0.000	0.000
2	99.10	0.060	0.0269	0.0003	0.3761	0.000	0.425
3	97.40	1.100	0.0256	0.0134	0.6273	0.016	0.790
4	95.10	3.050	0.0137	0.0413	0.7628	0.049	1.017
5	92.40	5.520	0.0130	0.0769	0.8322	0.091	1.112
6	89.60	8.180	0.0276	0.1154	0.8627	0.139	1.120
7	86.80	10.80	0.0541	0.1543	0.8706	0.187	1.079
8	84.30	13.30	0.0883	0.1919	0.8657	0.234	1.016
9	82.00	15.60	0.1264	0.2274	0.8541	0.279	0.944
10	79.90	17.70	0.1656	0.2601	0.8392	0.320	0.874

Source: Authors' *Computation using E-views 7*
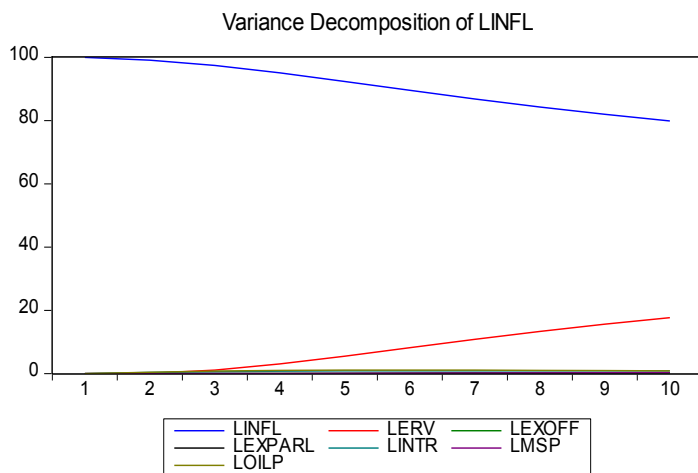
Fig 2. Variance Decomposition of Inflation
Source: Authors' *Computation using E-views 7*

V. SUMMARY OF RESULTS AND CONCLUSION

Summary of Main Findings

This study examines the degree of pass-through of the official and parallel exchange rates to inflation as well as the relationship between exchange rate volatility and inflation in Nigeria based on monthly time series data from January 2006 to December 2015). The Generalized Auto Regressive Conditional Heteroscedasticity (GARCH), Cointegration, Vector Auto Regression (VAR) analysis, Impulse Response Function and Variance Decomposition techniques were used in examining the relationship. Inflation is modeled as a function of exchange rate volatility, official and parallel exchange rate, interest rate, money supply and oil price.

The GARCH and VECM results reveal the there is a negative and significant relationship between exchange rate volatility and inflation in the short run while the co-integration result reveal a positive significant relationship in the long run. The short run result supports the work of [11], which showed that when volatility is high, inflation response is reduced as firms adopt a "wait and see" strategy. The impulse response and variance decomposition functions also reveal that exchange rate volatility very significant in determining inflation response and variance. The results also reveal that the parallel exchange rate only passes through to inflation in the

short run while official exchange rate only passes through to inflation in the long run. This means that the higher official exchange exchange rate would generate a poor inflation response in the short run and its effects would only be revealed in the long run. Also, the results in this present study suggest that exchange rate pass through is low in the short-run. This corroborate previous studies such as [14], [15], and [30] where it has been established that the notion of sticky prices is expected.

Recommendations

Furthermore, it was found that interest rate is negative but not significant in determining inflation both in the long and short run. Broad money supply has a negative insignificant relationship with inflation in the short run due to time deposits but positive and significant in the long run as theoretically expected. Oil price has a positive insignificant relationship with inflation in the short run but negative in the long run due to unfavorable terms of trade balance. Finally, the coefficient of error correction term indicate a rather a slow but significant speed of adjustment from the short-run distortion to long-run equilibrium due to sticky prices in the short-run.

Finally, from the results of the empirical study, the following recommendations are proposed to ensure price stability in Nigeria. Firstly, the the Central Bank should strengthen the managed float system, such that the parallel exchange rates are left to freely operate through the workings of demand and supply, while the official exchange rate is strictly managed by the central bank so that it is not devalued to reflect the value of the currency operating in the parallel market. This is due the fact that, the increases in the parallel exchange rate would affect inflation or may cause economic hardships only in the short run but not in the long run. However, a depreciation or devaluation of the official exchange rate would ultimately increase inflation over the long run. Secondly, the government should set up proper approaches and procedures that will guarantee the support of an exceptionally stable exchange rate as this is an important determinant of inflation. Thirdly, there is need to provide foreign exchange in order to reduce dollar scarcity and close the gap between the parallel and official exchange rate. Therefore, the government should direct its spending to the yielding sectors of the economy such as agriculture and manufacturing as this will go far in expanding the production of goods and services thereby stabilizing the exchange rate.

This current study is confronted with some limitations as it relies on the dollar exchange rate for the model therefore the relationship may not be the same if other major currencies were added in the model. The scope (i.e. January 2006 to December 2015) was also limited by available data. Thus, complementing what has been done in this study, it is recommended future scholars should focus on using other alternate currencies such as the Euro to model the relationship between exchange rate and inflation.

It may also be interesting to do a panel data study across countries in order to further strengthen the research .

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THE DYNAMICS OF SMALL BUSINESS IN AN EMERGING MARKET:CHALLENGES AND OPPORTUNITIES

Hector Iweka, Ph.D.
Lasell College
23 Maple Terrace
Newton, Massachusetts, USA, 02466
HIweka@Lasell.EDU

Abiola Babajide, Ph.D.
Covenant University
KM. 10 Idiroko Road, Canaan Land,
    Ota, Ogun State, Nigeria
 abiola.babajide@covenantuniversity.edu.ng

Felicia Omowunmi Olokoyo, Ph.D.
Covenant University
KM. 10 Idiroko Road, Canaan Land,
    Ota, Ogun State, Nigeria
felicia.olokoyo@covenantuniversity.edu.ng

ABSTRACT: Small-scale enterprises have and will continue to play a vital role in economic development of both developed and developing countries, small business is considered the driver of economic growth. This role includes infrastructure development, employment, reduction in poverty, wealth creation and development of human capital. Government of African Nations have developed and implemented various policies aimed to stimulate and grow entrepreneurial development; however these businesses still face various challenges during the introduction stage as well as the growth stage of the businesses. This paper examined the challenges that small-scale enterprises face in Nigeria during the early stages and also explore opportunities that these businesses could derive from their immediate environment. The study employed cross sectional survey method and analysis of variance (ANOVA) to analyze seventy one (71) copies of questionnaire returned from the field. The findings revealed that lack of access to finance and unfavorable macroeconomic environment still remain the major challenge faced by small businesses in Nigeria and that age and size of the businesses play significant role in all of this. The study therefore recommends that the SMEs funding agencies should not adopt a blanket financing option for all categories of business in terms of age and sizes within the economy. Rather, policies aimed at promoting the performance and growth of micro and small enterprises should adopt a sectional approach. Thus, resources for each category would address the most critical determinants of performance and growth in focal sub-category such as micro, small or medium enterprises.

Key words: Small Business, Emerging Market, Employment, Entrepreneurial Development

INTRODUCTION

Since 1986, government had reduced its role as the major driving force of the economy through the process of economic liberalization entrenched in the IMF pill of Structural Adjustment Programme. Emphasis, therefore, has shifted from large-scale industries to small and medium-scale industries, which have the potentials for developing domestic linkages for rapid and sustainable industrial development. Attention was focused on the organized private sector to spearhead subsequent industrialization programmes. The incentives given to encourage increased participation in these sectors were directed at solving and/or alleviating the problems encountered by industrialists in the country, thereby giving them opportunity to increase their contribution to the Gross Domestic Product (GDP) (Babajide 2011).

The contribution of Micro, Small & Medium Enterprises (MSMEs) to economic growth and sustainable development is globally acknowledged (CBN, 2004). There is an increasing recognition of its pivotal role in employment generation, income redistribution

and wealth creation (NISER, 2004). The micro, small and medium enterprises (MSMEs) represent about 87 per cent of all firms operating in Nigeria (USAID, 2005). Non-farm micro, small and medium enterprises account for over 25 per cent of total employment and 20 percent of the GDP (SMEDAN, 2007) compared to the cases of countries like Indonesia, Thailand and India where Micro, Small and Medium Enterprises (MSMEs) contribute almost 40 percent of the GDP (IFC, 2002).

There is a general consensus in literature that a positive relationship exist between small scale business and economic development (Birch, 1981; 1987), but the incessant proliferation of small businesses in Nigeria has not translated into economic development in most developing countries. This has necessitated why governments of nations develop and implement programs that will stimulate growth of the small businesses. In Nigeria, the case is not somewhat different from other developing countries, small businesses in Nigeria are beclouded with so many obstacles within the first year of operations, and statistics had it that only 15% of new businesses survive the first three years of operations in Nigeria. Some of the obstacles include lack of capital, poor infrastructure, lack of necessary skills to navigate the challenges of small business, government laws and regulations, high cost of production and lack of strategies for development and growth. Many of the businesses do not have growth strategy (SMEDAN, 2007).

This paper examines the challenges which small scale organizations face in Nigeria during the startup and growth stage of their operations business and also explore the opportunities these businesses could derive from their immediate environment. More importantly, the objective of this research is to develop a framework for the way forward and also explore the various strategies that will enhance small business development in Nigeria. The research focuses more on what should be done by different

stakeholders to help navigate these challenges. Some of the questions that helped generate this discussion include: What role should Nigerian government play to help small scale business navigate the challenges? What role should the entrepreneurs play to help navigate these challenges and also prepare them for success? What growth strategy should be put in place by small business operators to secure their future? What are the opportunities in the Nigerian business environment for small business organizations?

LITERATURE REVIEW

The impact of small businesses on economic development has not been in question. Many countries including Nigeria have developed and implemented various policies and programmes to stimulate the development of this sector of the economy (Okpara & Wynn, 2007). Nigeria since her independence in 1960 has relied more on petroleum products for her economic growth – oil and natural gas account for more than 80 percent of government income however, there is a need to develop the non-oil sector of the economy for diversification and sustainable economic development and the small and medium enterprises are often relied upon to help achieve rapid economic growth as witnessed in the case of the Asian tigers. In recent times, Nigerian government has invested much in other trade sectors to spur economic growth and also implement trade reforms needed to develop the country's trade deficit. Some of these programmes are aimed at supporting entrepreneur activities (Rojas, 2012). However the success of these programmes cannot be attributed to economic development. For monetary support, Nigerian government has introduced various programmes requiring commercial and other banks to allocate a portion of their loanable funds to small businesses. There were also other schemes to aid these businesses like the Nigerian Bank of Commerce and Industry, the Nigerian Industrial Development

Bank (NIDB), and other various World Bank programmes (Source?).

The expectations was for a vibrant economy and a thriving small business sector, however the effectiveness of these programmes remains unclear, and the rate of business failure continues to rise (Okpara& Wynn, 2007). Other researchers concurred stating that the growth and development of the small business sector should be a focus of the Nigerian government because of the potential impact to economic growth of Nigeria. However, there is no evidence that all the efforts, activities and schemes work (Chibuike, 2011). Whilst small scale businesses are an important part of the business landscape in any country, they are faced with significant challenges that inhibit their ability to function and contribute optimally to the economic development of many African countries. The position in Nigeria is not different from this generalized position (NIPC, 2009). Despite small scale business important contributions to economic growth, small enterprises are plagued by many problems including stagnation and failure in most sub-Saharan African countries (Bekele and Zekele, 2008). In Nigeria, the problem is not limited to lack of long-term financing and inadequate management skills and entrepreneurial capacity alone, but also, includes the combined effect of low market access, poor information flow, discriminatory legislation, poor access to land, weak linkage among different segments of the operations in the sector, weak operating capacities in terms of skills, knowledge and attitudes, as well as lack of infrastructure, and an unfavorable economic climate (SMEDAN, 2007).

Lack of access to finance has been identified as one of the major constraints to small business growth (Owualah, 1999; Carpenter, 2001; Anyawu, 2003; Lawson, 2007). The reason is that provision of financial services is an important means for mobilizing resources for more productive use (Watson and Everett, 1999).

The extent to which small enterprises can access fund determines the extent to which small firms can save and accumulate their own capital for further investment (Hossain, 1988). But small business enterprises in Nigeria find it difficult to gain access to formal financial institutions such as commercial banks for funds. The inability of the business to meet the conditionalities of the formal financial institutions for loan consideration provided a platform for attempt by informal institutions to fill the gap usually based on informal social networks; this is what gave birth to micro-financing (Bekele and Zekele, 2008).

Realizing the importance of small businesses as the engine of growth in the Nigerian economy, the government took some steps towards addressing the conditions that hinder their growth and survival. However, as argued by Ojo (2003), all these SMEs assistance programmes have failed to promote the development of SMEs. This was echoed by Yumkella (2003) who observes that all these programmes could not achieve their expected goals due largely to abuses, poor project evaluation and monitoring as well as moral hazards involved in using public funds for the purpose of promoting private sector enterprises. Thus, when compared with other developing countries, Variyam and Kraybill (1994) observe that many programmes for assisting small businesses implemented in many Sub-Saharan African (SSA) countries through cooperative services, mutual aid groups, business planning, product and market development, and the adoption of technology, failed to realize sustained growth and development in these small enterprises. Among the reasons given were that the small-scale enterprises are quite vulnerable to economic failure arising from problems related to business and managerial skills, access to finance and macroeconomic policy.

The reluctance of formal financial institutions to introduce innovative ways of providing meaningful financial assistance to the business is

attributed to lack of competition among financial service providers, in the sense that none of financial service providers came up with an innovative way of financing small businesses. In order to enhance the flow of financial services to the MSME subsector, Government had, in the past, initiated a series of programmes and policies targeted at the MSMEs. Notable among such programmes were the establishment of Industrial Development Centres across the country (1960-70), the Small Scale Industries Credit Guarantee Scheme (SSICS) 1971, specialized financial schemes through development financial institutions such as the Nigerian Industrial Development Bank (NIDB) 1964, Nigerian Bank for Commerce and Industry (NBCI) 1973, and the National Economic Recovery Fund (NERFUND) 1989. All of these institutions merged to form the Bank of Industry (BOI) in 2000. In the same year, government also merged the Nigeria Agricultural Cooperative Bank (NACB), the People's Bank of Nigeria (PBN) and Family Economic Advancement Program (FEAP) to form the Nigerian Agricultural Cooperative and Rural Development Bank Limited (NACRDB). The Bank was set up to enhance the provision of finance to the agricultural and rural sector. Government also facilitated and guaranteed external finance by the World Bank (including the SME I and SME II loan scheme) in 1989, and established the National Directorate of Employment (NDE) in 1986.

There is agreement that staring a business is risky and the survival of most of these businesses after five years is slim (Okpara& Wynn, 2007). As a result it is important business owners develop plans and strategies to enable them navigate the challenges within and outside the business. The effectiveness of these businesses depends on the management skills and mindset of the owners and managers this is why it is important for these businesses to have skills that are beyond management principles. They need to be strategic managers with a vision and also able to develop strategic plans. According to Kazooba 2006 lack of business management skills is a factor to the success of the business. Other researchers have identified lack of technical and managerial principles among the challenges of small business.

Despite the potential importance of small business in any economy, high mortality rate among this business is a matter of major concern in developing economies. International Finance Corporation (IFC) reported in 2002 that only 2 out of every 10 newly established businesses survive up to the fifth year in Nigeria. The report was corroborated by Small and Medium Enterprise Development Agency of Nigeria (SMEDAN) that only 15% of newly established businesses survive the first five years in Nigeria. This is a pointer to the fact that there is a problem.

The survival of these MSEs should reflect in employment generation, engagement of available local resources, local technology utilization, improved standard of living and growing gross domestic product (GDP). However, despite MSEs representing about 87% of all firms operating in Nigeria (USAID, 2005), they only account for 10% of total manufacturing output, 25% of total employment in the productive sector and 37% of GDP (Investment Climate Assessment (ICA) survey, 2009). A common problem for the Nigerian small business sector is that, the high rates of formation of new businesses evidenced in Corporate Affairs Commission (CAC) annual report have not yet translated into comparable high rates of small firm growth. New firms are being started but few grow rapidly to become significant international competitors. For the great majority of micro and small enterprise in Nigeria long term growth remains uncertain and bleak. The question is how many of these small businesses are transforming from the subsistence level at start-up to the stage of maturity and later expansion where they will have to employ more hands? Total productive output is also low compared to other emerging

economies like India, Sri Lanka and Thailand where SMEs contribute 40%, 55% and 47% respectively in 2002 into the productive sectors of the economy (UNCTAD, 2003).

METHODOLOGY
The research used questionnaire based on a target group identified by the researchers. The target group was small-scale enterprises located within two small scale industrial complexes in Lagos state. This location was selected because it has a high concentration of small scale business and also, provides a wide range of different businesses. The questionnaire included a qualitative questionnaire and a structured five-point Liket type of questionnaire with assigned values ranging from 1 which is strongly disagree to 5 which is strongly agree for face-to-face distribution to these businesses by the researchers and/or research assistants. The questionnaire was developed from other literature relating to problems faced by small businesses and also tested with a pilot study to identify and resolve any challenge and also incorporate any changes identified during the pilot study. A total of one hundred (100) copies of questionnaire were sent to the field, 71 were returned and found useful for the analysis. The data obtained were analyzed using descriptive statistics (Mean and standard deviation) and Analysis of Variance (ANOVA). The results obtained were as discussed below.

4.0 DATA ANALYSIS AND INTERPRETATION
4.1 Descriptive Analysis

Table 1: Age of Business

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 3 years	8	10.8	12.7	12.7
	4 - 7 years	21	28.4	33.3	46.0
	8 - 11 years	14	18.9	22.2	68.3
	12 - 15 years	12	16.2	19.0	87.3
	over 15 years	8	10.9	12.7	100.0
	Total	63	85.1	100.0	

Source: Field survey, 2013

Table 1 above shows that majority of the businesses have been in existence for more than 3 years, which implies that they are not entirely new businesses. Somehow majority of the respondent businesses have managed to move from existence stage to survival stage of the business circle despite environmental challenges they are facing.

Table 2: Number of employees by sm

		Frequency	Percent	Valid
Valid	1 employee	14	18.9	22.2
	2 - 5 employees	24	32.4	38.1
	6 - 10 employees	14	18.9	22.2
	11 - 15 employees	5	6.8	7.9
	16 - 100 employees	6	8.1	9.5
	Total	63	85.1	100.0

Source: Field survey, 2013

Table 2 shows that most of the businesses employed 2-5 paid employees in their businesses which suggests that most of the respondent businesses are microenterprise. The National policy on Micro, Small and Medium Enterprises (MSMEs) in Nigeria adopted in 2007 categorised companies registered or unregistered with less than ten (10) paid employee and less than N5 million in asset excluding land and building as micro enterprise. Microenterprise are expected to grow into small business with adequate investment in asset and application of appropriate technology as the business generate profit.

Table 3: Challenges facing small businesses

Table 3

	N	Mean	Std. Deviation
Lack of available capital from banks for asset and equipment	71	3.4507	1.27379
Competition from large organization	71	3.3380	1.46330
Inability to source for adequate capital	71	3.3099	1.66125
Lack of available capital from the government	71	3.2958	1.39790
Political instability in the government	71	3.2254	1.33307
Lack of good economic policies from government	71	3.1690	1.26475
Repaying my loans conveniently	71	2.9437	1.48213
Lack of customers	71	2.8	
Lack of capable management	71	2.8	
Lack of raw materials	71	2.7	
Lack of measurable goals for my business	71	2.7	
Using loans for other personal purposes	71	2.7	
Lack of a growth plan for my business	71	2.6	
Lack of technology	71	2.5	
Valid N (listwise)	71		

Source: Field survey, 2013

As Table 3 shows, the first major challenge face by MSMEs in Nigeria is access to finance, this has always be the research result. Even though there a lots of funding avenue set aside for MSMEs in Nigeria, this funds never gets to them. The small businesses are never the favourite of any bank, either private or public in terms funding. Very close to this is the Nigeria business environment which has been found to be rather too harsh for small businesses. Lack of adequate support from government, unfavourable macroeconomics variables and lack of good economic policy from government all pose as challenge to SMEs in Nigeria. This two major constraints couple with competition from large organizations dough tail into every other challenges face by SMEs in Nigeria.

As shown in table 3 above, other challenges are inability to repay loans obtained conveniently, majority of the business respondents must have obtained the loan from the informal market which has its own huge disadvantages. Another challenge identified is Lack of customer which may be as a result of weak purchasing power of the populace. Followed very closely is lack of managerial skill to manage the business which explained lack of measurable goals and diversion of loans obtained for personal use as well as lack of growth plan and lack of appropriate technology. Application of technology will require huge investment which most small businesses do not have.

Table 4: Most important factor in business

	N	Mean
Being ready for change	71	3.7324
Improving and training employees	71	3.7183
Discovering new resources	71	3.7183
Increasing my customer base	71	3.6901
Improving my management skills	71	3.6338
Emphasizing stability in my business	71	3.5775
Obtaining finances from investors or banks	71	3.4366
Development of new product for customers	71	3.3803
Discovering investment options	71	3.3521
Investing in major fixed assets (generators, machinery, etc)	71	3.3380
Discovering new resources of capital from government	71	3.3239
growth of the business	71	3.2535
Valid N (listwise)	71	

Source: Field survey, 2013

The study also investigates factors the SMEs owners considered as most important to them in business. Table 4 shows that most owners considered being ready for change as it comes there way as a very important factor in business. The ability to be able to adapt to changes in the

business environment is considered as one of the most important factor at the survival stage of a business entity. This is easier for a small business because of the flexibility in their operations and quick decision making process which is one of the reasons why small businesses grow at a faster rate than large corporations (Babajide, 2011). Improving and training employees is considered the next important factor, training is very crucial to business success, followed by discovering new resources and increasing the customer base of the business. Improving management skill is considered the fifth most important factor which will require capacity building on the part of the management. Obtaining finance from banks comes at the seventh position but it is surprising that growing the business comes as the least important factor to the small business owners. This confirm the classical school theory that not all small businesses are growth oriented and for certain firms' growth is a voluntary choice and not a must (Davidson, 1989, 1991; Masurel and Montfort, 2006; Babajide, 2011).

Table 5: **Financial Constraint and Business Expansion**

Would your profit from the last year cover the purchase of fixed asset?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Missing data	4	5.4	5.6	5.6
	No	32	43.2	45.1	50.7
	Yes	35	47.3	49.3	100.0
	Total	71	95.9	100.0	

Source: Field survey, 2013

The study also tested for financing constraint and expansion plan of SMEs in Nigeria. The financing constraint approach says that small business with improved access to credit rely less on internal funds for their investments, but this study shows that SMEs in Nigeria rely more on their internal funds for expansion which implies that SMEs in Nigeria are financially constraint.

4.2 Inferential statistics
Hypothesis 1
H_1: There is a significant relationship between the perceived usefulness of training programs and the frequency with which employees attend seminars, workshop and business training programs.

Table 6: **Usefulness of Training**

		How often ... seminar, w... programs in ...
Do you find the training programs useful for your business?	Pearson Correlation	.493[**]
	Sig. (2-tailed)	.000
	N	71

[**]. Correlation is significant at the 0.01 level (2-tailed).
Source: Field survey, 2013

With the analysis in table 6 above, the alternative hypothesis was accepted while the null hypothesis was rejected. This implies that most of the small business owners considered training and similar business workshop important for their business expansion. The perceived benefits and usefulness of training programs influences the frequency of attending training, possibly because organisations have seen the improvement in the productivity of their employees as a result of their training, which has positively impacted on the overall performance of the organisation.

Hypothesis 2
H_1: There is a significant difference in the major challenges faced by small businesses (using both Age and Size as factor analysis)
ANOVA

Table 7: **Challenges facing Small business (analysis using Age as factor analysis)**

	Sumof Squares	df	Mean Square	F	Sig.
Between Groups	1339.871	5	267.974	2.505	.040
Within Groups	6097.113	57	106.967		
Total	7436.984	62			

Decision: Accept alternative since p value < 0.05 differs

Source: Field survey, 2013

The study also examines the role of age and size on challenges facing the SMEs as perceive by the SMEs operators, this is to ascertain if the perceived challenge are common to firms of the same size. Majority of the firm respondent businesses are microenterprises employing between 2 – 5 paid employees and have been in operation for between 4 – 7 years. The result obtained as shown in table 7 reveals that age of the businesses have significantly influence their perceived challenges and that the challenges are common to firms of the same age. This is possibly because they perceived that older organizations around enjoy economies of scale, easy access to finance, have larger customer base because they have been around for a while, they can easily obtain credit as spontaneous source of finance, they can learn from past business success and failures, older businesses have more steady learning curves compared to younger ones because they have been around for a while.

ANOVA

Table 8: **Challenges facing Small business (analysis using Size as factor analysis)**

	Sum of Squares	Df	Mean Square
Between Groups	753.510	4	188.377
Within Groups	6396.490	58	110.284
Total	7150.000	62	

Source: Field survey, 2013

Analysis in table 8 shows that that the challenges facing firms of this size do not differ; certain problems are common/general to small businesses

Hypothesis 3

H$_1$: There is a significant difference in the important factor among small businesses in Nigeria (using both Age and Size as factor analysis)

ANOVA

Table 9: Important factor in business (analysis usi analysis)

	Sum of Squares	df	Mean Square	F
Between Groups	1939.246	5	387.849	2
Within Groups	7836.024	57	137.474	
Total	9775.270	62		

Source: Field survey, 2013

Decision: Accept alternative since p value < 0.05

The study also used the age factor to determine if factors important to small businesses are common to businesses of the same age group. Different businesses have different factors considered as being the most important, for example, the priorities of start-up companies is different from that of existing. As this tie with product/ organization life cycle; there are different priorities at introduction, growth, maturity and decline stages. As shown in Table 9, we accept the alternate hypothesis which implies that factors considered important differs significantly among businesses of the same age group.

ANOVA

Table 10: Important factor in business(analysis usi analysis)

	Sum of Squares	df	Mean Square	F
Between Groups	1208.238	4	302.060	2
Within Groups	7196.619	58	124.080	

ANOVA

Table 10: Important factor in business(analysis using Size as factor analysis)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1208.238	4	302.060	2.434	.057
Within Groups	7196.619	58	124.080		
Total	8404.857	62			

Source: Field survey, 2013

Also table 10 shows that factor critical to success of organizations differ significantly among small businesses as perceived by the business because various organizations have different priorities at different growth stage and size of the company play significant role in determining that. However, the hypothesis is significant at 10% level of significance.

Hypothesis 4

H₁: There is a significant relationship between the size of the business and the frequency of attending training programmes

Tables 11: Relationship Between Size and Frequency of Attending Training Programmes

		How often do you or your employees attend seminar, workshop, and business training programs in a year?
Number of employees employed	Pearson Correlation	-.416**
	Sig. (2-tailed)	.001
	N	63

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Field survey, 2013

In testing for the role of size in determining the frequency of attending training programmes, the result obtained from the study reveals that there is a negative correlation between size and frequency of attending business training programmes. This implies that the lager the size of the business in terms of employees, the lower the frequency of attending training particularly because of the cost-implication.

Hypothesis 5

H₁: There is a significant relationship between the size of the small business and the access to funds from banks and government.

Table 12:Relationship between the size of the small business and the access to funds from Banks and government.

		Lack of available capital from the government
Number of employees employed	Pearson Correlation	-.020
	Sig. (2-tailed)	.878
	N	63

Source: Field survey, 2013

Table 12, above shows the result of the relationship between size of the firm and the ability of the small firm to access funds from government and banks. The findings reveal an inverse relationship between size of the firm and access to government funding. This implies that the smaller the firm the more difficult it will be to access government fund. On the other hand the result shows a positive correlation between the size of the firm and access to capital from banks for asset and equipment, but the result is not statistically significant. This could means that what determines accessing funds from the government or private sector is the ability to repay/trade on equity, not the size.

Hypothesis 6

H₁: There is a significant relationship between the age of the small business and the access to funds from banks and government

Table 13: Relationship between the age of the small business and the access to funds from banks

		Lack of available capital from the government	Lack of available capital from banks for asset and equipment
Age of Business	Pearson Correlation	.062	.047
	Sig. (2-tailed)	.627	.716
	N	63	63

Source: Field survey, 2013

The result in table 13 shows that what determines accessing funds from the government or private sector is the ability to repay/trade on equity, not the age of the firm because there is no significant statistical relationship between the age of the small business and the access to funds from banks and governement, hence we reject the alternate hypothesis and accept the null hypothesis.

5.0 CONCLUSION AND RECOMMENDATIONS

This paper examined the challenges that small scale organizations face in Nigeria during the start-up and growth stage of the businesses and also explore factors considered most important to the business growth opportunities. The paper attempted to chart a way forward crucial to the development of SMEs in Nigeria. Access to capital and good policy framework that will enhance the development of SMEs remains the major challenges facings SMEs in Nigeria. Even though the small businesses have already positioned themselves to be able to navigate these challenges, their survival and growth is dependent on their ability to overcome the challenges in their immediate business environment. The Nigerian business environment, though very turbulent at the moment pose lots of opportunities to the SMEs in terms of its teaming population which is skewed toward the youth, diverse and abundant raw and untapped mineral resources, offering of training and workshops by small business development agency (SMEDAN) and various funding windows set aside by government to assist small businesses. There is no doubt that without proper regulatory framework for SMEs, the effect of government assistance will continue to be elusive. Based on the above, the following recommendations are put forward to chart a framework for SMEs development in Nigeria:

1. There should be a regulatory framework for the development of SMEs in Nigeria, a regulatory framework which the SMEs can identify with and formulated from ideas generated from the SMEs association.

2. The SMEs funding windows should be harnessed for effective disbursement.

3. SMEDAN should embark on a nation-wide survey of SMEs that will provide baseline information on the current state of SMEs in Nigeria.

4. The government programme for development of SMEs in the country should focus separately on microenterprises and not be lump together with SMEs because of their peculiarity.

5. The government should urgently tackle the problem of infrastructural development and maintenance. These include electricity, water and efficient transportation system which impact greater on MSE operations. The bureaucratic bottleneck involved in small business registration should also be removed.

6. Apart from providing training as done by SMEDAN, government should establish relevant well adapted and appropriately structured institutions and organizations to provide support for MSEs in such aspect as; procurement, supply and distribution of raw material, supply of local/imported machines for use on concessional terms, training in several technical grades, and create favourable market conditions.

7. The SME funding agencies should not adopt a blanket financing option for all categories of businesses in terms of age and sizes within the economy. Rather, policies aimed at promoting the performance and growth of micro and small

enterprises should adopt a sectional approach. Thus, resources for each category would address the most critical determinants of performance and growth in focal sub-category such as Micro, small or medium enterprises.

8. There should be more awareness among SMEs operators/owners on support services available to SMEs in the country.

9. Training programmes should be available at affordable rates to the SMEs and the SMEs should take advantages of the opportunities available in the economy to enhance their growth.

10. The decision to grow the business is personal; thus, SMEs should endeavour to enhance their potentials by developing their capacity and skills to manage the business.

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Effects of Incubation Temperature on the Physical and Chemical Properties of Yoghurt

Temitayo. E. Oladimeji, Iyi-Eweka. E., Oyinlola. R. Obanla

Department of Chemical Engineering,
Covenant University,
Ota, Nigeria
temitayo.fatoki@covenantuniversity.edu.ng

Joseph. O. Odigure

Department of Chemical Engineering,
Federal University of Technology,
Minna, Nigeria
josephodigure@futminna.edu.ng

Abstract—**Deterioration of milk-based products such as yoghurt is associated with changes in the environmental parameters during storage. The chemical and physical properties or characteristics of the yoghurt are affected by the production technological parameters like incubation temperature. This research investigated the effect of various incubation temperature on the quality of yoghurt. The milk sample was prepared and a starter culture was inoculated at 40_oC temperature into the samples. Incubations were performed also at various temperatures. The pH of fermented sample, viscosity and titrable acidity (TTA) were also determined. Results showed decrease in the pH value as the TTA (acid molecules) and viscousity increased with increasing incubation temperature. An optimum production temperature of 35^oC is recommended for the production of yoghurt.**

Keywords—*Incubation temperature; Yoghurt; Viscousity; Titrable acidity; Milk*

I. INTRODUCTION

A number of reports have emphasized the significance of food fermentation mainly because of the degradation or inactivation of anti-nutritive factors, toxins, as well as an improvement of the digestibility of foods that leads their major role in the diet of different regions [4]. Fermentation in food processing is the conversion of carbohydrates to alcohol and carbon dioxide or organic acids using yeast and/or bacteria, under anaerobic condition [8].

Yogurt is believed to be one of the oldest fermentation products known to humans, originating in the Middle East and Asia [1]. Yogurt is the resultant curd formed, during the fermentation reaction of lactose (milk sugar) in the milk and bacterial enzymes under certain conditions. This fermentation process is anaerobic. Lactose is a compound sugar, made up of the two simple sugars glucose and galactose. During the making of yogurt, the lactose is broken down by the lactase enzyme. In the course of the action of the bacterial enzyme on the lactose, lactic acids and acetaldehyde are produced which in turn lowers the pH of the milk causing it to have a sour taste or tart taste [2]. The pH of milk is about 6.7. However, during fermentation process the pH drops between 3.6-4.5, depending on the operating technological conditions. The lower pH affects the casein (milk protein), causing it to coagulate and precipitate, forming the solid or thick curd that makes up the

yogurt. The leftover watery liquid is the whey. The two bacteria most commonly used to make yogurt are Lactobacillusbulgaricus and Streptococcus thermophilus. The starters' milk can be inoculated in various forms using virgin bacteria or as in this project, by already-made yoghurt.

The quality of Yoghurt produced is highly affected by various factors which include the incubation temperature, amount of starter inoculated and the time or period of incubation. These are reflected in the yogurts pH (acidity), titrable acidity, viscosity and Brix of the product gotten. Researches showed that milk composition, applied thermal treatment and the incubation temperature influenced the acidification process and the characteristics of the final yogurt [3, 7, 5, 6]. As the incubation temperature is increased the viscosity of the yoghurt increases, the brix (percentage sugar) reduces, the pH reduces and titerable acidity increases. This results in a thicker gel more firmness and adhesiveness as incubation temperature is increased. Hence incubation temperature plays a major role in determining the quality of yogurt made.

Viscous yogurt is the product of an ideal temperature of yogurt milk and the stimulation of bacteria in starter culture. During the fermentation of milk, the yoghurt formed exhibits certain qualities that ascertain if it is fit for consumption or of good quality. During the process if the incubation temperature is not properly maintained the quality of the yoghurt produced may be of low or poor quality, hence the rate of reaction will be dependent on the incubation temperature. This determines the gel thickness and adhesiveness. This research investigates the optimum temperature at which quality yoghurt can be produced and the effect of the incubation temperature on the quality of the yoghurt.

II. MATERIALS AND METHODS

A small amount of the milk sample was dissolved in distilled water and the pH was determined. 67.90g of the milk samples (cowbell milk) were weighed separately into each empty beaker. Distilled water at 90^oC was used to fill the beakers containing the milk samples to its 500ml mark and stirred properly. The samples were cooled to 40^oC. Plain yoghurt bought from the supermarket was used as the starter culture.

Inoculation of the milk samples were performed at various temperature.

(b)   Incubation Temperature

The incubation temperature for the various samples were at temperature ranging from 30°C, 35°C, 40°C and 45°C

Incubation at 30°c:

The water bath was set at 30°C an hour before the milk samples were prepared. The inoculated milk samples were placed in the water bath for 24hours. The incubated samples were removed from the water bath after 24 hours of fermentation. The samples were stirred thoroughly with a spatula in one direction to make the samples (yoghurt) smooth after which left to cool to about 28°C. Incubations for temperature at 35°C, 40°C and 45°C were performed repeating the same procedure as above.

(c)   Determination of the pH of the fermented samples (yoghurt):

The pH meter probe was properly cleaned and checked before use. The pH for the fermented samples and the control sample were conducted using standard procedures. The readings of the pH meter for all the samples were recorded.

(d)   Determination of the titrable acidity using back titration:

1M sodium hydroxide was prepared and titrated against 25ml of each yoghurt samples and control sample using 2 drops of phenolphthalein indicator until it was neutralized and turned light pink.The titration was done thrice for each sample.The titre values were recorded.

(e)   Determination of the viscosity of the yoghurt samples:

The viscosities were determined using the standard procedure. Each sample was poured into the viscometer cup until it reached the marked point.The samples were properly stirred and the viscosities were checked at different revolutions per minute (30, 60, 100rpm).Viscosity values were recorded at the different rpm.

Control Experiment:

The control experiment was done using Hebron Yoghurt at a temperature of 28°C, the following results were gotten.

(a)   The viscousity

Table 1: The viscousity, pH and titrable acidity of the control sample.

pH	3.9
Titrable Acidity (ml)	1.7
Viscousity at 100rpm (cp)	12

(b) pH Analysis:

Table   2: pH of samples at different incubation temperature.

	Sample 1	Sample 2
Incubation Temperature(°C)	pH	pH
30	4.51	4.44
35	4.32	4.29
40	4.20	4.16
45	3.80	3.77

(c)   Titrable Acidity (TTA) Analysis of samples:

Table 3: TTA of samples 1 and 2 at different incubation temperatures

	SAMPLE 1	SAMPLE 2
Incubation Temperature (°C)	TTA (ml)	TTA (ml)
30	1.8	1.73
35	2.27	2.2
40	2.7	2.6
45	3.5	3.33

Table 4: Viscousity of samples (at 100rpm) at different incubation temperatures.

	Sample 1	Sample 2
Incubation Temperature(°C)	Viscousity, μ (cp)	Viscousity, μ (cp)
30	56.5	55
35	60	61.5
40	68	69
45	76	75

III.   DISCUSSION OF RESULTS

During experimental analysis two samples were collected at each incubation temperature to ensure consistency and accuracy of results.

(a)   Variation of pH with the Incubation Temperature

In general, the two quality parameters used to assess yogurt are the pH and the titrable acid. The pH is a measure of the hydrogen ion concentration, while titrable acid (TTA) is the total number of acid molecules and determines the actual hydrogen ion available. The pH value of the yoghurt samples produced are presented in Table 2. The Table shows a drop in the value of the pH for both samples produced. This results shows a decline in pH values as the incubation temperatures increased, i.e. the pH value of the yoghurt is affected by the incubation temperature. The decrease of pH during the storage can be attributed to the high bacterial metabolic activity with the consumption of lactose and lactic acid production which occurred because the increment in incubation temperature was favourable this was similarly observed.

The use of high incubation temperature resulted in a decrease in gelation time and pH values [5]. This decline in the pH results also shows that the incubation temperature affects the acidity of yoghurt. As the incubation temperature was increased the pH of the samples dropped, and the samples became very acidic. Hence the higher the incubation temperature, the higher the acidity of yoghurt.

During fermentation process, it was observed that the pH of the milk samples dropped from 6.7 to about 4.51 to 3.33. This implies an increase in the acid production and this in turn inhibits the growth of pathogenic organisms which can cause food spoilage, food poisoning and disease.

(b) Effects of the Incubation Temperature on the Titrable Acidity (TTA) of Yoghurt

The titrable acidity which measures the acid molecules present was carried out on the samples and an opposite trends were observed in the level of titratable acidity in the yoghurt during analysis. The titrable acidity shows an increase in the TTA (acid molecules) of the yoghurt as the incubation temperature was increased. This shows that there is a proportional relationship between the incubation temperature of the yoghurt and the titrable acidity. The volume sodium hydroxide required to neutralize the yoghurt samples increases with increasing incubation temperature hence there is an increase in the acidity of the yoghurt.

(c). Effects of the Incubation Temperature on the Viscousity of Yoghurt

The OFIT Viscometer was used to determine the apparent viscousities of the yoghurt samples at 28°C in centipoise (cp). The results of the variation of viscosity and incubation temperature are presented in Table 4.5. The viscosity of the yoghurt increases as the incubation temperature is increased. It was observed that as the incubation temperature was increased the gel structure of the yoghurt was firmer and thicker. This in turn caused the yoghurt to be more viscous.

The viscosity is highly affected by the particular temperature of incubation, as some bacteria do not grow well in certain temperatures. It was observed that for two samples incubated at 30°C had certain properties different from other samples which were very viscous and not slimy.

(d) Change in Sensory Attribute

As samples were incubated at different temperatures there was a change and difference in their sensory attributes which includes taste, feel and smoothness. The samples incubated at 30°C were observed to have a creamy and non-tangy taste. The texture was very smooth but not as viscous as those at the others produced at lower temperatures. In the other samples produced as the incubation temperature increased the taste became increasingly sour and tangy, samples also became very thick but less smooth.

IV. CONCLUSION

Yogurt production is affected by the production technological conditions. Increase in the incubation temperature (42-45°C) resulted to increase in the coagulation of the milk protein present (induced by themophilic bacteria) and viscousity. This also resulted in increased acidity of the yoghurt. Yoghurt should not be produced below 35°C as to ensure health safety. Hence the incubation temperature determines both the physical and chemical properties (pH and TTA) of yoghurt as it facilitates the bacteria in the starter to produce viscous yoghurt.

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Whistle-Blowing and Quality of Financial Reporting in the Nigeria Banking Sector

ERIN, Olayinka; OGUNDELE, Iyiola
Covenant University
Ota, Nigeria
erinolayinka@yahoo.com; ogundeleiyiola@yahoo.com

OGUNDELE, Olaoye
Department of Business Administration and management
Babcock University
Ilishan-Remo, Nigeria
Olaoye.ogundele@gmail.com

Abstract— This paper examines whistle-blowing and the quality of financial reporting in the Nigerian banking sector. This paper addresses the research question using the big four audit firms (KPMG, PWC, Ernst & Young and Akintola Williams Deloitte) as the respondents for the study to test the research hypothesis. The total sample size of 275 was used for the study. This study uses regression analysis method to investigate the effects of whistle-blowing on the quality of financial reporting in the Nigerian banking sector. The study uses adjusted R^2 as a primary metrics for measuring the model specification. The results show that the R square, which is coefficient of determination reveal a high value for all the parameters (KPMG- 72.8%, PWC- 61.2%, Ernst & Young-58.2%, Akintola Williams Deloitte- 64.0%) in explaining the model. The empirical findings show that whistle-blowing adoption has a positive significant relationship on the quality of financial reporting in the Nigerian banking sector. This paper recommends that regulatory authorities should put adequate measures in place to ensure continued compliance from the people saddled with the responsibility to prepare banks' financial statement.

Keywords—Whistle-blowing; quality of financial reporting; accountability; nigerian banking sector; transparency

Heading 1

In recent times financial institutions especially banks have come under huge criticism because of the unethical and unprofessional ways of doing business which led to major financial crisis across the globe [3]. Due to this development, the quality of financial reporting of most banks has undergone different regulatory scrutiny in order to protect the interest of all stakeholders. Most countries of the world have issued guidelines on the subject of whistle-blowing, so that organizations would conduct their operations in the most ethical and professional way.

Whistle-blowing is the disclosure by staff or member of an organization (former or current) the illegal, unprofessional and illegitimate practices of organization's employee or employer to an authorized persons or organization that may be able to effect action [19]. Whistle-blowing is important corporate governance, financial and internal control mechanism that help to prevent and deter leakages, abuse of office and fraudulent financial malpractices [22].

Whistle-blowing becomes relevant because of the response of the public for greater financial accountability, financial transparency and financial integrity of financial reporting processes of organizations in recent times. The report of Committee of Sponsoring Organizations of the Treadway Commission in the US [5] and Sarbanes-Oxley Act [24] identified whistle-blowing as an important business ethics that is capable of improving the economic stability and financial reporting process of any country. Therefore, different countries of the world have incorporated whistle-blowing as part of their corporate governance guidelines and financial reporting process.

The statement of research problem identified in this study are, firstly, the banking crisis in Nigeria in 2009 was as a result of unethical behaviors by most banks' Chief Executive Officers and bank's management which resulted to manipulation of financial reports and creative accounting that led to loss of investment for many shareholders. Secondly, Transparency International [25], ranked Nigeria 136 out of 167 countries as the most corrupt country in terms of financial transparency and accountability. However, there has not been adequate research into the link between whistle-blowing and quality of financial reporting in Nigeria. Hence, there is need for this study to examine whistle-blowing and quality of financial reporting in the Nigerian banking sector in order to fill gap in this study.

The Central Bank of Nigeria (CBN) in October, 2014 [4] issued a circular and guidelines on whistle-blowing policy for banks and other financial institutions in Nigeria. This guideline is aimed at improving quality of financial reporting in the Nigerian banking sector. The objective of this study based on CBN whistle-blowing guidelines is to examine the overall impact of whistle-blowing policy on the quality of financial reporting in the Nigerian banking sector.

Heading 2

I.   WHISTLE-BLOWING AND NIGERIAN BANKING SECTOR

The concept of whistle-blowing has generated debates in literature on what actually constitute whistle-blowing [11] [13] [18]. Though, there are different perspectives on the definition of whistle-blowing, however, there are commonalities on the subject of whistle-blowing. Whistle-blowing is a deliberate and

obligatory act of disclosure, which gets on public records and is made by a person who has privileged access to information of an organization about the illegality, fraudulent practices or other wrongdoing of a person or organization to an external entity having power to rectify the wrongdoing [11]. The essence of whistle-blowing in any organization is to eliminate unethical behavior or practices that may affect the quality of financial reporting.

The Central Bank of Nigeria in 2014 mandated all banks in Nigeria to incorporate whistle-blowing policy as part of their quarterly reporting requirement. The essence of this directive is to ensure integrity in the financial reporting process in the Nigerian banking sector and also to comply with global corporate governance code [4]. Reference [14] states that the objective of whistle-blowing is to serve public interest by reducing frauds and other financial malpractices in the Nigerian banking sector. Also, to ensure the integrity and transparency of financial reports in the Nigerian banking sector.

II. QUALITY OF FINANCIAL REPORTING AND WHISTLE-BLOWING

Reference [24] [4] developed a guideline on the process of whistle-blowing that would guide financial institutions in their internal operations. It is expected that this policy will lead to high quality of financial reporting in the banking industry. Also, organizations are to act within the capacity of the policy.

Whistle-blowing and Transparency

Reference [17] opines that whistle-blowing has received attention in recent times because it has led to financial transparency of most financial institutions. They believe that whistle-blowing has reduced the incidence of fraud in workplaces. A survey conducted by Association of Certified Fraud Examiners [1] revealed that whistle-blowing has reduced fraud by 48% in most financial institutions globally. The survey revealed that whistle-blowing has led to transparency in the financial reporting process of most financial institutions in the world.

Whistle-blowing and Independence

The Enron and WorldCom scandal in 2002 brought about the integrity and independence of financial reporting in bad light [10]. Part of whistle-blowing objective is to ensure that financial information is free from undue interference, so as to ensure its independence. Reference [21] study show that whistle-blowing implementation has improved to a large extent the independence of financial reports from undue influence from external parties.

Whistle-blowing and Value Relevance

Reference [15] reveals that the ultimate goal of whistle-blowing is the stakeholders. Their study demonstrate that the essence of whistle-blowing is to make financial statements robust and add value to organization's stakeholders by

removing frauds, financial malpractices and unethical behaviors that could hamper the objective of quality financial reporting which is value relevance. Whistle-blowing makes the preparation of financial reporting credible and add value to stakeholders who make relevant and timely decisions about financial statements.

Whistle-blowing and Reliability

Whistle-blowing has become a common strategy with the objective of ensuring reliability of financial reporting in many countries [1]. Reference [15] opines that whistle-blowing has become a de-facto procedure for effective financial reporting with a view to ensure that financial statements are free from intentional error and fraud. Their study further confirmed that whistle-blowing has helped reduce financial statement misstatement and error especially in emerging economies.

Whistle-blowing and Accountability

Whistle-blowing policy is aimed at ensuring that there is accountability on the part of owners and preparers of financial reports [2]. Reference [26] opines that if whistle-blowing is given proper consideration in organizations, it would engender accountability on the part of those saddles with the responsibility in preparing the financial statement. Financial result must show a true and fair view of company's position before it is considered accountable to stakeholders who have interest in the organization.

III. EMPIRICAL STUDIES REVIEW

Reference [26] examines the influence of individual, team and contextual factors on external auditors' whistle-blowing intentions in Barbados. Survey design was used a through the use of questionnaire to 250 external auditors and 18 individual interview as well as 2 focus group were conducted in Barbados to gather information about the conceptual model on whistle-blowing intention among external auditors. The study reveals that respondents preferred anonymous internal channel of reporting and showed a general reluctance to report externally. Furthermore, the findings show that open-door policy, hotline and clearly defined policies could encourage whistle-blowing.

Reference [7] examines accounting students' intent to blow the whistle on corporate fraudulent financial reporting. The study explore an experiment involving accounting students to ascertain their intent to externally blow the whistle on fraudulent financial reporting given a specified personal and societal consequences of such actions. Findings show majority of the participants indicated a tendency to blow the whistle while few indicated otherwise.

Reference [9] conducted a study on good governance and whistle-blowing: a case of a Higher Education Institution (HEI) in South Africa. The study seeks to examine the extent to which employees are encouraged to blow the whistle at higher education institutions, despite legislation which protect disclosure in good faith. Questionnaires were administered to all employees of Durban University of Technology in South Africa. The findings show that employees are of the opinion

that practices relating to whistle-blowing have not encouraged whistle-blowing in the institution.

Reference [8] conducted a study on the propensity of whistle-blowing: empirical evidence from China, Taiwan and the United States. A survey design was used through the use of questionnaire to respondents of the three countries. The results show that Americans have a greater tendency to engage in whistle-blowing than Chinese and Taiwanese. The intention of Taiwanese and Chinese to whistle-blow is influenced by the degree of amount involved and also by the extent of unprofessional or illegitimate practices of companies.

Reference [20] examines whistle-blowing and anti-corruption crusade: evidence from Nigeria. The study investigated the extent to which whistle-blowing predicted corruption perception index (CPI) score, the extent to which employees engaged in whistle-blowing, and why they did not report cases of wrongdoings. Respondents of 536 employees were sampled from public organizations in South-western Nigeria. The findings show that whistle-blowing could significantly enhance the country's CPI score because the more the citizens engage in whistle-blowing the better for the country's CPI score.

Reference [23] examines the effect of whistle-blowing practices on organization performance in the Nigerian public sector. Survey research was adopted in the study, a total of 700 questionnaires were administered using simple random technique. The findings show a significant relationship between whistle-blowing practices and organization performance in the Nigerian public sector. The result shows that employees feel uncomfortable to report unethical practices within the organization to external bodies.

IV. HYPOTHESES DEVELOPMENT

The main objective of this study is to examine the impact of whistle-blowing policy on the quality of financial reporting in the Nigerian banking sector. The prediction of this study is that adoption of whistle-blowing policy will improve the quality of financial reporting in the Nigerian banking sector.

Reference [2] examines whistle-blowing and quality of financial reporting in financial institutions. It was observed that whistle-blowing policy is expected to improve the level of quality of financial reporting in financial institutions globally. The study affirms that whistle-blowing policy has the ability to improve financial reporting and reduce tendencies for financial fraud and illegalities.

Based on literatures reviewed, this study thus predicts that:

HI: Whistle-blowing policy has significant effects on the quality of financial reporting in the Nigerian banking sector.

V. THEORETICAL FRAMEWORK

This study adopts ethics and moral theory based on [12] proposition. Kant's theory assumes that is a moral duty to tell the truth and report any wrongdoing by virtue of being rational. In support of Kant, [8] affirms that whistle-blowing is a moral obligation of employees to act right and disclosure wrongdoing in good faith. Based on both arguments, accountants and preparers of financial statements have the moral right to act in the public interest and honor public trust by demonstrating a commitment to professionalism.

Heading 3

This study uses survey design method as data were collected through the use of questionnaire. All the big four audit firms (KPMG, PWC, Akintola Williams Deloitte and Ernst & Young) were used as respondents for the questionnaire distributed. The reason why the big four audit firms were selected is because CBN mandated banks' external auditors to ensure that Nigerian banks complied with the whistle-blowing policy and that audit firms must also conduct assessment of banks' whistle-blowing compliance as part of their audit function. The big four audit were also selected as respondents due to their on-field nature of work and experience that afford them the opportunity to confront corporate wrongdoings in most clients organization.

The audit departments of the big four audit firms were selected as respondents to the questionnaire distributed. The total population for this study is one thousand (1000) audit employees (Transparency Report, 2014) while the sample size is two hundred and eighty five (285) audit employees. Sample size was derived through Taro Yamane formula.

Based on the calculation above, 285 sample size with error limit of 5% is considered fit for the study. Out of 285 sample size, 275 people responded to the questionnaire which represents 96% response rate while 4% represents rejection rate. The distribution of the questionnaire were as follows; KPMG-70, PWC-80, Ernst & Young-65; Akintola Williams Deloitte-60. The questionnaire was constructed using a five-point Likert scale. The questionnaire was divided into two sections; Section A comprises the personal information of the respondents while Section B is on questions relating to the hypothesis. The data collected were analyzed with the use of both descriptive and inferential statistics.

Linear regression method was used in this study as the statistical method for analyzing the data gathered. This study adopts linear regression because it allows adjusted coefficient of determination (adj. R^2) as a unit to measure the relationship between dependent variables (Whistle-blowing policy) and independent variables (Quality of financial reporting). The Statistical Package for Social Sciences (SPSS) was used to analyze the data collected for the study.

Model Specification

The basis for this model specification is hinged on the literature reviewed and theoretical framework which seeks to explain the relationship between whistle-blowing policy and quality of financial reporting in the Nigerian banking sector. This is carried out from the perception of ethics and moral theory. Ethics and moral theory consider whistle-blowing and quality of financial reporting as variables that affect organization interest by taking into account its effects on all company's' stakeholders.

WB= (QFR), where, WB= Whistle-Blowing, QFR= Quality of Financial Reporting.

Consequently, WB policy can be represented as follows:

Equation (1) is WB Policy = f (QFR) (I)

Assuming a linear relationship, we can rewrite all the above equation (I) in an explicit functional form after taking into consideration independent variables as:

Equation (2) is $QFR = \beta_0 + \beta_1 TRANS + \beta_2 ACC + \beta_3 REL + \beta_4 IND + \beta_5 VR + e$ ………………….. (II)

Where:

B0= Constant term, TRANS= Transparency, ACC= Accountability, REL= Reliability, IND= Independence, VR= Value Relevance

Heading 4

Table 1 shows the result of regression analysis for the model specification. The results show that the R square, which is coefficient of determination reveal a high value for all the parameters (KPMG-72.8%, PWC- 61.2%, Ernst & Young- 58.2%, Akintola Williams Deloitte- 78.8%) in explaining the model.

TABLE 1 REGRESSION ANALYSIS (MODEL SUMMARY)

	KPMG	PWC	Ernst & Young	Akintola Williams Deloitte
R	0.808	0.645	0.745	0.788
R^2	0.728	0.612	0.582	0.640

Source: SPSS 20 Output from Field Survey (2016)

Table 2 shows the results of the aggregate correlation coefficients for the model specification. The results shows that all the coefficient have a positive value which indicates that whistle-blowing has positive significant effects on the quality of financial reporting in the Nigerian banking sector. All the results of the big four audit firms show a significant value (β_1 (0.831), β_2 (0.654), β_3 (0.545), β_4 (0.570), β_5 (0.642), p<0.05) which means that the variation explained by the model is not due to chance.

TABLE II MODEL CORRELATION COEFFICIENT

Model	B	Std. Error	Beta	t-test statistic	Sig.
(Constant)	4.578	3.660	2.667	2.165	0.000
β_1 (Transparency)	.790	0.089	0.831	1.017	0.001
β_2 (Accountability)	.539	0.079	0.654	1.879	0.002
β_3 (Reliability)	.443	0.076	0.545	1.887	0.001
β_4 (Independence)	.513	0.071	0.570	1.587	0.000
β_5 (Value Relevance)	.727	0.068	0.642	1.404	0.000

Source: SPSS 20 Output from Field Survey (2016)

Therefore, the null hypothesis is rejected while the alternative hypothesis is accepted accordingly. The perception of the respondents is that whistle-blowing has contributed to high quality of financial reporting in the Nigerian banking sector.

Heading 5

This paper examines whistle-blowing policy and quality of financial reporting in the Nigerian banking sector where the big four audit firms were used as the respondents for the questionnaire distributed. The study reveals that whistle-blowing policy has contributed significantly to the quality of financial reporting in the Nigerian banking sector taking into account all the elements of a good financial reporting. Hence, there is need for continued compliance to regulatory policy on the part of banks' management and employees respectively.

VI. POLICY IMPLICATION OF FINDINGS

The following policy implications are highlighted based on the research findings in this paper:

The implementation of whistle-blowing will boost the confidence of financial analysts and institutional investors who rely on banks financial reports to make investment decisions. The effect on the Nigerian economy is that it will improve the level of foreign direct investment (FDI) into the country because of high confidence global investors will place on Nigerian banking financial reporting process.

The compliance of Nigerian banks to whistle-blowing will boost the country transparency index from global rating agencies. Also, it will improve the country's image on corruption perception index which has remained high among one of the most corrupt countries in the world.

VII. RECOMMENDATIONS

The following recommendations were made based on the above policy implication of findings:

(i) This paper recommends that regulatory authorities should put adequate measures in place to ensure continued compliance from the people saddled with the responsibility to prepare bank's financial statement. Also, measures should be taken to enhance the quality disclosure of relevant financial reporting information that will help users take useful economic decisions.

(ii) There is need for regulators to put proper measures in place to protect whistle-blowers from intimidation and harassment so that all stakeholders' interest would be protected.

VIII. CONTRIBUTION TO KNOWLEDGE

This study informs research on whistle-blowing and quality of financial reporting in the Nigerian banking sector. This paper contributes to knowledge in the following ways:

(i) This paper include accountability, transparency, value relevance, reliability and independence as essential qualities of

financial reporting which serves as a metric for measuring quality of financial reporting regarding whistle-blowing. This could be a guide for public policy concerning banking sector accounting framework.

(ii) This paper contributes to banking sector accounting framework for national development and capacity building. It will help in building transparency, professionalism and ethics in the Nigerian banking industry.

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A Social Lifecycle Assessment Model for Sachet Water Production in Nigeria

Dunmade, I.S.
Mechanical Engineering Department
Covenant University
Ota, Nigeria
israel_dunmade@yahoo.ca

Loto, C.O.
Mechanical Engineering Department
Covenant University
Ota, Nigeria
cleophas.loto@covenantuniversity.edu.ng

Onawumi, A.S.
Mechanical Engineering Department
LAUTECH
Ogbomosho, Nigeria
ayodele.onawumi@covenantuniversity.edu.ng

Oyawale, F.
Mechanical Engineering Department
Covenant University
Ota, Nigeria
festus.oyawale@covenantuniversity.edu.ng

Abstract— **In the last two decades sachet water production and consumption has become an integral part of our consumption culture in Nigerian cities and towns. Its emergence and growth has some significant environmental and socio-economic implications. The aim of this study was to assess social impacts of sachet water production in Nigeria. This paper reports a Social Lifecycle Assessment Methodology developed to evaluate social effects of sachet water production on workers and on the local community where its production is taking place. The methodology is demonstrated with a case study on a Sachet Water brand production by a company in Sango-Ota. The social performance score of the sachet water production facility is 35.7% on workers and 50% on local community. The overall social performance is 42.3%. Results of the analysis revealed social benefits and community engagement as significant issues. The facility therefore needs to make significant improvement on a number of social aspects of its operations with regard to workers. These results provide valuable insight for those who seek to produce or purchase responsibly. The contributions made by this study include articulation of social indicators that are relevant to Nigeria, especially to sachet water production. This being the first reported sLCA study in our country, the developed sLCA model and the case study would provide a platform for future comprehensive sLCA study of a number of Nigerian products and economic activities.**

Keywords— *social sustainability, lifecycle assessment, sachet water, sustainable development, impact assessment*

I. INTRODUCTION (*Heading 1*)

Water packaging in polythene sachet has become one of the most common ways of making water available for people on a journey, at various ceremonies and work sites in Nigeria. It is often used on occasions such wedding ceremony, birthday celebration, burial ceremony, and many other situations when large number of people are gathered for entertainment. It is popularly called "pure water". Like we all know that whatever we do has consequences. There are several positive and negative consequences of sachet water as a product and there are consequences of the facilities that are producing them. According to [1], "society is taking increasing interest in assessing social impacts of various human activities". However there are varieties of methods and approaches that are used in evaluating social impacts of our activities. The chosen approach depends on the object of interest. For example, one can utilize social impact assessment or health impact assessment if the focus is on a product, project or facility. According to [2], "social impacts are caused by changes."For instance, setting up a production facility where it has never been in existence is a change. Among the possible effects of such changes include increased employment opportunities and more traffic. These effects in turn have consequences such as improved standard of living from employment and death or injuries in traffic. There is therefore a need to evaluate the overarching social impacts of a product and/or facility with the aim of providing information and shedding lights on areas where negative impacts needs to be addressed and where positive impacts could be enhanced. One of the tools for evaluating social impacts is social lifecycle assessment (sLCA). It is one of the complimentary members of lifecycle assessment family. As the name implies, it is concerned with the social and socio-economic impacts of products, process, activities and facilities. It is a tool used to analyze the way products and business activities affects human well-being. According to [3], "Social Life Cycle Assessment (SLCA) is emerging as a powerful and necessary tool in sustainability science." However, the methodological aspects and applications of sLCA are not yet completely developed. They are currently at the evolutionary stage [4, 5]. sLCA is implemented in four steps, just like the counterpart lifecycle assessment tools. The four steps are: goal and scope definition, lifecycle inventory, lifecycle impact assessment, and lifecycle interpretation (Figures 1 and 2).
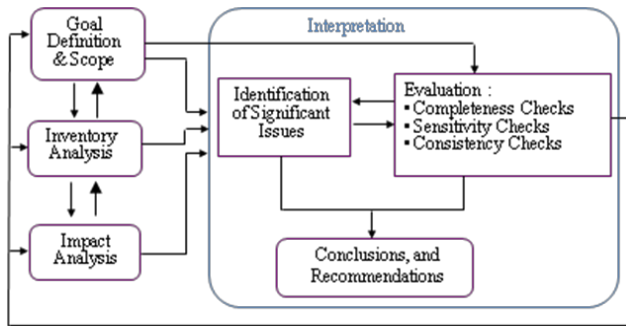
Fig. 1. An illustration of conventional lifecycle assessment process steps
[Source: Dunmade, 2015]
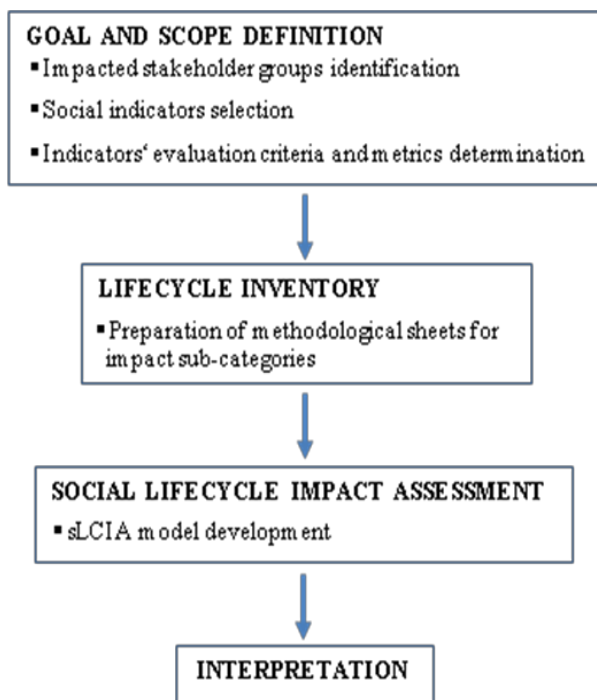
Fig. 2. Additional activities undertaken for sLCA at each LCA stage

II. GOAL AND SCOPE DEFINITION

A. The goal of the study

According to [5], the goal of a lifecycle assessment should specify the intended application, objectives of the study, and intended audience. The goal of this study therefore is to provide awareness of the potential social consequences of sachet water production so that manufacturers and policy makers can make informed decisions at that stage of the sachet water product lifecycle. The work is also aimed at identifying hotspots in social sustainability aspect which will be useful in developing design strategies to support the development of

sustainable water sachet production facility. To meet the goal of this research, the following questions will be answered:

- What are the appropriate social criteria that should be used to assess the social sustainability of sachet water production?
- How should stakeholders assess the attainment of those criteria based on their experience in a specific case?

What are social sustainability hotspots within the production stage of the sachet water lifecycle that needs further research and policy development?

B. Scope of the study

This sLCA study involves the development of a sLCA model for sachet water production and demonstrating it with a case study on a sachet water brand production by a company in Sango-Ota. At this stage of the study, we determined the function of the system, its functional unit, the system boundaries, data averaging, limitations and exclusions [6, 7]. We also identified affected stakeholder groups, impact categories, subcategories and indicator to be included in the analysis based on the goal of the study. Furthermore we articulate the criteria for scoring the performance of the production facility on each indicator and determine the indicator scoring metrics in preparation for the lifecycle inventory.

B.1 Sachet water production system

Figure 3 below is an illustration of the production process of the sachet water brand used as a case study. The source of the water used is a well. When water is pumped from the well it is either stored in a number of storage tanks or pumped through a number of biological and ultraviolet treatment devices before being passed to another set of storage tanks from where it is packaged. The treated water is metered into 500ml sachet packaging and automatically sealed. Twenty sachets of water are then packed together in another polythene for onward distribution to retailers. Consumers purchase individual sachet or packs of twenty sachets from retailers. When a sachet of water is emptied, the sachet waste is disposed off. There are different levels of automation used in the industrial sub-sector depending on the ability of the investor. The process at this case study facility is about 60 – 70% automated.

B.2 Function and functional unit

The function of sachet water in this study is to quench human thirst, thereby preventing dehydration and associated consequences. The functional unit used in this study is a pack of sachet water containing 20 units of 500ml sachet water.

B.3 System boundaries

The scope of the study covers the production stage of sachet water lifecycle as a representation of sachet water production in Lagos/Ogun Area. The distribution and consumption of the sachet water is mainly within Sango-Ota metropolis. Only about 10% of the distribution goes to Lagos. This study did not include consumption and residual management stages of the sachet water lifecycle. Furthermore, transport of sachet water involved in distributing the product to

the retailers is excluded. These activities also have social impacts, but are not covered within the scope of the study because the focus was on sachet water production.
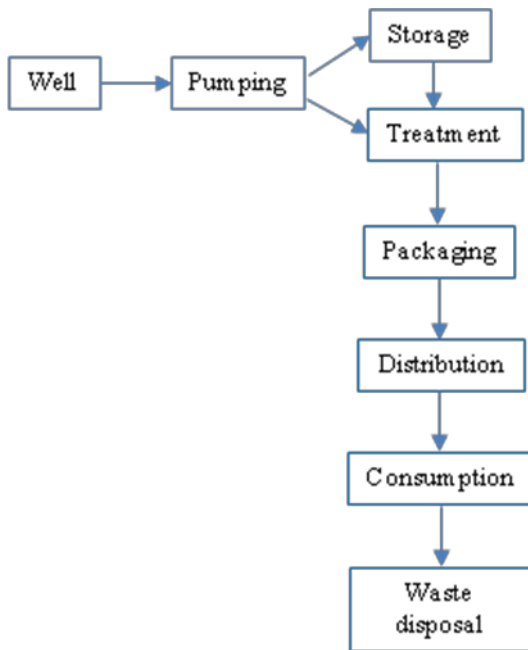
Fig. 3. The case studied Sachet water production process lifecycle

III. LIFECYCLE INVENTORY (LCI)

This involves articulation and quantification of data to be used for impact analysis. Two major approaches have emerged in sLCA community regarding lifecycle inventory data to use. The first approach depends on company/site specific data. But they are often difficult to access. The second approach depends on generic data such as those obtainable from national censuses or public surveys which are easier to access [8]. According to [9], the development of social indicators that can be integrated into LCA depends on the sector that is monitored and the national context. Data used for this analysis is a site specific data from the sachet water production facility in Sango-Ota, Ogun State, Nigeria.

A. Data Collection

There are three forms of social LCA data: quantitative, semi-quantitative (yes/no or rating scale responses) and qualitative (descriptive text) [10-15]. At this stage we prepared the interview questions and developed the methodological sheets for relevant subcategories in line with the UNEP/SETAC methodological sheets for 31 subcategories of impact [16]. The data was collected in the form of face-to-face interviews and site observation on Wednesday 10 February 2016. The data collected are qualitative, semi-quantitative and quantitative in nature. The proprietor and the production supervisor were independently interviewed. The questions asked ranged from raw material acquisition through water sourcing, treatments, packaging, marketing and distribution, socio-political impacts, employment matters, community

relations and many other vital issues bordering on societal impacts of the production facility and that of the sachet water product brand. One of the value chain actors (i.e. plastic bottle producer/polythene supplier) was also interviewed on the same day. The lifecycle inventory data reported is an average of the data collected in each category from the stakeholders. Tables 1 and 2 are samples of lifecycle inventory analysis results of this study. They show some of the appropriate social criteria that should be used to assess the social sustainability of sachet water production regarding workers and local community matters.

Table 1 Sample LCI _ Stakeholder category: Workers

Subcategories	Inventory Indicator	Normalized scoring metric	Averaged score	Maximum possible score
Freedom of Association and Collective Bargaining	1. Employment is not conditioned by any restrictions on the right to collective bargaining	Yes = 1, No = -1, N/A or Unverified = 0	1	1
	7. Workers have access to a neutral, binding, and independent dispute resolution procedure	Yes = 1, No = -1, N/A or Unverified = 0	0	
Child labour	1. Absence of working children under the legal age	Yes = 1, No = -1, N/A or Unverified = 0	1	1
	3. Records on all workers stating names and ages or dates of birth are kept on file	Yes = 1, No = -1, N/A or Unverified = 0	1	1
	2. The lowest paid workers considered their wages meets their needs	Yes = 1, No = -1, N/A or Unverified = 0	-1	1
	4. Regular and documented payment of workers (weekly, bi-weekly)	Yes = 1, No = -1, N/A or Unverified = 0	1	1
Hours of Work	1. Respect of contractual agreements concerning overtime	Yes = 1, No = -1, N/A or Unverified = 0	0	
Forced Labour	1. Workers are free to terminate their employment within the prevailing limits	Yes = 1, No = -1, N/A or Unverified = 0	1	1
	2. Workers are bonded by debts exceeding legal limits to the employer	Yes = -1, No = 1, N/A or Unverified = 0	1	1

I. SOCIAL LIFECYCLE IMPACT ASSESSMENT (sLCIA)

Social Impact refers to consequence of positive and negative pressure on social end points, i.e. the well-being of stakeholders. There are six steps in conventional (environmental) lifecycle impact assessment. The six steps are: definition of impact categories, classification,

characterization, normalization, grouping and weighting [6, 7]. The same is transposed unto social lifecycle impact assessment. However, this stage of the lifecycle is still a work in progress in view of the evolving understanding of possible social consequences of products, products and facilities. There are several factors that bring variations in effects caused by products and facilities as experienced by individuals and groups of people. The list of such impacts cannot be fixed but examples can be found in social lifecycle assessment literature. Furthermore, consensus is yet to be reached on a number of them [17-25].

A. Selection of impact categories and classification

Following the published UNEP/SETAC sLCA guidelines, a top-down method is adopted to select the stakeholder categories and subcategories [26]. The guidelines identified five stakeholders, namely: workers, consumers, local community, society, and value chain actors. For this study, impacts on only two of the five stakeholder groups were considered relevant in view of the scope of the research. The considered stakeholder categories are workers and local community. In sLCA classification for this study, situation relevant social impact subcategories and indicators were mapped into the relevant two of the five stakeholder categories. The social impacts assessed in this study have to do with human rights, working conditions, health and safety, cultural heritage and socio-economic repercussions. The selection of subcategories is based on UNEP/SETAC methodological sheets, currently relevant indicators for that Nigerian industrial sector and the scope of the study. The indicators of the selected subcategories are defined by a set of semi-quantitative data.

B. Characterization and normalization

This is the stage when life cycle inventory data is modeled to evaluate impacts of a product, process or a facility. It is the process of converting the social information into interpretable indicators of a list of impacts. Two methods are often used in analyzing and reporting social impacts in the sLCA, namely: quantitative approach which is based on scoring and the qualitative approach that simply reports the impacts in linguistic terms. A quantitative approach was adopted in this study. This quantitative approach was adopted because the results obtainable from the approach provide a platform for comparison with results that would be obtained from future studies of other similar production facilities. It would also facilitate determination of the extent to which the production system is improved whenever it is done. The quantitative approach used in this study involved the development of a customized simple additive weighting scoring model for analyzing the social impact of sachet water production. The model was implemented in Microsoft excel program [3, 26-34].

C. The sLCIA Calculation

The facility performance for each stakeholder group was assessed by compiling its normalized indicators scores at sub-category level. The weighted totals of all relevant sub-categories for each stakeholder group were then summed up to obtain the facility's score with regard to the stakeholder group. The overall social impact (score) of the facility is finally calculated by adding all relevant stakeholders' scores together. The normalization at subcategories level becomes necessary to avoid certain subcategories dominating the final result.

Table 2 Sample LCI _Stakeholder category: Local community

Subcategories	Inventory Indicator	Normalized scoring metric	Averaged score	Maximum possible score
Community Engagement	1. Availability of written policies on community engagement at organization level	Yes = 1, No = -1, N/A or Unverified = 0	-1	1
Cultural heritage	1. Cultural Heritage in Urgent Need of Safeguarding due to corporate activities	Yes = -1, No = 1, N/A or Unverified = 0	1	1
Local Employment	1. Percentage of workforce hired locally	% > 50 = 1, % between 10 - 49.9 = 0, % < 10 = -1	1	1
	3. Percentage of spending on locally-based suppliers	% > 50 = 1, % between 10 - 49.9 = 0, % < 10 = -1	1	1
Access to Material Resources	1. Has the organization developed project-related infrastructure with mutual community access and benefit	Yes = 1, No = -1, N/A or Unverified = 0	1	1
	2. Tendency for material resource conflict between organization and local community	Yes = -1, No = 1, N/A or Unverified = 0	1	1
Safe and Healthy Living Conditions	3. Management effort to minimize use of hazardous substances	Yes = 1, No = -1, N/A or Unverified = 0	1	1

C.1 The SIMSaW model
C.1.1 Facility's absolute scoring model
Let i be the ith social indicator

In_i is the facility's score on ith indicator in sub-category j under category t with respect to stakeholder group k. The original data of indicators are data provided by the company and national statistical data that represents an average condition in certain national context. For the quantitative indicators, the indicator values are normalized to a scale of −1 to 1, and −1 is considered to be the worst and 1 is the best social performance.

n_{In} is the total number of indicators considered for a sub-category

w_j is the importance weight attached to the jth sub-category Importance weight is applied at the sub-category level because it is usually the highest level at which the product impact is assessed.

The score of the facility for sub-category j (under category t with regard to stakeholder group k,)

$$J_k = \frac{1}{n_{In}} \sum_{i=1}^{I} In_i \qquad (1)$$

The facility's score for stakeholder category t

$$T_k = \frac{\sum_{j=1}^{J} w_j J_j}{\sum_{j=1}^{J} w_j} \qquad (2)$$

The overall social impact (score) by the facility in absolute term,

$$S = T_1 + T_2 + \ldots + T_T \qquad (3)$$

However, to make the results obtained meaningful, it needs to be reported and interpreted in relation to obtainable maximum score in that scenario.

C.1.2 Maximum obtainable score determination
The maximum obtainable score for sachet water production can be calculated as follow:

The maximum obtainable normalized score for sub-category j with regard to stakeholder group k

$$J_k^{max} = \frac{\sum_{i=1}^{I} In_i^{max}}{n_{In}} \qquad (4)$$

where In_j^{max} is the maximum obtainable score with regard to social indicator j

The maximum obtainable weighted score for social impact category t with regard to stakeholder group k,

$$T_k^{max} = \frac{\sum_{j=1}^{J} w_j J_j^{max}}{\sum_{j=1}^{J} w_j} \qquad (5)$$

The maximum obtainable overall social impact (score),

$$S_{max} = T_1 + T_2 + \ldots + T_T \qquad (6)$$

The overall social impact of the sachet water production facility in relation to the possible achievable score,

$$S_R = S/S_{max} \qquad (7)$$

D. Normalization

Conventionally, this has to do with the rescaling of characterization results into a comparable range. The comparison may be in relation to the benchmark, industry standard, national standard or international standard. The normalization in this study is made in relation to the benchmark as represented by maximum obtainable value in each indicator category. The importance weight is also normalized. The normalization aspects were already built into the model.

E. Weighting

This involves attaching importance values to the normalized subcategories' results. Although the model provided for importance weighting, in this study all indicators are adjudged to be of equal importance. Consequently the weighting is unity and this cancels out the weighting aspect of the model.

For the quantitative indicators we convert the linguistic rating to numerical values in the range of −1 to 1. For example, the semi-quantitative indicators, such as cultural heritage, are evaluated by determining if the product or the process causes damage to cultural heritage or not, values of −1 is assigned if such indicator has negative impact, 1 if it has positive impact and 0 if it is not applicable or unassessed/unverified.

F. Sample calculation

Taking the health and safety sub-category under worker stakeholder category as an example to demonstrate the calculation procedure:

The facility's normalized score on health and safety (hs) sub-category

$$J_{hs} = \frac{1}{4}[1 + (-1) + 1 + 1] = 0.5 \ \ldots\ldots\ldots\ldots\ldots (8)$$

The maximum obtainable normalized score by the facility on health and safety under worker stakeholder category

$$J_{hs}^{max} = \frac{1}{4}[1 + 1 + 1 + 1] = 1 \ \ldots\ldots\ldots\ldots\ldots (9)$$

II. RESULTS AND DISCUSSION

Tables 1 and 2 are the lifecycle inventory data resulting from the interview and site observation while Figure 4 is an illustration of the lifecycle impact assessment results obtained from the analysis of the data from Tables 1 and 2 based on the scoring model developed. The lifecycle impact assessment results were calculated by using equations 1 – 7 with the first step exemplified in section F above. The calculation showed that the social impact score for workers (wkr) = 2.5 while the score for local community = 3. The overall social impact score for the sachet water production facility = 5.5. Similarly, the maximum obtainable overall social impact score by the

facility = 7 + 6 = 13. The overall social impact of the sachet water production facility in relation to the possible achievable score, S_R = 5.5/13 = 0.423.
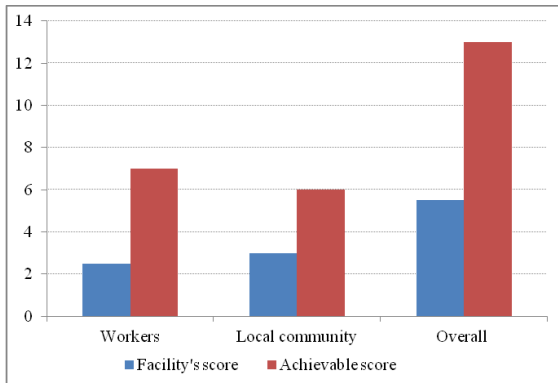
Fig. 4. Sachet water production facility's social performance score in comparison with achievable score.

A. The sLCA Interpretation

According to ISO 1440/44, we are to examine the results obtained from lifecycle inventory and lifecycle impact assessment for interpretation of the results. An examination of the lifecycle inventory results in Tables 1 – 2 and lifecycle impact assessment results revealed social benefits (under workers stakeholder category) and community engagement (under local community stakeholder category) as significant issues. Further evaluation of the results show the social performance of the facility under workers stakeholder category and local community stakeholder category (in comparison with possible performance score) to be 35.7% and 50% respectively. The facility's overall social impact score = 42.3%. Using the interpretation criteria table (Table 3), the social lifecycle impact assessment of the sachet water facility showed that the facility's social performance is poor to workers while it is okay with regard to the local community matters.

Table 3 Interpretation criteria

Percentage score	Remark
≥ 80	Excellent
61 - 79	Very good
50 - 60	Good
21 - 49	Poor
0 - 20	Very poor

A.1 Social impact on workers

The impact of pure water production on the worker was evaluated in terms of fairness of salary as there is no known/observed child labor nor forced labor practice in/by the organization. The salary/wage payment is considered unfair in view of the cost of living in Sango-Ota area. For example, a management staff of the company with MSc. degree receives about N32000 salary per month. One can then imagine what the factory staff is earning. However, this is typical of the general exploitation of staff in the private sector in our country. This is consequent upon high unemployment rate in Nigeria. The effect of such income on the workers' well being can then be interpolated. This accounts for 2.5 points score of the production facility out of a maximum obtainable 7 points score.

A.2 Impact on the local community

Evaluation of the facility's impacts on the local community showed an average score. Interview information revealed that the company provides the neighborhood free potable water from 5:30am to 9:00am twice a week. The production activities of the organization do not have negative impact on cultural heritage of the people as it does not infringe on the local communities cultural practices as at when due. The production of processed and packaged water in sachet instead of women and children having to fetch water from stream for festivities actually make cultural practice easier. These accounts for the company's 3 points score out of the maximum possible score of 6 points. The company's total score for the two stakeholder categories evaluated is 5.5 points out of the 13 points. This is below average of the total score.

B. Evaluation

The process of implementing the sLCA study was evaluated to ensure conformity with the ISO 14040/44, UNEP/SETAC guidelines on sLCA and methodology sheets provided UNEP/SETAC on sLCA. In addition, the scope of the study, data collected, and impact analysis steps undertaken were also examined in terms of their adequacy in meeting the goals of the study. Best practices were adopted where no definite guide was available.

C. Conclusion

A social lifecycle assessment model was developed for sachet water production. The model was implemented with a case study on a sachet water brand production in Sango Ota. On the overall, the analysis showed that the facility has poor social performance. The facility would therefore need to make significant improvement on a number of social aspects of its operations with regard to workers. The model and its demonstration with a case study have shown appropriate social criteria that should be used to assess the social sustainability sachet water production process. It also showed how stakeholders can assess the attainment of those criteria based on their experience in a specific case. Furthermore it helped to pinpoint social sustainability hotspots within the production stage of the sachet water lifecycle that needs further improvement.

Moreover, the study has opened up an essential area of sustainability studies that is yet to be explored in this country. The developed sLCA model and the case study provided a platform for comprehensive evaluation of our industrial activities in terms of their social sustainability. It would be a good reference for future sLCA study of many Nigerian

manufactured or imported products and on our other economic activities.

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Android Based Smart Home System

Adamu S. Kadalla, Ahmed I. Tijjani and Matthew K. Luka
Department of Electrical and Electronics Engineering
Modibbo Adama University of Technology, Yola, Nigeria

Abstract—**Conventional electrical installations used in various building today poses great difficulty for physically challenged and elderly persons to operate them. Sometimes it is also inconvenient for normal person to use productively. Because of the increasing number of both the elderly and the disabled persons, an implementation of a smart home system is proposed in this paper. In addition to the convenience, the system also provides a platform for *inclusion* of the elderly and physically challenged individuals in both homes and offices, thereby enabling them to contribute meaningful to the development of the economy. The system gives home users wireless control over the house hold lighting systems, ventilation systems and the home main gate using an application running on an android smart phone. It also provides the user with an up to date temperature reading of the surrounding and the energy consumed by the device in the house. A centralized controller was developed around PIC 18F4550 microcontroller to handle the data acquisition and processing for the system. The overall system performance was demonstrated in controlling lamps, fans and gate of a prototyped one bedroom flat and confirmed the success of the design.**

Keywords —Android, Wi-Fi, Inclusive development, Smart Home, Energy Measurement, Microcontroller

I. INTRODUCTION

There is an increasing acceleration toward the Internet of Things (IoT) trend, where everything is becoming smarter by using information and communication technology (ICT). An ordinary card becomes smart card when a chip is embedded in it. A card reader also becomes smart card reader just because it reads a smart card. Smartphone evolved from mobile phones which in turn derived from a fixed line telephone technology. This technological trend have the effect of making the home smarter. Modern home are gradually shifting from the use of distributed switches to acentralized switching system that is based on wireless communications technology. This trend will significantly reduce the inconveniences associated withdistributed switches located in different areas of the home. This is especially beneficial for persons with special needs such as the elderly or physically challenge persons. Invariably, smart home technology provides a simple solution for improving the home and enhancing convenience and productivity. Smart homes have been defined as the incorporation of technology and services via home networking for improving quality of life[1]. Smart homesare realized by the deploying a network of sensors,

actuators, biomedical monitors and other monitoring systems coupled with special wireless and wired system. These devices and systems gives residents the ability to program, manage, and operate various home systems such lighting systems, ventilation systems, electrical appliances and other household installations. The monitoring devices and systems are usually small and can be wearable or installed anywhere around the home.

Smart home technology is not only envisioned for luxury and *technological sophistication*, rather it is primarily a system that provides *inclusiveness* for persons with special needs like the elderly and the physically challenged individuals. According to the World Health Organization (WHO),around 785 million persons aged 15 years and older live with disability[2].A substantial number of these individuals; about 110 million (14%)have significant difficulties in effectively performing their daily activities. A similar report by the Population Division of United Nations indicates that approximately 10% of the World's population is older than 60 years and it is empirically predicated that this figure will reach upto 21% by 2050[3]. This pervasive and unprecedented ageing trend has an enduring and profound implications for different aspects of human life. Smart technologies are promising platforms for improving life and productivity, thereby mitigating the challenges of aging and disability. The application of the smart home system is open ended and only limited by human imagination [4]. Nevertheless, the major application areas include the elderly home care, improving energy efficiency and demand-side management, enhancing comfort and safety of homes and so on. Smart homes obviously have the ability to make life easier and more convenient as well as improve productivity. It is also a means of ensuring energy efficiency and savings. For example sensor networks based onZ-Wave and ZigBee can be used to place some devices on *sleepmode* which reduces their functionality and consequently their power consumption until wake up commands are given. Smart home adjust the home to suit our needs in response to a more efficient lifestyles. For example, lights can be automatically turned off when a person leaves the room, and rooms can be cooled or heated depending on who is there at any given moment. This adjustment of the home translates into lower electric bills in a pre-defined manner. The conveniences of smart home technology promises tremendous benefits for an elderly person living alone, which oftentimes is the case.Because of the versatility of its areas of application and

increase in the usage of the smartphone, smart home systems has drawn the attention of many researchers and companies. For instance,[5], [6]presented Bluetooth based home automation systems using Android Smartphones connected directly to a bluetooth sub-controller. However, the bluetooth technology does not provide a means of iinternetcontrollability. Home devices were physically connected to a Bluetooth sub-controller which is then accessed and controlled by the Smartphone using built-in Bluetooth connectivity. Bluetooth is also limited to short distance and the system can only be paired with one device at a time. Also in[7], a Wi-Fi based approach was used. It consists of hardware interface modules, a micro Web-server based on Arduino Ethernet and an Android compatible Smartphone application. Our contribution is the design of an Android based smart home system from scratch that will be more flexible and cost effective. A Wi-Fi access point infrastructure is usedto integrate internet controllability of the home.

II. SYSTEM DESCRIPTION

The overall system consist of a sensors unit, actuators unit and main controller unit. Fig. 1. Shows the functional block diagram of the system. User interface is provided by an application installed on an android smartphone through which commands can be issued by the end user.These commands are converted into "GET /" request by the android application and send through Wi-Fi connection to the smart home controller with the aid of Wi-Fi Module.The controller process the received command and act upon the request. This request can be switching ON/OFF load, reading the ambient temperature, opening/closing the house gate, or reading the energy consumed by the home. After processing the request, a feedback in form of JavaScript Object Notation (JSON) is generated by the controller and transmitted back to the android application via the same link. Upon receiving the feedback, the application update or populate the user interface.

III. HARDWARE ASPECT

The controller unit consist of PIC18F4550 microcontroller and a Wi-Fi Module. The module is made up from MCW1001 TCP Stack and MRF24WB0BA wireless chip. This section is subdivided into home automation and energy metering system. Communication between the smart home system and the android smart phone is achieved via an Access Point or a router. Home automation involves the incorporation of intelligence into various electrical and electronic devices to better fulfill several functions in the house for the well-being of the householders. Example of systems that can be automated are ventilation systems, cooking machines, air conditioners and heaters, refrigerators, thermometers, lighting system, security cameras,

power outlets, energy meters, smoke and sound detectors, televisions, game consoles and other entertainment devices, doors and windows controllers, etc. The intelligent functions can be realized by using sensors and actuators.
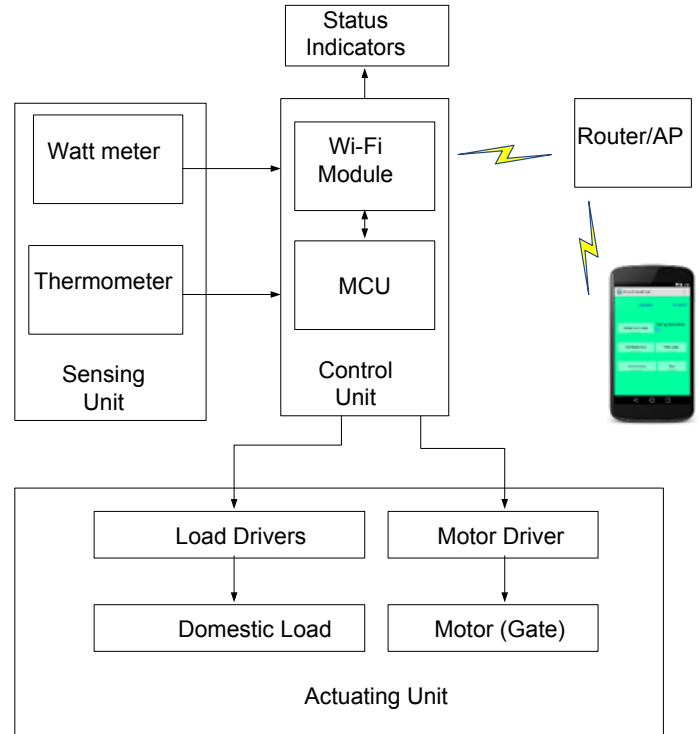
Fig. 1 System functional Block Diagram

A. Lighting and ventilation system

In this paper four lamps and one fan are used as lighting and ventilation respectively. They are statically switched using TRIACs. The speed of the fan is controlled using Pulse Width Modulation (PWM).Fig. 2 shows the circuit diagram of the load drivers.
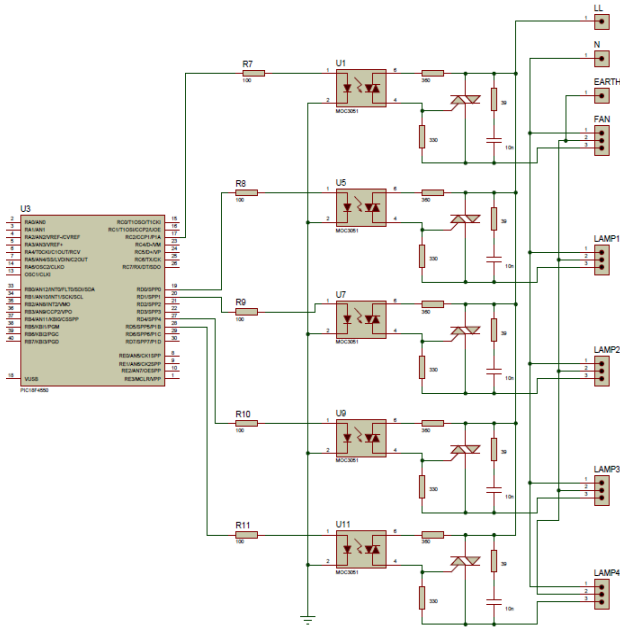
Fig. 2. Domestic Load Drivers

B. Temperature sensing unit

The surrounding ambient temperature was measured using a digital thermometer (DS18B20) and the readings are transmitted to the microcontroller via one wire communication (I^2C) technology. The microcontroller compute the temperature and include it in the JSON file any time a GET request is made. The circuit of Fig. 3 shows how the sensor was interfaced with microcontroller.
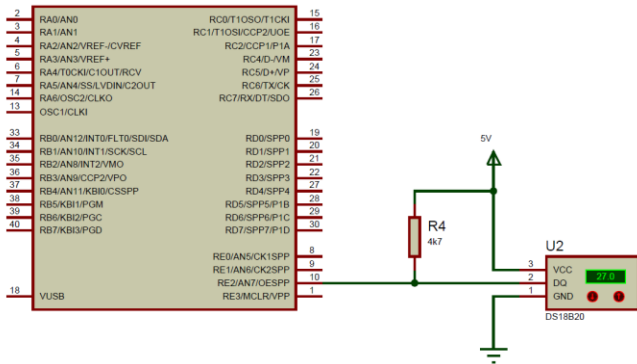
Fig. 3 Temperature sensor.

C. Gate controller

The house main gate is operated using H-Bridge driver which drive the motor either open or close based on the user input. Two limit switches were used to interrupt the supply when the gate is fully opened or closed. This is illustrated in Figure 4.0.
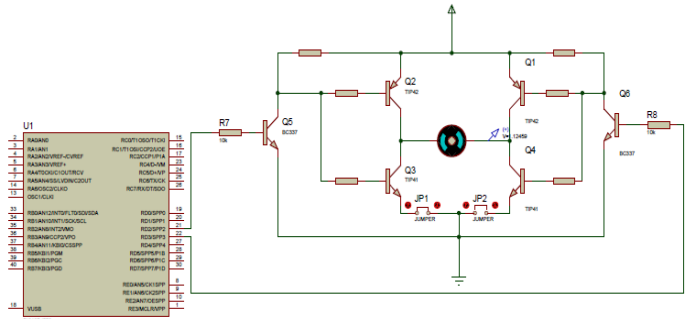
Fig. 4 H-Bridge Motor Driver

D. Energy Metering System

This portion of the smart home measures the energy consumed by the home. It consist of a voltage and current sensing component. Hall Effect sensor and opto-couplers were used to measure the current consumed by the load and voltage level respectively. This analog parameters are converted into digital using the in-build Analog to Digital Converter (ADC) of the microcontroller. The ADCs are sampled every one second. The calibrated digital values are multiplied to give the power consumed. Energy consumed is obtain by multiplying thepower by number of seconds and stored in the EEPROM of the microcontroller the equation 1 below shows how the energy usage isupdated.

$$E_{new\_value} = E_{old\_value} + ivt \qquad (1)$$

Where E_{new_value} represent the value to be store in the EEPROM, E_{old_value} is the previously stored value from EEPROM and i, v and t are the instantaneous current, voltage and number of seconds respectively.Timing was achieved using internal timer module of the microcontroller. Refer to Fig. 5 for the circuit diagram
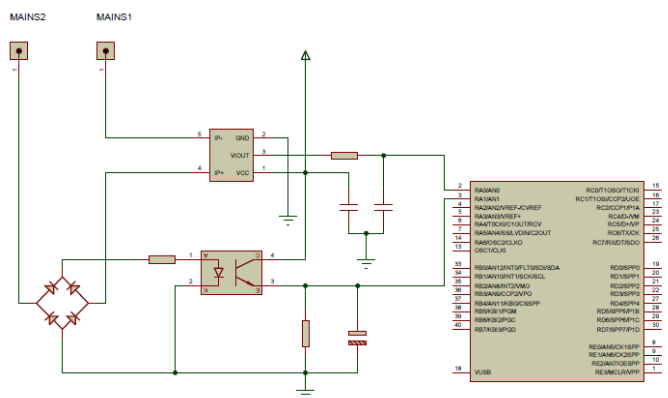
Fig. 5 Watt Meter

IV. MICROCONTROLLER PROGRAM AND SMART HOME
ADBROID APP

The controller unit consist of microcontroller which required a program to function. The program can be written in various programming languages like Assembly, C, BASIC and others.The flowchart shown in Fig.8 represents the program flow of the smart home. The microcontroller initialize the Wi-Fi module to scan for a specified access point or router and connect to it after authentication is made. It also store the state of the loads and sensors in EEPROM after executing a request.
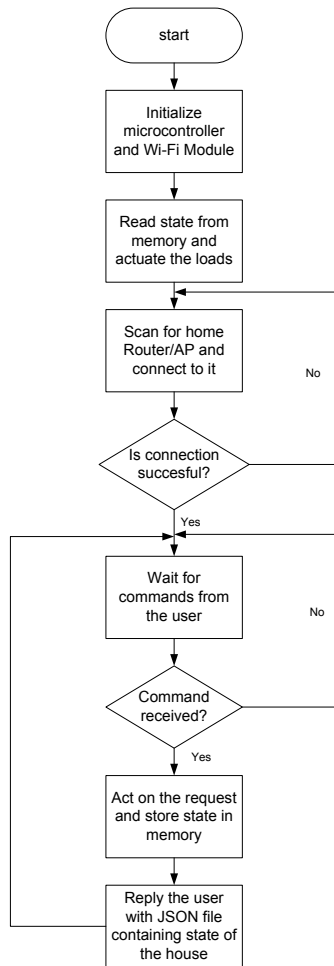
Fig. 6 Program Flow Chart

The stored state will always be loaded whenever the system is powered on. Command from the android application is made upof GET request as explained below.

$$GET \ /x = y$$

Where x represents a load while y is the state of the load.For example, a, b, c, d, e, and f represent fan, Lamp1, lamp2, lamp3, lamp4 and gate respectively. The State of each load is represented by either 0 or 1 for the lamps and 0, 1, 2, 3, for the

fan. The following is the content of the JSON file replied by the controller to the android application.

{"SmartHome":[{"name":"fan","value":"0"},{"name":"lamp 1","value":"1"},{"name":"lamp2","value":"0"},{"name":"lamp3 ","value":"0"},{"name":"lamp4","value":"0"},{"name":"energy" ,"value":"0032"},{"name":"temp","value":"00546"},{"name":"g ate","value":"0"}]}

Android is an open source software stack for mobile devices that includes an operating system, middleware, and key applications. The android platform consist of several wireless connectivity options including Wi-Fi, Bluetooth, and wireless data over a cellular connection. It also provide a wide range of useful tools and libraries that can be used to build rich applications.The Android software development process consist of a number of steps for creating applications for the Android operating system. Applications are usually developed in Java programming language using the Android software development kit (SDK), but other development environments are also available. Android applications are built as a combination of different components that can be invoked individually. For instance, the main activity of Fig. 7 provides a single screen for user interface to other components. Services for various componentsindependently performs various functions in the background.Fig. 7 shows the use cases diagram of the smart home application for this work.
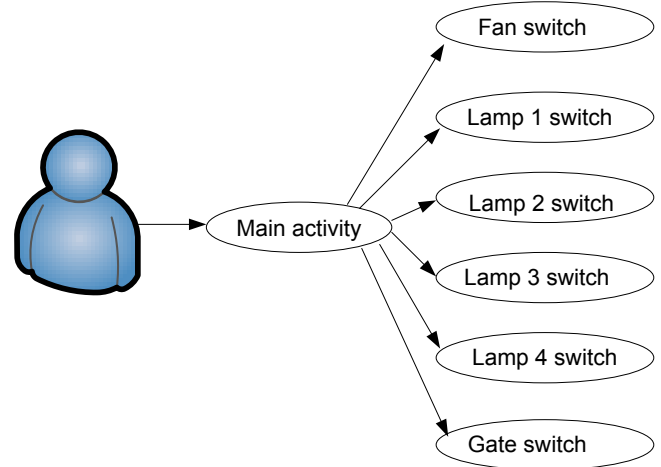
Fig. 7 Use Case Diagram

Theapp was developed using Android Studio. It contains a Seek Bar that is used to control the fan, Toggle Buttons for Lamps and gate control and two labels for displaying the temperature and energy consumed by the house. Fig. 8 shows the snap shot of the application user interface.
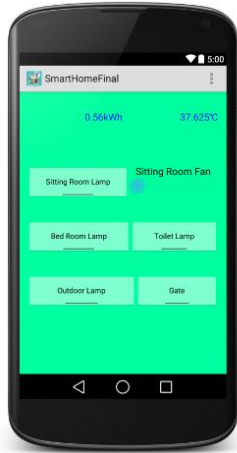
Fig. 8 Smart Home app

V. CONCLUSION

Generally, mobile applications can be used to improve productivity. For physically challenged and elderly individuals in particular, it is a veritable platform for significant contribution to the work force of the economy. This will help leverage the experience of professionals who are constrained by age or disability by incorporating convenience that enhance productivity into their working environment and homes. In this work an android based platform for enhanced convenience and productivity was developed. Additionally, the system gives the ambient temperature of a desired location in the home, to serve as an environmental safety indicator. The system also updates the user on the energy consumption of the home. This will facilitate demand-side management which is beneficial for both the user and the electricity utility company.

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COMFORT ANALYSIS OF COMMERCIAL MOTORCYCLISTS USING PROTECTIVE HELMETS OPERATING IN OGBOMOSO, OYO STATE, NIGERIA.

Onawumi, A. Samuel,
Oyawale F. A.
Dunmade, I. S
Ajayi, O. Oluseyi
Mechanical Engineering Department
Covenant University,
Ota. Nigeria
ayodele.onawumi@covenantuniversity.edu.ng
festus.oyawale@covenantuniversity.edu.ng,
israel.dunmade@covenantuniversity.edu.ng
oluseyi.ajayi@covenantuniversity.edu.ng

Obasanya, O. O
Mechanical Engineering Department,
Ladoke Akintola University of Technology,
Ogbomoso, Nigeria
olas_exambook@yahoo.com

Abstract: Wearing Personal protection gear primarily for safety is a basic requirement in riding two-wheel vehicles with Helmet being the most important of them. The continuing avoidance of the use of helmet among Nigerian motorcycle riders calls for investigative studies on its user friendliness and sustainability. This study investigates the effect of available makes of helmet on riders' comfort, safety and attitude towards the use of the protective gear in the study area. Five nodal points were identified for testing of temperature change with time of riding business and the effect on performance and riding behaviour. Riders' awareness of safety rule and level of compliance were investigated. Unavailability of adequate variety of helmet and attitudinal challenges were observed to have significant effect on the safety and performance of business riders of motorcycle in Nigeria. Development of effective anthropometry database was suggested for the design and production adequate

Key word: Personal protective gear, comfort, nodal points, heat, attitude

I. INTRODUCTION (*HEADING 1*)

Human head has been identified as the most delicate and highly exposed part of human body Consequently vivid efforts were made by research into the area of motorcycle accident and specifically on the effectiveness of helmets in some developed countries (Lawrence *et al*. 2002, Liu *et al*. 2008). The impact of such research was reflected in the quality standard established for design of helmets. The possibility of cyclist involved in auto-crash to be killed is higher compared with operators of other road vehicles. Unlike in advanced countries where standards were developed most of the income countries have little or no legislation on the operation and safety of motorcycles (EEVC, 1993). Protective wears prescribed for safety of motorcycle riders includes helmet, motorcycle jacket, gloves, pants, boots or other heavy boots. Helmet remains the most important head gear that any cyclist is expected to wear Motor-cycles are one of the most popular transportation modes in Nigeria. The total number of registered motorcycles in Nigeria was 31.11 % of the total stock of registered vehicles in the year 2005 and the number keeps increasing every year. Also motorcycles were found to account for one out of every four vehicles involved in crashes in Nigeria. (Arosanyin *et al* 2012). The comfort of motorcyclists has not drawn much public attention in Nigeria until a few years ago, when the frequency of motorcycles' accident became high. Helmet design that would be acceptable by large percentile user population remain a serious challenge as a result of so many factors that require attention and particular consideration such as the anthropometrics of head which determines the shape, size and style of the helmet, safety and comfort demand of individual users and other work related psychosocial factors. The market situation particularly in the U.S. where there are mandatory helmet laws depict that helmets comes in large varieties with divergent variation in protective/comfort attributes which create much task in search, choice and availability of fitting helmet. It has been

reported that wearing helmets reduces air-flow around the head and leads to an increase in heat-related stress as a result of the temperature distribution between the head and helmet liner (Pang, *et al* 2011). This internal heat generated between the head and helmet liner results in a state of discomfort for the rider. Poor quality helmet often exposes the rider to motorcycle related head injury when there is a fatal accident (Lee *et al* 2010, NHSTA, 1996). There is a popular resentment of cyclist and commuters to wearing of helmet in low income countries because of its perceived negative effect on riders' security and performance (Muhamad, 2011). With the increasing economic and cost of injury record relating to motorcycle riding worldwide, a study comfort of cyclist using helmet will be highly needful considering the ineffectiveness of mandatory helmet laws in Nigeria.

A. *Nigerian Motorcyclist and Challenged Attitude to wearing of Helmet*

While it is widely accepted that use of helmet is essential when riding motorcycle to prevent head injury and fatality due to motorcycle crash, the attitude of riders towards this safety practice is still far from expectation and highly discouraging particularly in Nigeria. A study of motorcycle crash characteristics in Lagos Nigeria by Oni et al (2011) revealed only 12.4 % of the motorcyclist use helmet while driving and Ogunmodede et al (2012) found that 33 % of riders of motorcycles in Oyo state used crash helmet while a study conducted on riders in the north-central of Nigeria informed that none of the motorcyclist used crash helmet (Nwadiaro et al, 2011). Onawumi and Oyawale (2016) and Akinlade and Brieger, (2004) recognised the contributions of Federal Road Safety Commission (FRSC) of Nigeria in the enforcement of road worthiness of motorcycle and safety rules and regulation on motorist in Nigeria. Still the disgusting feeling of riders to use of crash helmet call for further psychosocial study of the rider's attitude towards this safety requirement. Likewise, the incessant and almost generally poor attitude suggest implicitly that user comfort must have been challenged by the available crash helmet.

B. *Human Physiology and Helmet Design*

The skin covering head has several veins and arteries having sensitive functions which are to be performed at specific body and environmental conditions. Specific among the arteries and veins under the cover of helmet are Pariental emissary vein, zygomaticoobital artery, frontal branch of supervisial temporal artery and vein, parental branch of supervisial temoporal artery and vein, supraorbital artery and vein and supratrochelear artery and vein. (Merriam-Webster, 2016).

Human skull is an important, complex and very sensitive part of human skeletal system. It is a bony structure consisting of twenty-two bone arranged into eight cranial bones and fourteen facial bones which among many other functions provide needed protection for human brain in other to prevent injury, protect and support the sense organs resident in the head region, store calcium and regulate the endocrine. Human brain regulates and controls volume of human activities including the control of central and peripheral nervous systems. The temperature for human body temperature is regulated by hypothalamus in the brain with its limit at 2.05^{o}C. A serious hazard that a motorcycle rider is susceptible to when accident occur is head injury which affects the brain and if fatal may lead to brain damage or death. Susceptibility of human head to head injury has been found to vary with sex and age with men being more prone to the hazard than women. The effectiveness of helmet to protect wearer from injury is called to question when its material, shape and other design qualities fail to match human musculoskeletal requirements. This may have been a reason for non-compliance of motor cycle riders with road traffic law relating to wearing of helmet is a strong tendency among motor cycle riders.

In this study the response of riders to heat induced by the helmet and resulting physical and psychological changes it introduced were investigated using commercial motorcyclists in Ogbomoso Southwestern Nigeria as subject The temperature distributions on the head of the rider and body temperature of the motorcycle rider were obtained and analyzed. The helmets design for specific user population in a particular geographical location could make a lot of difference which affects the effectiveness, reliability and comfortability of the safety wear.

The effect of heat on the head has been studied by researchers and was found to be adverse on people exposed to the scourge of the heat for a long time. The head temperature increases exponentially in response to the long exposure to fixed afternoon temperature. Human body effectively regulate temperature to maximum of 36.81 ^{O}C even as the ambient temperature increased to 42 ^{O}C which lay credence to human warm bloodedness. The homoeothermic nature could have ceased in the case of rider wearing helmet as he operates the with the vehicle in the scourge of heat form sunlight.

II. Materials and Method

Two prominent models of helmets used in Ogbomoso Southwestern Nigeria (Skyo Serpent and JC Yoli Helmets) were considered for this study. Calibrated data-logging five channels temperature measuring device was used to measure the temperature changes with each channel attached to each of the five nodal points on the head of the test subject as presented in Table 1. Helmet was securely fixed on the subject's head with the probes on and the meter firmly stuck to the waist while the subject is engaged with the ridding of the motorcycle. Data were obtained in triplicate to obtain the representative values for temperature (^{o}C) and duration (minute) gradient at varying hour of the work day. The subject used in this study was certified to be healthy and do not surfer from and any known medical

challenge. Thermal responses of the subject were taken for each of the helmet separately and analysed.

The temperature of the motor-cyclist was taken and recorded at every interval of 30 minutes for a cycle of 180 minutes. The body temperature of the motor-cyclist was taken before the start of the experiment and further measured at 30minutes interval along with the measurement of the subject's head temperature. Student t-test of paired samples was used to compare difference between nodal /sensor locations after 30 minutes of conducting the experiment at significant level, $\alpha = 0.05$. The subjects whose means of livelihood is business riding of motorcycle was informed of the study and with his consent was dressed up in the study attire typical of his usual day job wears with helmet and the data logged five-channel temperature measuring devise. The instrument has removable data storage card (memory card) where recorded data were store and save appropriately for further analysis. Each subject wore a helmet at a time in order to keep separate record of human responses to heat. The study was carried out between the hours of 12noon and 3:00pm. A time when heat from the sunshine reached its peak.

Table 1: Nodal Description of Test Subject

Nodes	Description of Location on Human Skull (Merriam-Webster)	
	Bone	Muscle
1	Occipital bone	Occipitalis
2	Sphenoid bone	Temporalis
3	Parietal bone	Cranial aponeurosis
4	Frontal bone	Frontalis
5	Temporal bone	Temporalis

Figure 1: The Measurement of Temperature Distribution on Motorcyclist Head.

III. Results and Discursion

The variation of heat on subject's head having the helmet on with time while carrying out normal day job for a duration of 2hr 20minutes (between the hour of 12:00 and 14:30) with the probes placed on each of the segments on the skull is present in figure 2. The temperature of the heat produced on the wearer of skyo serpent is consistently higher than that of JC Yoli in all the five points where the channels were located. This suggests significant level of discomfort as the temperature reached 41.9 ^{o}C, The variation of temperature with location is also revealing

for each of the helmet used by the rider. The temperature at parietal bone (upper rear of the skull) increases at highest rate for both make of helmet considered.

A. Average Head Temperature Variations

The temperature on the head of motor-cyclist with the two helmets firmly secured increases progressively as the working time of operation increases and on average the temperature for the two helmets investigated increased between 0.1 – 0.4 ^{o}C for Skyo Serpent above JC Yoli Helmet. Normal body temperature of healthy adult ranges between 36.5 and 37.5 degree C. A wider range of normal temperature as reveled in literature is 33.2 – 38.2 ^{o}C. The head temperature variation on the average range between 36.3 – 42.37 and 38.1 – 41.1 for riders wearing Skyo Serpent and JC Yoli respectively (figure 2f). This is indicative of the pressure placed on hypothalamus and possible consequential increase in brain temperature with minimum and maximum differences for wearer of Skyo Serpent and JC Yoli (3.1, 4.17) and (2.9, 3.9) degrees C respectively. Though helmets are observed to constitute unsafe condition JC Yoli shows a near acceptable range hence making it preferable to Skyo Serpent helmet. The obvious implication is the irrational and irritable behaviour of riders exposed to excessive scourge of heat from sunlight as brain may fail to effectively regulate certain human behavioural activity.

The result of interview conducted on the motorcyclists using the two common helmets informed that the subjects using Skyo Serpent Helmet which typically lacked internal foam padding experienced high degree of discomfort when compared with users of JC Yoli Helmet which has internal foam padding with other accessories. This implies more discomfort is experienced by the user of Skyo serpent which could result in fatal accident experience resulting from the significantly high temperature stresses. Body temperature of the commercial motorcyclist increases as work duration increases. The body temperature when the rider was covered with Skyo Serpent is higher than JC Yoli helmet. The selected helmets, one (JC Yoli) represent the full faced type and the other (Skyo Serpent) represent half covered type. JC Yoli covers whole head leaving only the eyes area open, while the Skyo Serpent cover only the skull leaving the eye, nose, ear and mouth open.

B. Average Head Modelling

The resulting heat produced on the skull of the subject wearing Skyo serpent and JC Yoli helmets were used to develop a model as shown in figures 3 and 4 respectively. The models gave a relationship between the temperature on the skull and duration of operation of motorcycle with $(R_{skyo})^2 = 0.9962$ and $(R_{JC})^2 = 0.9988$.

The models are presented in equations 1 and 2:

$$T_{skyo} = -0.0001t^2 + 0.0496t + 37.38 \qquad 1$$

$$T_{JC\ Yoli} = -0.0002t^2 + 0.0535t + 36.852 \qquad 2$$

Where: T = Temperature in degree C and t = Duration in minutes.
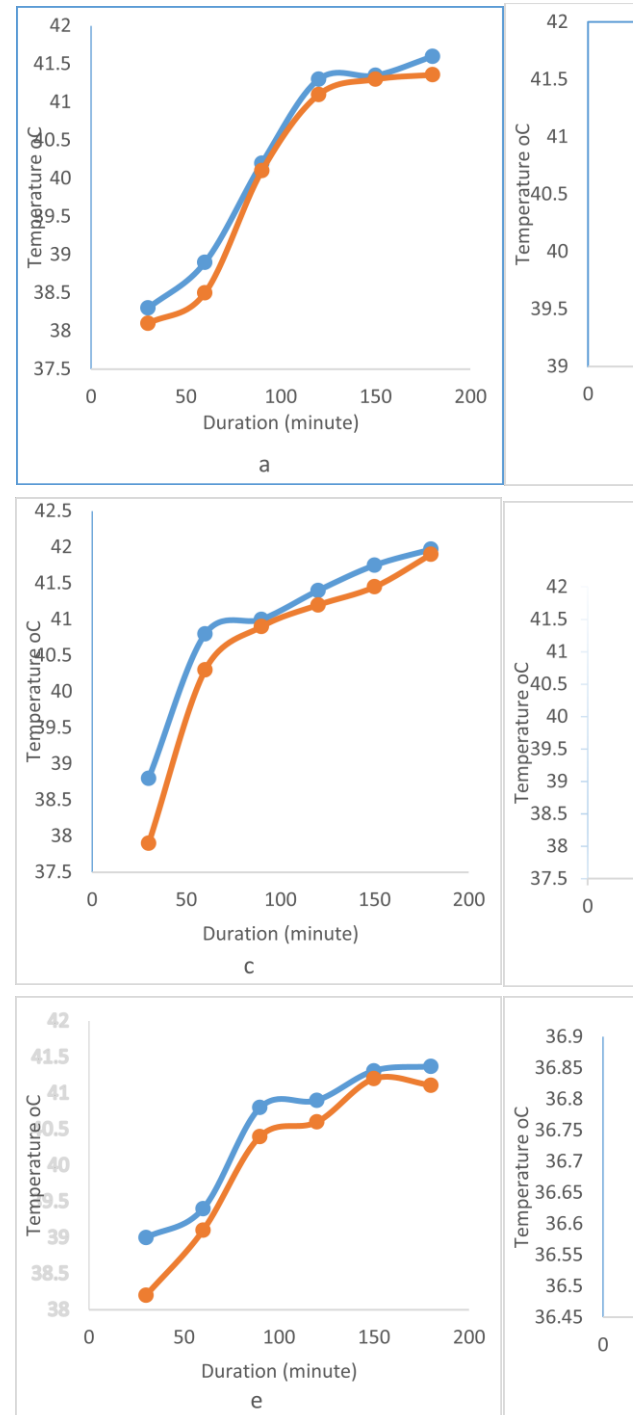
Figure 2: Skull Temperature of Motor-cyclist wearing Skyo Serpent ▬
probe located on   a: Occipital bone,   b: Sphenoid bone. c: Parietal bor
f: Body
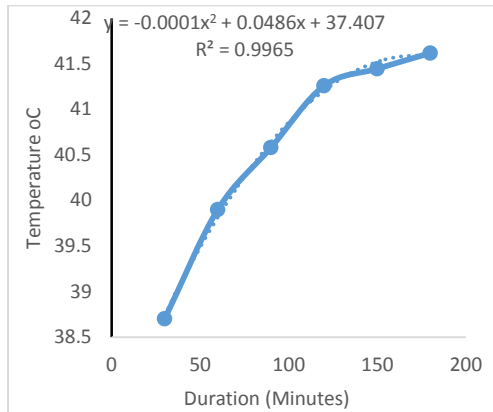
Figure 3: Average Skull Temperature of Motorcyclist wearing Skyo Serpent
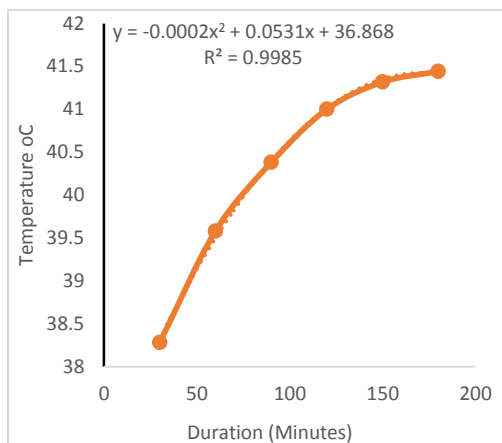
Figure 4: Average Skull Temperature of Motorcyclist wearing JC Yoli Helmets

IV. Conclusions

The degree of discomfort experienced by motor-cyclists differs and largely depends on the type of helmets used and the working hours. With the five channels temperature device equipped with the selected helmets, on average, the head temperature increased between 0.1 – 0.4 $^{\circ}$C for Skyo Serpent above JC Yoli Helmet. This increment pose a danger on the comfort of motor-cyclist, as it can leads to high degree of discomfort for the rider.

Recommendation

The need for design of safer and ergonomically suitable helmet for cyclist in equatorial and tropical region of Nigeria becomes inevitable as the existing helmets have failed to provide sufficient vents that could reduce accumulation of heat which consequently lead to the irritable feelings of the users. Continuous education of motorcyclists on safety issues and licensing of riders for the categories of either public or private use of motorcycle to enhance correct attitude towards the use of helmet.

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Technology Acquisition and Productivity among Nigerian Firms

Adekemi J. Oluwadare
Science Policy Research and Innovation Studies
National Centre for Technology Management,
Ile-Ife, Nigeria
adekemijessica@gmail.com (corresponding e-mail)

Olufemi Obembe and David O. Olayungbo
Department of Economics
Obafemi Awolowo University,
Ile-Ife, Nigeria.
f_obembe@yahoo.com, doolayungbo@oauife.edu.ng

Abstract – **This study examines the statistical relationship between technology acquisition and productivity in Nigerian firms. The role of technology in firm operations has been well explored in developed economies, but little evidence exists in the developing country context, especially in Nigeria. Technology acquisition, broadly described as a process in which firms obtain technology from both internal and external sources, is measured in this study as the sum of expenditure on R&D, royalty payments and technical/license fees. The Cobb-Douglas production function is modeled with acquired technology as an input into the production process. Output, capital and labour included in the productivity equation are measured by turnover, fixed assets and labour cost, respectively. Data was obtained from the published annual reports and accounts of selected manufacturing firms listed on the Nigerian Stock Exchange between 2001 and 2013. The firms are distributed across approximately eight sectors and the dominant ones are firms in the consumer goods, industrial goods and healthcare sectors. The data obtained was analysed using the Arellano and Bond Generalized Method of Moments (GMM) technique which is known to address problems of endogeneity. The GMM estimates obtained indicate a negative and insignificant relationship between technology acquisition and productivity in Nigerian firms. This was against the apriori expectation. This provides evidence that foreign-sourced technology negatively impacts on economic development in the country and might indicate that the technology acquisition/transfer processes in the country do not incorporate the development of internal absorptive capacity. Policy recommendations provided in this study include designing industrial policies in Nigeria to ensure effective technology acquisition/transfer processes and to develop and promote the use of indigenous technology in the private sector.**

Keywords–Technology Acquisition; Productivity; Firms; Nigeria; GMM

I. INTRODUCTION

In today's knowledge-driven society, technology plays a central role in real economic growth and development. Technology constitutes the totality of the use and application of knowledge, skills, tools, and materials for the well-being of man. The application of science and technology to manufacturing activities led to the scientific and industrial revolutions in the 17th and 18th century, respectively. Technology has since been driving industrial activities and technological innovation is right at the centre of economic growth. Much of modern growth theory was developed at a time when economists began "to stress savings, investment, and capital accumulation as key drivers of gross national product levels and growth" [1]. Early economic contributions such as [2], illustrate how long-run economic growth depends on technical change. Scholarly contributions to the endogenous growth theory reveal that a consistent increase in economic growth is made possible by consistent investments in the creation of new technologies [3]. There is evidence that growth in traditional factors of production such as capital and labour explain less than half of productivity growth in countries [4]; the 'residual' is ascribed to technical change. According to [5], technology adoption and adaptation is fundamental to increasing productivity in developing countries. Technical change has the benefit of increasing firm efficiency, improving the quality of goods and services, increasing consumer demand as well as reducing costs of production [4]. Companies hence seek to introduce technology into their production process, and this can be done by either developing the technology internally or by buying new technologies from external sources. Firm-level technical change is driven by increases in the firm's knowledge base through successive knowledge-enhancing investments by the company [6].

Technology acquisition, broadly described as a process in which firms buy technology from external sources, provides a host of benefits to companies, ranging from the development of new products, to gaining entrance into new markets. Acquiring knowledge and technology involves adopting and adapting knowledge externally (e.g. through an open trading regime, foreign investment, and licensing agreements), as well as creating knowledge internally through research and development [7]. Three major means of acquiring technology include research and development (R&D), technology transfer and technology adoption [8]. The exploitation of technology in production and firm operations is motivated by different factors which include satisfying consumer needs, improving export potential, gaining competitive edge in the market and entering into new markets. To do this, firms in Nigeria, like in many other developing countries, rely on existing technology in the developed economies which is acquired through direct purchase of technological equipment, technical support agreement and technology licensing [9]. There are however,

many underlying factors to ensure that firms effectively exploit foreign technology, and the factor most importantly identified in the literature is the absorptive capacity of the firms, which is further strengthened by the capacity to conduct R&D. This has motivated a lot of recent studies examining the local absorptive capacities of Nigerian firms.

The rise of the knowledge-based economy is an indication that economies are now growing with respect to their exploitation of knowledge and technology rather than just possession of natural resources; it is important for Nigeria to follow this growth path. Furthermore, the private sector plays an important role in enhancing economic growth and development and a burgeoning private sector is hugely dependent on technological progress and innovations. Global competition and trade is now the case of industrialized economies striving to retain their technology and innovation lead; emerging economies seeking to catch up; and less developed economies initiating measures to promote industrialization and structural change [10]. In reality, the catching up process of developing economies will require a great deal of efforts as advanced economies continue to push knowledge frontiers forward. Given that the capability to set new knowledge frontiers by developing nations is low, most settle for the absorption and adaptation of already existing technologies. Technology is at the core of much of the activities of firms and it is a tool that forward-thinking governments employ in providing solutions to underdevelopment, unemployment and poverty. Acquiring technology from overseas plays an important role at early stages of economic development as much of the knowledge and technology required for innovative growth in developing countries will be foreign-sourced [11], [12]. Thus, "many developing countries largely benefit from importing readily available technologies from abroad to complement their technological capability" [13].

The primary objective of this study is to examine the impact of technology on productivity of Nigerian firms. The focus of this study is on non-financial firms in Nigeria which are listed on the Nigerian Stock Exchange (NSE) between 2001 and 2013. The study period was selected in order to allow for the use of more recent firm data; and listed firms were considered in order to ease the process of data collection. This study covers forty-two (42) firms and the data was extracted from the annual reports and accounts of the firms.

II. THE PROCESS OF TECHNOLOGY ACQUISITION

Firms engage in the process of technology acquisition by either adopting technology developed outside the firm, or engaging in internal R&D to develop own technology. With respect to the former, firms can adopt knowledge or technology embodied in purchased technologically sophisticated plant and equipment, intermediate and final goods imports, inward FDI, expatriate personnel, licensing and franchising [14]. R&D on the other hand, comprise "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" [15]. Thus, whether internal or external, R&D contributes significantly to firms' productivity growth as a source of new technologies and applications. However, for firms to maximize the benefits of sourcing technology externally, there must be a minimum level of absorptive capacity [8], which is the ability to learn and implement technologies and processes developed elsewhere [16]. For countries acquiring technology acquisition from abroad, there is further need for openness to trade, foreign direct investment and technology licensing. Therefore, improving the policy and business environments to create conditions favourable for international trade and to attract FDI has benefits for firms' technology acquisitions.

III. EVIDENCE FROM LITERATURE

This section presents evidence of the relationship between technology acquisition and productivity among firms. In examining what drives international and domestic technology transfer strategies of firms and the impact of these transfers on firms' productivity performance, [17] discovered that Flemish innovating firms engaging in international knowledge sourcing strategies record substantially and significantly higher productivity growth. Firms which combine foreign transfer strategies with local technology acquisition experience the largest impact. This suggests that "a diverse external technology strategy combining local technologies as well as know-how from abroad is most likely to improve firm performance". Reference [18] sought to determine the factors influencing total factor productivity (TFP) growth in Malaysia by analysing the TFP growth rate between 1971 and 2004. TFP grows when technological change is introduced or when existing technology and economic inputs are used more efficiently. For the test period, TFP growth in Malaysia was not encouraging due to negative contribution from technical efficiency. Growth in TFP attributable to innovative change only accounts for a small fraction of GDP per labour growth and so, growth may not be sustainable on a long-term basis. The author identified the needs of the Malaysian economy as including enhancement of productivity-based catching-up capability, increase in the number of skilled workers to operate sophisticated technology and the adoption of new technology.

In a study of high-tech Taiwan firms for the period 1994–2000, [19] provided evidence of a positive relationship between R&D expenditure and productivity growth. The results of the analyses revealed an estimate of R&D capital elasticity lying between 0.18 and 0.20, at the 1 percent significance level, showing that R&D has a significant impact on productivity growth in Taiwan manufacturing firms. Although the Schumpeterian hypothesis that the returns on R&D are an increasing function of firm size was tested, the study could not demonstrate that the impact of R&D on productivity growth is an increasing function of firm size. High-tech firms, by virtue of huge investments in R&D are able to create more value resulting from new product

development. The effect of R&D investment on firm productivity is thus stronger in high-tech firms than in other industrial firms. In a panel study analysis of 16 OECD countries, [20] provide evidence of the role of new technology in the improvement of the productivity of firms by estimating the contribution of technical change to productivity growth. The authors take into account, domestic business R&D, public R&D and foreign business R&D as major sources of new technology, and assess their impact on output growth. The results of their analysis reveal the importance of R&D investments on productivity and economic growth. Based on their study, the authors conclude that absorptive capacity is a basic requirement for benefiting from other countries' R&D. Overall, the study points to the importance of technology for economic growth, be it developed by business, by the public sector or coming from foreign sources.

Technological diversity no doubt exists among firms in Africa as proven by [21]. The productivity of firms across the five African nations (Ghana, Kenya, Nigeria, Tanzania, South Africa) studied by the authors differs significantly because of differences in returns to education and forms of technology employed. A major finding from their study is that the country location of a firm influences the technology adopted by such firm. This implies that African governments seeking to improve productivity in the private sector must provide the appropriate environment for firms to operate. In support of this, [22] shows that strengthening the manufacturing base of a country requires a certain level of education among the workforce. An investigation on the impact of technology investment on the export potential of firms in Southwest Nigeria by [9] shows that investments in technology are dominated by imported technologies, and are not directly targeted at improving the export potential of firms. Most of the firms make use of equipment that is largely foreign technology and no firm was observed to use a completely locally-fabricated production facility. It was also discovered that technology collaboration in the firms is largely in the form of technical support agreement and technology licensing. Export-motivated investments in technology only occurred in about 10% of the surveyed firms. Evidence is provided in the study by [23], that the adoption of Information and Communication Technology (ICT) in the Nigerian banking sector impacts positively on productivity, in terms of efficient operations, improved customer satisfaction, competitive advantage and records accuracy.

Economic growth theory in recent years, has witnessed a lot of research into the sources of productivity growth with scholars, policymakers, and the business press paying great attention to this subject [24]. Investment in factors of production such as labour and capital, together with the technical progress in industries has been identified as key contributors to productivity. Accelerating technical change has, in particular, been identified as the main source of permanent increases in productivity [25], whereas low levels of technology serves as an obstacle to productivity [26]. Hence, it

is expected that as firms invest in the acquisition of knowledge and technology, they experience increase in productivity.

IV. DESCRIPTION OF DATA AND VARIABLES

The data used in this study has panel/longitudinal characteristics. Panel data is widely used in estimating dynamic econometric models, and "its advantages over aggregate time series data is that panel data offers to investigate heterogeneity in adjustment dynamics between different types of individuals or firms, whereas time series data has the possibility that underlying microeconomic dynamics may be obscured by aggregation biases," [27]. The firms included in this study were limited to those in the manufacturing sectors. As a result, firms listed on the Nigerian Stock Exchange (NSE) as service and financial service firms are not included in the data. Publicly quoted firms on the NSE are used in this study in order to aid accessibility to their financial reports and other information. At the time of data collection (March 2015), there were 112 manufacturing firms listed on the NSE and 42 (37.5%) were selected, cutting across the consumer goods, industrial goods, pharmaceutical, oil and gas, construction/real estate and agricultural sectors. The data for each variable used in this study was extracted from the annual reports and accounts of the selected firms; therefore, the accessibility to annual reports for the years 2001 to 2013 determined which firm would be included in the study. Distribution of the sampled firms according to sector of activity is presented in Table I.

Technology acquisition is measured as the sum of firms' expenditure on R&D, royalty payments and technical/license fees. R&D expenditure is the amount spent on research projects in a given year; royalties are paid for access to the use of patents, trademarks/brands and inventions; technical/license fees are paid for the provision of technological, scientific and professional assistance for product manufacture. Output, Labour and Capital in the Cobb-Douglas production function (1) are measured, respectively, by firm turnover, wages and fixed assets.

V. MODEL SPECIFICATION

The model specification for this study examines the effect of technology acquisition on productivity, and is adapted from [28]. The first equation in the model is the standard Cobb-Douglas production function which is given as follows:

$$Y_{it} = L_{it}^{\beta L} K_{it}^{\beta K} A_{it} \qquad (1)$$

Where:

Y_{it} is output

L_{it} is labour

TABLE I.   SECTORIAL DISTRIBUTION OF FIRMS

Sector	Number of Firms	Percentage of Total

Consumer Goods	13	31
Industrial Goods	9	21
Health Care	7	17
Oil & Gas	5	12
Others*	8	19
Total	**42**	**100**

*Construction/Real Estate, Conglomerates, Agriculture, Natural Resources

K_{it} is capital

A_{it} is a measure of total factor productivity,

Subscript it indicates values for firm i in year t.

Equation (1) describes the relationship between a firm's output, and its capital stock, labour stock and the productivity of the technique employed. This equation is further transformed into a regression equation by taking logs of the variables and by introducing lagged values of the dependent variable with a weight denoted by λ, firm-specific effects (α_i) to allow for unobserved firm heterogeneity, and ε_{it} which is the error term and is assumed to be serially uncorrelated over time.

Equation (2) below is thus generated:

$$y_{it} = \lambda y_{(i,t-1)} + (1-\lambda)\beta_L l_{it} + (1-\lambda)\beta_K k_{it} + (1-\lambda)a_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

Where:

y_{it}, l_{it}, k_{it} and a_{it} denote logs of Y_{it}, L_{it}, K_{it} and A_{it}, respectively.

Taking first differences eliminates the firm fixed effect α_i and (2) becomes:

$$\Delta y_{it} = \lambda \Delta y_{(i,t-1)} + (1-\lambda)\beta_L \Delta l_{it} + (1-\lambda)\beta_K \Delta k_{it} + \Delta a_{it} + \Delta \varepsilon_{it} \quad (3)$$

The sources of productivity are specified by using the level of technology acquisition in year t-1 (p_{it-1}). Competition in year t-1 ($c_{i,t-1}$) is also included in the model as a source of productivity. This is in support of the work done by [29], which documents that competition has a positive and significant impact on productivity growth of Nigerian firms.

$$\Delta a_{it} = \beta_1 p_{(i,t-1)} + \beta_2 c_{(i,t-1)} + \gamma_1 g_{(i,t-1)} \quad (4)$$

g_{it-1} represents the lagged values of corporate governance, introduced as a control variable. Equations 3 and 4 represent the productivity growth model. This model also corresponds to the productivity growth model in [30].

VI. METHOD OF ESTIMATION AND RESULTS

A regression analysis is carried out to define the statistical relationship between technology and productivity. The [31]

Generalized Method of Moments (GMM) technique, known to address problems of endogeneity, is used in this study. Endogeneity is a major challenge in econometric analysis in much of social science studies, and can be caused by omitted variables, measurement error or simultaneity [32]. The problem of endogeneity is implied by the correlation of explanatory variable(s) with the error term, leading to biased estimates. Consistent estimates can however be obtained using the GMM technique which allows for valid instruments to be obtained in a dynamic panel data model [27], [33]. The use of instrumental variables helps to control for unobserved heterogeneity in the model. A good instrument is determined by its correlation with the key independent variable, and absence of correlation with the dependent variable [32]. Valid instruments are also expected to satisfy the condition of no correlation with the error term. To effectively estimate the model parameters, it is important to validate the instruments of the model by verifying the absence of serial correlation in the error term. This is because an "estimator that uses lags as instruments under the assumption of white noise errors would lose its consistency if in fact the errors were serially correlated" [31]. The Arellano-Bond test of autocorrelation and Sargan test of over-identifying restrictions are used to achieve this and are reported in the table below.

Table II shows the GMM estimates of the relationship between technology acquisition and productivity in the firms. Concerning the relationship between technology and productivity, the GMM estimates in the table do not support the apriori expectation of a positive relationship. The coefficient of expenditure on technology acquisition indicates a negative relationship with productivity. The model coefficient is negative (-0.051) and not significant at 0.05 or 0.10 levels. The result implies that a 1 percent increase in the level of technology acquisition decreases productivity by 5.1 percent. The results of the specification tests reveal the absence of serial correlation in the residuals and the validity of the instruments. The null hypothesis at the first-order serial correlation is rejected as Prob = 0.0301 < 0.05 while the null hypothesis is accepted at the second order given that Prob = 0.1694 > 0.05. The Sargan test of over-identifying restrictions shows the validity of the instruments with a probability value of 1.0000 > 0.05.

TABLE II.   THE IMPACT OF TECHNOLOGY ACQUISITION ON PRODUCTIVITY

SystemGMM Dynamic Panel – two-step results

Dependent Variable - Output Δy_{it}			
Independent Variables	Coefficients	Standard Error	P-Value
Lagged Dependent Variable ($\Delta y_{i,t-1}$)	-0.222	0.111	0.045*
Log of Labour (Δl_{it})	0.097	0.048	0.043*
Log of Capital (Δk_{it})	0.014	0.036	0.697
Corporate Governance ($g_{i,t-1}$)	0.298	1.434	0.835
Log of Expenditure on Technology ($p_{i,t-1}$)	-0.051	0.044	0.241
Competition ($c_{i,t-1}$)	0.088	0.248	0.723
Constant Term	0.521	0.808	0.519
Number of Observations:	308		
Number of Instruments:	137		
Specification Tests			
Arellano-Bond test for AR(1) in first differences [H0: There is no first-order serial correlation in residuals]	z = -2.1687 Prob > z = 0.0301		
Arellano-Bond test for AR(2) in first differences [H0: There is no second-order serial correlation in residuals]	z = -1.3742 Prob > z = 0.1694		
Sargan test of over-identifying restrictions [H0: Over-identifying restrictions are valid]	chi2(129) = 23.18872 Prob>chi2 = 1.0000		

* 0.05 level of significance

VII. DISCUSSION OF FINDINGS

The results reveal a negative relationship between technology acquisitions and productivity among Nigerian firms. A possible justification for this result could be that two components of technology acquisition (technical fees and royalty payments) by the firms are mostly foreign-sourced and may therefore not be tailor-made to the needs of the Nigerian economy. It was observed during the data collection process that expenditure on technology acquisition mostly comprises payments of fees to the parent companies of the firms. It can thus be inferred that the true nature of technology acquisition in Nigerian quoted firms may indeed be a source through which multinational firms transfer funds out of the country and not necessarily as a result of a demand to introduce innovative products. This study shows that imported technology negatively impacts on economic development in the country and also signifies the importance of indigenous technology in economic development. By implication, knowledge produced at the world technology frontier is not readily absorbable by the Nigerian economy, and thus necessitates modifications. Inferring from [34], trading with a country on the world technology frontier may show only a slightly positive effect on TFP growth, while leaving rates of innovation unaffected in developing economies. References [13], [5] and [12] posit that increasing productivity in developing countries via the adoption of foreign technologies requires the pre-condition that there is an internal ability to adapt the technologies to local conditions and that they are complementary to the technological capabilities of local firms; meanwhile, a study by [35], revealed that firms in Nigeria have low-level absorptive capacity. The lack of persistency in R&D can induce low productivity [36], while TFP growth can be stunted in spite of technological change when there is no 'productivity-based catching-up' capability in the acquiring country [18]. This study thus provides another instance where foreign acquired technology does not translate into increased productivity.

It can further be inferred from the findings in this study that firm productivity in Nigeria will be hindered by inappropriate technology investments. Knowledge acquisition in the sampled firms is largely embedded in patents and trademarks owned by foreign multinationals and there is no evidence of modifications to suit domestic needs. This means that the indigenous technological and knowledge base needs to be strengthened, as also affirmed by [37] in order to improve productivity growth. Free-riding on rich countries' technologies, in the presence of weak intellectual property regulations have the potential to limit radical R&D that can lead to innovative products and services, thereby limiting sustained productivity growth [38], [39]. Being a late developer in the technology game can give firms, industries and whole economies advantages, only if they understand how to capitalise on them [40]. For developing countries to successfully ride on the wings of developed countries on their path to development, [41] posit that they must transit from learning from FDI as an initial channel, to licensing and then to indigenous R&D.

VIII. CONCLUSION

The main aim of this study is to identify the nature of relationship between the acquisition of technology and productivity in Nigeria using data from firms listed on the Nigerian Stock Exchange. The contribution of this study is vital because not many studies have examined the impact of technology on firm performance in Nigeria. The GMM approach, known to effectively address problems of endogeneity in models, was used in the data analysis and the estimates showed a negative relationship between technology acquisition and productivity among Nigerian firms. This is contrary to many findings in the literature on the impact of technology on firm performance and has been explained to mean that the capacity to absorb the acquired technology may be low or non-existent in Nigerian firms. The results of this study indicate a need for further investigation into the channels of technology acquisition in Nigeria.

A better understanding of the relationship between technology and productivity will further aid in framing the right policies for the private sector in Nigeria. This study

provides evidence for policy makers that transfer of technology into the country needs to be deliberate and properly regulated. This implies that firms' technology acquisition processes will not produce desired national results if they are not tailored towards the unique needs of the economy. Also, if the investment and business climate in the country is not conducive, especially with respect to intellectual property (IP) rights protection, multinational firms will be forced to restrict R&D activities to their home country. This is because the effectiveness of the process of technology acquisition and development is guaranteed under an effective system of IP protection. Industrial policies should thus be designed to ensure effective technology acquisition and research and development activities in Nigerian firms. In particular, policies should be put in place to encourage firms to develop technological and innovative solutions which are specific to the Nigerian economy, and also to stimulate the growth of indigenous firms with significant local content in their production inputs, ensuring the exploitation of the nation's resources. Therefore, attention should be paid to the development of indigenous knowledge and domestic solutions in the economy, and also to the development of the absorptive capacity of Nigerian firms.

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Diversity and Inclusion Fosters Innovative Development in an Emerging Networked Society

Oladunni Aigbe
aanuegbedeyi@yahoo.com

Abstract - **A culture of diversity maximizes different perspectives, ideas, and personalities and takes advantage of inclusion; in order to tap into the prime of talent banks, thereby fostering innovation and attaining transformative value. This is driven by the eco system of the all advancing networked society which enables everyone, everything and everywhere to be connected in real time and impact on the way collaborations are done. It is an environment where different ideas, outlooks, and experiences brought to a sphere of influence are respected, irrespective of who brings it. It is a setting where individuals are able to uniquely fulfill their potentials whilst valuing, supporting and respecting differences. In the gender divide there is a disparity that does not enhance the value of the female gender and their contributions. Through varied efforts by organizations and pro-women societal bodies for gender parity; this has been on a continuous improvement road map amidst varied cultural, unconscious bias, etc challenges. These bodies foster the added value the female gender brings into the specific or related sphere influence and prove that the inclusivity of the female gender builds stronger, smarter, financially robust and productive teams. Inclusive engagement of all workforces especially the female workforce can improve a company's financial base, as diversity is maximized through a shared vision and value system, amidst differences in personalities and perspectives. Inclusion is a corporate responsibility for any trans-generational organization that wants to remain relevant and sustain its essence in a highly competitive environment. The Networked Society enhances the transformational power of ICT to spur socio-economic development, promote responsible career and business practices, as it takes advantage of diverse work place experiences that have an inclusive culture. This results in more connections, added communication, new functions and new behaviors. This would shape the future; create a positive heritage for generations ahead as the fundamentals of diversity and conscious inclusion continually form the building blocks for its sustainability.**

Keywords

Diversity, Inclusion, Innovation, Development, Networked Society

I. INTRODUCTION

The current digital revolution is constantly enforcing a change that is gaining a rapid adaptation by all, in the advancing connected village where almost anything is possible. The use of digital tools has become and is still becoming second nature and everyone everywhere is empowered to achieve diverse creative possibilities, engage across unlimited borders, change the way governments and industries function, solve issues that border on development, technology advancements etc. This has made the entire landscape more inclusive as diversity has also been embraced to accept this all continuous and advancing change.

ICT is now an integral part of our work and living environment, and will continually be a vital resource for business, government and the society at large. It will play a fundamental role in facilitating organizations of all sizes to collaboratively connect and compete more effectively.

Despite these, there are various factors, challenges, experiences and effects this has brought so far and is also anticipated for the future. Hence, it is beneficial to discover what these changes are and their value; how to minimize risks of errors in advancement and the approach for future development ensuring that the outputs are sustainable and trans generational.

In view of these, this paper is aimed not only at highlighting the status, successes, challenges, and issues that adapting diversity and an inclusive culture amidst a rapid advancing networked society entails but will highlight proven practical and sustainable methodological solutions.

This paper would kindle awareness, stir intelligent discussions and attract varied talent to enhance viable development in our continent.

II. DESCRIPTION OF CONCEPTS

A. Diversity

The definition of Diversity is broad, as it transcends beyond gender, nationality, progeny, ethnicity, religion, age and other factors, to also imply diverse personal experiences and proficiencies, family conditions, functional expertise, inherent skills, etc.

Diversity on a face value should be a divisive factor but if taken proper advantage of is actually a unifying one that draws people close together and stimulates the ability to make a significant difference. It maximizes personal strengths which are an integral of a unified strength which is a basis of the building blocks of any organization that desires to thrive sustainably.

Diverse teams have a range of perspectives, ideas and experiences which enhances creativity, as the power of each individual makes up the cohesive whole. It is about getting the

right fusion or mix. When a team is diverse in practice, the experiences, perspectives and ideas would normally make them outshine the homogenous ones. This is because, heterogeneous teams have more innovative business decisions which lead to excellent results and improved performance. Diversity is not a medium for competition within a team but rather an avenue to stimulate creative and excellent results. Diversity is a recipe for global achievements.

B. Inclusion

Inclusion confirms to us that each and every individual in the mix of employees, resources, team members, students, etc is valued, welcomed and is respected for the skills they bring and the contributions and impact they make. It entails valuing, supporting and respecting dissimilarities. It is about a work environment where each person is able to fulfill their potential and where their contribution is maximized. Inclusion also borders on making the most of gender, generational and cultural diversity to ensure respect and professionalism remain the long standing bed rock for sustainable development. Diverse inclusivity makes a team stronger and provides room for untapped ideas and innovative reasoning, to enhance the value of any task or assignment where it could have been naturally ignored due to cultural bias.

Inclusivity in this paper would emphasize on the female gender at all levels and the contributions that they bring to any team, organization or sphere of influence. Disparity in the gender divide is not only parity and social issue, but also a serious challenge to innovative inclusion and economic sustainability. Female gender inclusion on boards has the possibility to lead to improved ethical orientation, sustainability, corporate responsibility and greater corporate transparency. Joint intelligence of a group is strongly associated with the proportion of females in the group, making for smarter and more productive teams. Organizations that are willing to have gender parity with not a few numbers of women at all levels will outperform financially, actualize higher operating margins and market capitalization.

C. Networked Society

The Networked Society is where everyone, everything and everywhere will be connected in real time. It is envisioned by Ericsson (an Information and Communications Technology ICT company), to realize an ecosystem where everything that benefits from a connection will have one as widespread internet connectivity drives change for individuals and communities.

"When one person connects, their world changes; with everything connected, our world changes"[1].

In a world where five billion people are connected; mobility, broadband, and cloud are changing the pattern of society; digital transformation will disrupt business landscapes. This will spur creating new business value in this age of connectivity. It is therefore required to understand the changes that can help any group create new business value, and learn how to convert pressures and risks to opportunities in the age of connectivity.

As each one, everything and every location will be connected in real time, this will result in sustainable trans generational impact as innovation and collaboration will change.

The impact the connections in the Networked Society would have on the world is of prior importance than even the connections. It is about:

- new approaches to collaborate, share and get cognizant;

- ingenious ways of executing business that are creating productiveness in the public and private sectors;

- shaping the future jointly and acquire resolutions to some of the enormous challenges confronting our continent and the globe.

Taking a cue from the 'thought and technology leader' in this emerging networked society - Ericsson, it has been observed that the networked society necessitates taking on innovative new delivery models. Astute networks that are scalable and proffer superior performance are of the utmost importance. Using widespread broadband connectivity, VOIP and media companies are helping end users move above physical media to sociable, synergetic and always accessible networked adventure. The following points are instances:

- Endowed students and teachers are turning conventional pattern of education upside down;

- Entrepreneurs are starting up businesses on the Internet in under 30 minutes;

- About 2.5 billion "unbanked" persons around the globe are progressively gaining access to standard financial services.

Hans Vestberg, Ericsson President and CEO says

"We believe in a Networked Society, where connectivity will only be the starting point for new ways of innovating, collaborating and socializing."[1]

III. STATEMENT OF PROBLEM

The ICT industry has been traditionally male dominated and there are relatively low percentages of women with ICT-related degrees. To promote innovative development that is sustainable in Africa, the need for a diverse and inclusive networked society cannot be over emphasized. This would require a strategy that is aimed at education and proficiency so as to ensure the needed skills are developed to succeed within the team or organization's entire strategy, and develop a talent

acquisition and retention conduit for posterity. It enhances transparent inter communication and engagement to grow the art of inclusion where every person is appreciated; which results in innovation and business excellence. Here are some discussions:

A. Why Is Fostering Diversity And Inclusion Important To Enhancing Innovative Development In This Networked Society?

Diversity nurtures new ideas. Our differences make us exceptional, our varied experiences encourages more discovery. Fostering openness in communication would necessitate diversity of thought, welcome new ideas and experiences. This is required because diverse viewpoints show the capability to see things differently – and that is the core of real innovation. Unconscious or implicit bias happens when our brains make automatic judgments about people and situations without us realizing it. These biases are shaped by our backgrounds, cultures and experiences. We all hold these biases – they are a part of human nature – and they can have a profound influence over our decision making.

Diversity acknowledges the differences everyone brings to the workplace. Inclusion confirms that each and every one is valued and welcome. A productive organization strives to be a workplace that respects and appreciates individual differences. When diversity is absent, what obtain are the same thought line, same background and same path in solving problems. Diverse teams are the outstanding ones – with high performance, continuous innovation, with a variety of experiences, perspectives, cultural influences and references. Hence, becoming the most creative and thus the most resourceful and networked society effective.

Applying diversity in technology facilitates a win-win scenario where communities are positively influenced; individuals are helped in their day to day life, which on the holistic view would transform people on a personal and professional level. It is encouraged that teams continue to strive to be productive centers where diversity nurtures new ideas and ways of cooperating, and where groups can elevate their unique potential, strengthened by the teams that surround them.

"To enhance sustainable goals, it is required to 'reduce inequalities'. In order to reduce inequalities we must work with inclusion in all strands of diversity. We need to learn to embrace our differences and appreciate the equal value of everyone. I am proud to be an ambassador for this Global Sustainable Development Goal".

Bina Chaurasia – Chief Human Resource Officer, Ericsson.

B. The African Scenario

1) The Technology Challenge: Fostering Sustainable Technology Revolution In Africa

A fundamental shift in technology is spurred by the Networked Society, which is at equivalence with the industrialized transformation and major improvements such as the steam engine, electricity and steel manufacturing. Devices for automated distribution, such as forums, communities and blogs, as well as e-commerce, began to portray a more substantial part. Today, digitization is producing a second economy that is enormous, automated and invisible – carrying with it the largest transformation since the industrialized revolution. Mobility, internet of things and fervent digitization are having a transformational effect on business standards across industries and the society as a whole. Connected individuals and the internet of things will continue to generate massive amounts of data. This imputes enormous pressure on the network system; which needs to be proficient in delivering personalized end-to-end services, relevant applications, and at rather high expectations. It is required to be handled seamlessly irrespective of the number of subscribers or the amount of bandwidth capacity demanded. Ericsson Region Sub Saharan Africa (RSSA) have recently launched the Ericsson ICT Professional Foundation Program which is an online portal that is open to the general public to acquire basic understanding of these concepts. This would be a spring board to the world of opportunities the ICT industry has to offer. It would aid aspiring young professionals and technology enthusiasts across Africa to enhance ICT capabilities. It attracts no cost. The Modules include:

- Ericsson Business and Industry Introduction
- Evolved Packet Core overviews
- Telecoms Operating and Business Support Systems courses (OSS/BSS) overviews
- Network Protocol, IPv6 and IP evolution overviews
- TV & Media overviews

2) Enhancing Diversity And Inclusivity In Africa Whilst Fostering Innovative And Sustainable Development In The Networked Society.

In Africa, ICT is facilitating some basic personal needs, for instance communication, finance, security, education, safety and healthiness. Technologies such as mobility and broadband helps to save funds and time, increase earnings, spur entrepreneurship and increased job formation, promote untapped innovative opportunities etc. These include and are not limited to:

• Banking the Unbanked: the mobile money initiative for instance is gaining grounds across Africa; it initially had a very strong imprint in Kenya. Sending, receiving money and general transacting is no longer limited to the banking hall. With this evolution, the mobile phones, tabs, notes, pads are gradually replacing wallets and purses.

• Learning outside the classroom: Learning takes place everywhere as everyone (whether high schooled educated or

less) with a data enabled mobile device at the least, has a very good idea what a search engine such as Google can do in resolving whatever their quest is (can even resolve arguments). The advantage of their search being refined if the spelling is incorrect is also a plus to want to discover more.
• Business engagements: innovative models for online business enable entrepreneurs to develop their enterprises to achieve end user needs and expectations in new ways. An example is the use of social media by even the not well learned to achieve small scale business objectives. The use of WhatsApp, BBM, Instagram for instance are avenues for sharing fashion, style, goods and services, hair looks, etc, amongst artisans which boosts their need to get mobile phones that would serve those purposes and lots more.

There are dynamic and challenging expectations which necessitate a flexible portfolio and approach in fostering innovative and sustainable development. Taking ownership of specific task or assignments and accepting responsibility of the inevitable changes that this would demand will be a spring board in the right direction. The momentum of business tasks from commodity development to consumer feedback has accelerated in the continuous dynamic universal market place. Keeping up with the pace would require simultaneous business acumen and predictive analysis, to manage unforeseen market threats and opportunities and for faster decision-making.
In fostering inclusivity, more women recruitment needs to be emphasized. It is essential to create and invest in an environment where women are visibly empowered; recognized for the ideas, knowledge and influence they bring and give opportunities for education and career advancement at any level without any bias. It is vital to constantly strive to ensure equal treatment of all individuals regardless of gender.

IV. METHODOLOGY

Practical application of inclusivity and diversity in fostering technological advancement for trans-generational sustainability is very essential.
It is required to encourage the female gender to take up challenges that seem to be "only men can dos" both educationally and career growth wise.
Here are highlighted examples from Ericsson and LeanIn:
Ericsson has collaborated with other organizations to achieve these developmental and inclusive diverse experiences and also solely achieved same on a cascaded note.

☐ Careers International – Top Women Summit: Ericsson is a sponsor of the Top Women Summit held by Careers International. At the summit participants have the opportunity to meet representatives from leading companies, personally discuss their career with top managers and international recruiters, network with a select group of future female leaders, and learn about the latest industry trends and career opportunities.

☐ Broadband Commission for Digital Development: Ericsson collaborates with the Broadband Commission for Digital Development. The working group on Gender and Broadband has a three-pronged procedure to raising the number of women in ICT professions: firstly, to create demand among girls and women for careers in ICT; secondly, to ensure a better supply of science, technology, engineering and math education to girls and women; and thirdly, to achieve long-term sustainability by encouraging ICT businesses to attract, recruit, retain and promote women.

☐ Employee Resource Groups: the Staff team has voluntary groups created around a common goal and stirred in that line. They drive, promote and support a diverse and inclusive work culture enhancing unique insights, concepts and perspectives. The employee resource groups are an illustration of the company's commitment to diversity and inclusion. Groups on a global scale connect and engage in mentoring schemes, career development, networking opportunities, information forums, recruitment programs, and several volunteer events.

☐ Girls in ICT: Ericsson organizes events for this cause, including collaborative workshops, school visits, seminars etc. The objective is to encourage and endow girls and young women to cogitate professions in ICT.

☐ Watermark: Ericsson helps Watermark which is a group of executive women who have risen to the topmost levels of their areas of endeavors. They connect, enhance and press for the progress of women in the work place.

☐ TechWomen: Ericsson supports TechWomen, an initiative that empowers, connects, and supports the next generation of women leaders in science, technology, engineering, and mathematics (STEM) from Africa and the Middle East by providing them the access and opportunity needed to advance their careers, pursue their dreams, and inspire women and girls in their communities. [3]

LeanIn, a diverse and global organization which stemmed from the volume "Lean In" has also focused on inspiring women to pursue their goals, and changing the discussion from what 'we can't do to what we can do'[4]. LeanIn.org became the next phase which included circles. Circles are a voluntary relationship that fosters internal networking, learning and knowledge sharing. It allows individuals to share their business and personal experience, information, values, skills, perspectives, attitudes and behaviors with others; thus boosting personal and professional development. The other expected results are an opportunity for mutual learning, access the knowledge and experiences of experts, initiate a more organized collaboration with individuals that can provide new insights and perspectives.
LeanIn assists women through three vital approaches:

• Community: LeanIn wants women to have the confidence and know-how in achieving their goals. This starts with an active and supportive community. Each day LeanIn encourages an open exchange of ideas and information. They

also share LeanIn Stories—short narratives of periods in life when people choose to either "lean in" or "lean back". It is intended to inspire, teach, correct, encourage and connect.

• Education: LeanIn offers a growing library of free online lectures on topics including leadership and communication. Produced in partnership with the Clayman Institute for Gender Studies at Stanford University and other well-known authorities. The lectures offer women practical capabilities they can apply in their everyday life.

• Circles: Lean In Circles are small groups that meet monthly to encourage and support each other in an atmosphere of confidentiality and trust. LeanIn provides the materials and support to run a successful Circle, including online spaces that make it easy for members to stay up-to-date and connected [5].

Maximizing the LeanIn Circle would require these from team members:

□ INTERPERSONAL RESPECT: with diversity as a background, to achieve team excellence, it is paramount to be open, listen carefully and respectfully to other people's perspectives. Always note that all perspectives are valued, no person is inferior or superior.

□ OPENNESS & CURIOSITY: stay open especially if regular thought patterns are challenged

□ PARTICIPATION: a real and sustainable change will only occur when there is an open dialog and not to allow your ideas and opinions to go unheard. Reflections could come after discussions and this will spur further discussion and continuity of the dialogue to reach the target result.

V. RECOMMENDATION

Through this conference avenue, it is proposed to have a Diverse and Inclusive Technology Society Factory herein after referred to as DITS Factory would be an avenue to acquire and retain scarce talent whilst creating avenues for discovering hidden and unbelievable talents. It is well known that discovery is recovery; so then it is time to tap into the loads of potentials in individuals that do not even know it is inherent. Diversity and Inclusion is work in progress that should produce sustainable results that are trans-generational. The factory could include these initiatives: workshops and seminars, mentorship program, community service, diversity sponsorships, photo competitions, innovative idea (with results) competitions etc. Whatever the size the initiative is, it should be challenging and sustainable! It would be an avenue to share with the world what makes Africa unique and how we would make the most of Technology to enhance our development rapidly on the bedrock of diverse inclusivity.

DITS factory would consciously manage cultural barriers and challenges, biases, etc that could likely be road blocks for developmental attainments.

Highlighted are suggested initiatives that can be adapt as a follow through to this Presentation, via the DITS Factory:

› Promote LeanIn as an external tool for enabling constructive dialogue among people (students, staff, members of the public, etc) around topics relating to diversity and inclusion (or any other topic within any specific team that would address inclusivity, diversity, sustainable innovative development, maximizing the riches of the network society) and social feed that allows for conversations with circle members and sharing of articles, photos, and videos. Lean in circles has locally sponsored programs, mentoring forum, etc.

› Partner with technology companies like Ericsson to support the provision of cloud-based solution to enable live lectures online, listen and interact with tutors through data enable mobile devices. Covenant university can partner with other top universities, technology based industries (intra and inter Africa) to develop joint educational ecosystems, providing free online programs that are accessible to anyone.

› Partner with technology companies like Ericsson and relevant identified technology companies to have an R&D site as highlighted earlier that will concentrate on intelligent transport systems (ITS); smart grid technologies for the utility sector; cloud applications; TV and multimedia; broadband communication; and machine-to-machine (M2M) technologies. Greenhouse gas emissions (GHG) will be evidently reduced by more intelligent electricity grids and connected transportation systems. This will in turn open the way for a low-carbon economy and redefine urban landscapes.

› Attracting women to ICT by promoting practical applications of ICT initiatives with respect to how technology is changing the industry and society, as well as the community in general. Doing things in technology, positively influences the community, helps individuals in their everyday life; to transform people on a personal and professional level. Taking a cue from Ericsson, like Girls in ICT days / TechnoGirls, etc.

› Strive to create an environment where people can work more effectively across cultures by providing the resources and training necessary to build and manage high performing teams across the continent. Managing Unconscious Bias training would also be required.

› Inspire inclusivity in all endeavors to promote the feminine line of involvement. It will be required to support awareness and appreciation of cultural differences in the unique sphere of influence and to focus on the strength that cultural diversity brings. Recruitments could be through referral program or female target hiring. Appreciation of diversity by the male gender as a competitive advantage to any

productive team rather than a threat will foster team spirit and excellent results.

› Managing the diversity challenge: the fact that the ICT industry has been traditionally male dominated and relatively low percentage of women with ICT-related degrees, it is required to encourage the female gender to take up challenges that seem to be "only men can do" both educationally and career growth wise.

› Enhancing services and tasks for improved energy efficiency, opportunities are created for transformative solutions that essentially modify the way we live and work. Promote building a climate positive city, applying a climate smart and proficient infrastructure, connecting persons, homes and workspaces.

In addition to these initiatives and others that will spring up, it is expedient to put in a conscious, deliberate and consistent commitment to ensure a balanced gender representation for inclusive growth to occur. This is vital to Africa's developmental rise. These initiatives need to be actively encouraged across all levels of endeavors.

"To see a desired change in any task or assignment, it requires a conscious, deliberate and consistent effort to realize its actualization"
Faith Oyedepo   Vice President Education, Living Faith Church World Wide.

VI.   CONCLUSION

Today, technology gives the liberty to challenge conventional standards and find solutions to the issues our society faces; as it has demonstrated to be an essential enabler of an enhanced quality of life and economic advancement. The main players in the Networked Society are those who fathom its necessities and have the capability to rethink, innovate and reinvent so as to grab the opportunity of this value-building ecosystem.

In a complex, diverse and ever changing world, leaders and aspiring leaders need to be agile, flexible and demonstrate willingness and initiative to learn and grow. Thoughtful and inclusive leaders mobilize a diverse, dynamic and pro-feminine team. Diversity and inclusivity promoting leaders energize, engage, develop and retain talent through the conduit of an advancing networked society that promotes the value that the feminine gender bring to the team's productivity. Since diversity and inclusion enables organizations to appreciate diverse personalities, talents and promote gender parity, this will in turn spur motivation for delivery even when very high expected monetary motivation is not immediately present.

To remain diversely inclusive in approach at attaining any innovative feat whilst maximizing the benefits the networked society has to offer our community where intelligent females are, it is required to involve everyone, evaluate progress regularly and be focused in approach – have specific targets. Creativity, consistency and continuity are the rules of engagement for trans- generational sustainability.

As enabled people and societies are the pilots of essential change, this will lead to business opportunities and solutions that would handle global issues such as paucity, urbanization, access to education and health care, climate variations and the productive utilization of natural resources with the back bone of feminine inclusivity. Evolving ICT is the essential facilitator of the progressive transformation, as real time connections will demand new requirements whilst opening opportunities beyond the imagination.

Connectivity is aptly the start point for fresh approaches to collaborating, innovating and transacting business, which will promote problem solving initiatives rather than problem amplification concerns. It will launch new entries to lifelong learning, improved quality of life and economic boom. The joint forces of mobility, broadband and the cloud will revolutionize every part of our world especially in cities which will always cascade to villages as their residents will prospectively accept the innovation and transformation technology brings rather than shun it.
"Connectivity in the future will change behaviors of people, business and society."
Hans Vestberg, Ericsson President and CEO

Stay Productively Engaging!

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Interactive Effects of Exchange Rate Volatility and Foreign Capital Inflows on Economic Growth in Nigeria

Olusuyi E. Ajayi
Department of Economics
Bells University of Technology,
Ogun State, Nigeria.
E-mail: olusuyiajayi@yahoo.co.uk

T. O. Akinbobola
Department of Economics,
Obafemi Awolowo University,
Ile Ife, Nigeria.

Samuel Okposin
Department of Economics and Development Studies,
Covenant University,
Ota, Nigeria.

Oluyomi Ola-David
Department of Economics and Development Studies,
Covenant University,
Ota, Nigeria.

Abstract

Various literature have attested to the vital roles of foreign capital inflow in bridging the savings-investment gaps in the developing countries in other to bring about the so much desired development. The impediment of exchange rate volatility (EXRV) on sourcing for this much desired foreign capital is also notable. However it was observed in literature that the negative effect of EXRV could be mitigated by the level of financial development prevalent in the country. This study investigates the interaction of financial development with exchange rate volatility on one hand and of financial development with capital inflows on the other hand. The result of our GMM estimation indicates significant positive effect of FDI, FD, interaction of FDI with FD and interaction of EXRV with FD on GDP. However, remittance, lag of EXRV and interaction of remittance with FD has significant negative impact on GDP. This study posits that government in its efforts to diversify the economy for future growth should promote infrastructure and adequate financial development that will attract FDI to agric and agro allied industries and diversify remittances from consumption into investment.

Keywords: *Exchange rate volatility, foreign capital inflow, interactive effects, financial development, financial liberalisation, savings-investment gap*

I. INTRODUCTION

Nigeria is the most populous country in Sub-Saharan Africa which is highly endowed with both human and natural resources that make her a toast of both foreign and local investors. During colonial era and immediate post colonial era in the 1950s and 1960s its economy was largely dependent on agricultural products. However, with the large scale discovery of oil in the early 1970s the country gradually reduced its agricultural production until the economy became monoculturally dependent on oil revenue a situation that have been prevalent in the last few decades. However the dwindling oil revenue arising from the fall in international oil prices of recent is putting a lot of pressure on the Nigerian economy. In particular the downturn being currently faced by Nigerian economy needs an urgent economic policy to remedy. It is on this note that the current administration in Nigeria is thinking along policy shift from overdependence on oil to agriculture, solid mineral and agro allied industries. The lean purse of the Nigerian government however did not encourage the development of the necessary infrastructures for economic development that could attract foreign investment to the nation [1].

Theoretical and empirical literature has applauded investment as a fundamental channel of accelerated economic growth [2]. Literature have identified foreign capital inflow as an important source of augmenting the savings - investment gap in most capital resource deficient economies like Nigeria [3] [4]. Thus, there is the quest to attract foreign fund across the globe to mitigate the effect of this shortfall. However, EXRV which is the risk

associated with unexpected and unpredictable movement in the exchange rate has been further proved in literature as impediment to foreign capital inflow. As a matter of fact neither low nor high exchange rate volatility is good for the economy. The Structural Adjustment Programme (SAP) introduced by Nigerian Government in 1986 to stabilise overvalued naira was however not successful.

Literature have extensively explained that the effect of exchange rate volatility as well as the foreign capital inflow on economic growth will be largely dependent on the level of capital development prevalent in the local economy [5]. This study in the light of this assertion focus on the investigation of interactive effect of exchange rate volatility and financial development on one hand and the interactive effect of foreign capital inflow and financial development on economic growth of Nigeria between 1970 and 2013 .

II. LITERATURE REVIEW

The review of literature focuses on theories on exchange rate volatility, theories on FDI, theories on workers remittance and some basic economic growth theories. It has been theorised that exchange rate volatility has direct negative impact on the economic growth however it is dependent on the level of financial development in the economy [6]. In other words low financial development in the presence of high exchange rate volatility will depressed the economy growth and vice versa. This was evidence in Chile between 1975 and 2000.

The most celebrated theory on FDI and Economic growth was OLI theory propounded by Dunning which explain motives behind FDI flow to another country. He identified three main conditions considered by firms for making investment abroad as firm specific ownership advantage, Location advantage and Internalisation incentives (OLI). The firm specific advantage includes competitive advantage such as proprietary, technology, managerial and marketing advantages which the foreign company has over local firms. Location advantage specify the advantage the host country has in form of raw material supply, high labour supply at low cost, abundance of natural resources and wide market. Dunning emphasised the significant role of the government in regards to monetary and fiscal policies and its ability to attract FDI flow [7]. Argarwal criticized this OLI theory as being eclectic, static and not paying particular attention to political and sociological element [8].

Another macroeconomic theory of capital inflow is the International Monetary theory (IMA) widely publicized by Emerson who believed that stability in exchange rate that accompany monetary union should improve trade and investment in the economy even as they noted that exchange rate volatility could be detrimental to FDI [9]. For example, Morsink and Molle in their empirical work adopted IMA approach and discovered exchange rate volatility as a restricting factor to FDI flows between two countries [10].

The rate of return theory on FDI on the other hand postulates that FDI flows is a function of international differences in rates of returns on capital relative to the required rate of return. They argued that capital will naturally flow from countries with low rate of returns to countries with higher rate of returns. The Portfolio theory by Tobin and Markowitz theorised that investors besides maximizing profit also endeavour to minimize their risk by way of spreading their investment in various countries [11] [12].

Theory on foreign capital inflow was further extended to workers remittance. In advancing motives for workers remittance Kaasschieter in his pure altruism theory anchored his argument on migrants concern for the welfare of their family and associate in his or her home country [13]. The second theory of workers remittance is the implicit family agreement theory propounded by Lucas and Stark, where family agreed to sponsor the migrant abroad in expectation of remittance of both principal and interest when gainfully employed [14]. The third theory is the portfolio management decision in which the migrant consider macroeconomic factors such as interest rate, exchange rate, inflation rate and economic policies prevalent in both home and foreign countries before taking decision on remitting fund home for investment purpose. Only the portfolio management decision theory that has element of investment drives which have the ability to grow the economy while others are consumption driven.

One of the topical issues in economics for all time has been that of economic growth The earlier classical economics theories pioneered by Adam Smith, recognised the mechanism that influence economic growth as productive investment as well as capital accumulation [15]. Classical economists concentrated on physical capital and economic growth while no reference was made to financial capital. The first Economist to recognise the place of financial capital in growth theory was Keynes in his simple macroeconomic open economic model of national income where he theorised that foreign capital flow (E-M) is required to bridge the saving-Investment gap in the domestic economy [16]. In advancing growth model, neoclassical economists led

by Solow postulate the role of steady state where investment is equal to depreciation as a sine qua non for economic growth. However, as capital grows over time, diminishing returns sets in to make depreciation higher than investment thereby impeding economic growth. To guarantee economic growth therefore savings rate need to be increased so as to ensure the steady state. Solow therefore advocated the flow of foreign capital in order to improve savings required for growth in the domestic economy [17].

A. Review of Empirical Literature

There are conflicting views in literature concerning the effect of exchange rate volatility on capital inflow. Some studies observe a positive effect [18] [19] [20]. While some others noted a negative effect [21]. Literature has also shown that conflicting results of the effect of exchange rate volatility on FDI flow to the host country could be largely dependent on the technique of estimation applied. For instance, while Osinubi and Amaghionyeodiwe used OLS and Error Correction model (ECM) estimation techniques discovered a significant positive relationship between EXRV and FDI, Udoh and Eghwakhide using GARCH model observed a negative effect of EXRV on FDI [22] [23]. We observed that most literature on the effect of capital inflow proxy by FDI noted positive relationship both internationally and locally [24] [25] [26] [27] [28] [29] [30]. The only exemption to this discussion was that of Oyinlola who arrived at the negative effect of FDI on economic growth using the two-gap model [24].

Literature also advanced the importance of financial development (FD) in reducing the negative impact of EXRV on economic growth. Aghion et al. interacted FD with EXRV and observed a significant positive impact on GDP whose result is better than the one obtained with FD and EXRV separately [31]. Lee in his study of the effect of FDI on economic growth in Vietnam anchored the positive effect of FDI on economic growth to the spillover effect that FDI has on technological transfer to the host country [32].

Most of the studies that used remittance to proxy foreign capital inflow in their study of the impact of foreign capital inflow on economic growth both internationally and in the local Nigerian context found a positive relationship between remittance and economic growth [33] [34] [35] [36].

III. METHOD

A. Model Specification

This study adopts a model developed by Borensztein, De Grezorio and Lee [37]. The model starts from general production function given by Solow which is explicitly given as:

$Y = f(K, L, A)$ -- (1)

Where Y = GDP

K = Capital input,   L = Labour input

A = the level of technological knowledge.

Decomposing capital to physical capital (K) and financial capital (FDI and REM.) as presented by Balassa [38], then we have:

$Y = f(K, FDI, REM, L, A)$ --------------------------- (2)

If we denote financial liberalization as FL, then:

$Y = f(K, FDI, REM., L, FL)$ ------------------------ (3)

Financial development as represented by FD could be introduced into the model because of its importance:
$Y = f(K, FDI, REM, L, FL, FD)$ --------------------- (4)

If we proxy FD by money supply (M_2) and introduce other variables of interest (EXRV) into the model then

$Y = f(K, FDI, REM, L, FL, M_2, EXRV)$ ---------- (5)

From the implicit model above, we therefore proceed to build our explicit model thus:

$Y = \propto_0 + \propto_1 K + \propto_2 FDI. + \propto_3 REM + \propto_4 L + \propto_5 FL + \propto_6 M_2 + \propto_7 EXRV + U$ --------- (6)

To examine the interactive effect of financial development and EXRV as well as interactive effect of financial development and capital flow we extend equation 6 to obtain:
$Y = \propto_0 + \propto_1 K + \propto_2 FDI + \propto_3 REM + \propto_4 L + \propto_5 FL + \propto_6 M_2 + \propto_7 EXRV + \propto_8 (FDI * M_2) + \propto_9 (REM * M_2) + \propto_{10} (EXRV * M_2)$ ---------- (7)

We expect the coefficient of the variables to have the following signs: $\propto_0 > 0$, $\propto_1 > 0$, $\propto_2 > 0$, $\propto_3 > 0$, $\propto_4 > 0$, $\propto_5 > 0$, $\propto_6 > 0$, $\propto_7 < 0$. $\propto_8 > 0$, $\propto_9 > 0$, $\propto_{10} > 0$,

B. Estimation Techniques

We adopt the Generalised Method of Moments (GMM) estimators which provide consistent estimators when lagged of dependent variables are used to overcome the inconsistency inherent in OLS estimation technique. This is necessary in order to overcome the problem of endogeneity that is inherent in the long run growth determinants [39]. This method is widely used by other studies because of its consistency [40] [41].

In applying this method, the explanatory variables are instrumentalized with their suitable lags so that the instruments are not correlated with the error term.

Therefore this study adopted GMM. Taking the first-difference transformation of equation 7 to observe the interactive effect as stipulated below:

$$\Delta Y_t = \propto_1 \Delta Y_{t-1} + \propto_2 \Delta K + \propto_3 \Delta FDI + \propto_4 \Delta REM + \propto_5 \Delta L + \propto_6 \Delta FL + \propto_7 \Delta M_2 + \propto_8 \Delta EXRV + \propto_9 \Delta(FDI * M_2) + \propto_{10} \Delta(REM * M_2) + \propto_{11} \Delta(EXRV * M_2) + \Delta \cup_t \text{----------------------- (8)}$$

C. Estimation of Exchange Rate Volatility

We adopt the Standard Deviation of the first difference of logarithms of the exchange rate in estimating Exchange Rate Volatility. Here the change in exchange rate is computed over one month using end of month data. The standard deviation is calculated over a one year period as an indicator of short run volatility as well as over a forty three years period to capture long run variability.

D. Sources of Data

Data on Various variables to be used in the study such as Exchange rate, GDP, FDI and money supply, were sourced from volumes of the Central Banks of Nigeria (CBN) Statistical Bulletin. On the other hand, data on Workers' remittances, Capital and labour were sourced from the World Development Indicator (WDI). Exchange rate volatility was computed by the author by applying standard deviation on the exchange rate data collected from CBN Statistical Bulletin.

IV. DATA ANALYSIS AND RESULTS

We present the table of our results of GMM estimation techniques below. The R-Squared of 0.989923 shows that the variation in dependent variable (GDP) was 98.99 percent jointly explained by all the explanatory variables. The Adjusted R^2 of 0.985086 shows that the model has high goodness of fit as the explanatory power of this model is approximately 98 percent of the total variation in GDP. The validity of the instrument in the estimation was justified by the Prob. J- Statistics of 0.996631 which is closer to 1.0. Also the standard error of all the variables which lies between 0 and 1 indicates that the coefficients of the estimator are reliable.

Dependent Variable: LY
Method: Generalized Method of Moments
Sample (adjusted): 1975 2012

Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	89.06894	6.773421	13.14977	0.0000
LY(-1)	0.059938	0.043837	1.367291	0.1837
LK	0.056590	0.006807	8.312968	0.0000
LL	-5.113565	0.384071	-13.31411	0.0000
LFDII	0.031636	0.037048	0.853906	0.4013
LREM	-0.016072	0.038236	-0.420325	0.6778
LFL	-0.206870	0.011042	-18.73555	0.0000
LFD	0.907283	0.047884	18.94732	0.0000
EXTV	0.001599	0.028248	0.056592	0.9553
EXTV(-1)	-0.026617	0.002073	-12.83790	0.0000
LFDII*LFD	0.004502	0.004169	1.079774	0.2906
LREM*LFD	-0.004485	0.003478	-1.289339	0.2091
EXTV*LFD	0.000205	0.002151	0.095277	0.9249

R-squared	0.989923	Mean dependent var		12.36462
Adjusted R-squared	0.985086	S.D. dependent var		1.011974
S.E. of regression	0.123586	Sum squared resid		0.381840
Durbin-Watson stat	1.444900	J-statistic		10.00801
Instrument rank	38	Prob(J-statistic)		0.996631

We now examine the effect of each of the explanatory variables on the growth of the Nigerian economy. The coefficient of FDI which is 0.031636 shows that there was positive and very significant effect of FDI on GDP as demonstrated in the probability of 0.4013 In other words a percentage change in FDI lead to 0.032 percentage change in GDP.

Remittance on the other hand had insignificant negative effect on the Nigerian economy as evidenced in its negative coefficient of 0.016072 and probability of 0.6778.This shows that a one percent change in remittance will lead to 0.016 percentage change in GDP. This result was contrary to empirical evidence in previous literatures on Nigeria which produced positive relationship between remittance and economic growth [36] [42] [43]. The negative effect of remittance on economic growth in Nigeria could be justified by the fact that most of the fund that come to Nigeria via remittance were consumed rather than invested. This is in line with findings in literature [44] [45]. Effort should therefore be geared towards encouraging remittance flow towards investment that could lead to both human and physical capital accumulation.

EXRV shows an interesting position. Here there is positive but insignificant effect of EXRV on GDP as

evidence in its positive coefficient of 0.001599 and probability of 0.9553 which is contrary to the theory that specified that EXRV has a negative effect on GDP. But a study by Aghion, Howit and Mayer opined that the extent of financial development will dictate the impact of EXRV on economic growth [**6**]. For instance a lower degree of financial development with high EXRV will aggravate the divergence of the economy growth rate while a country with well developed financial system will neutralize the negative effect of EXRV. The various reforms implemented by Nigeria's government overtime might have explained the positive effect of EXRV on GDP in Nigeria.

Financial liberalisation was found to have negative but highly significant effect on economic growth. This shows that a percentage increase in financial liberalisation will lead to retardation in economic growth by 0.21 percent. On the other hand financial development was found to have positive significant effect on the economic growth in Nigeria as evidenced in the positive coefficient of 0.907283 and probability of 0.0000, This means that for every percentage change in financial development there is 0.907 percentage increase in economic growth. The interaction of FDI with FD shows a positive and significant effect on GDP as demonstrated in the positive coefficient of 0.004502 and probability of 0.2906.This shows that this interactive effect shows that the percentage change in the interactive effect will lead to 0. 0045 percent change in the economy and this is higher than the growth of 0.032 percent in economic growth when FDI alone is considered. Also the interaction of EXRV with FD also shows significant positive effect on economic growth as demonstrated by the coefficient of 0.000205 and probability of 0.9249. However the interaction of remittance with FD shows a significant negative effect on the economic growth as demonstrated in the negative coefficient of 0.004485 and probability of 0.2091. Even though the result still shows negative impact but there was a reduction in the negative effect when interaction takes place (0.004485) than when remittance alone is considered (0.016072)

The result of the general Method of Moment (GMM) regression analysis show R^2 to be 0.989923, implying that all the explanatory variables jointly explain the variation in the GDP by 98.99 percent . This was buttressed further by Adjusted R^2 of 0.985086 which imply that the model has high goodness of fit. The FDI was discovered to have significant positive effect on GDP. We also noted that workers remittance have a significant negative effect on GDP

EXRV has positive but insignificant effect on economic growth contrary to negative effect posited by theory but which could be justified by the level of financial development prevalent in Nigeria in line with the findings of another study [**6**]. Financial development has a positive and very significant effect on economic growth in Nigeria. On the other hand financial liberalisation has a negative but significant effect on economic growth in Nigeria. The interactive effect of FD with FDI as well as EXRV show an improvement in economic growth. Even though interactive effect of Remittance and FD shows a negative effect on economic growth, there was an improvement over a situation of remittance alone.

V. CONCLUDING REMARKS

The study shows that FDI has a positive and significant effect on economic growth in Nigeria. On the other hand remittance has a negative effect on the economic growth in Nigeria as it affects consumption and not investment which is capable of improving economic growth. Also EXRV has positive but insignificant relationship with economic growth in Nigeria contrary to basic theory on EXRV. The interactive effect of FD and capital inflow as well as EXRV shows a promising future for Nigerian economy.

This study therefore admonishes government to provide enabling infrastructural and financial development that will not only encourage greater financial inclusion in rural area but also attract the inflow of FDI to agric sector, solid mineral sector and agro allied industry if their intension to diversify Nigerian economy from its dependence on oil should succeed. This will help to bridge financial, technological and managerial gap that exist in the domestic Nigerian economy presently. Also financial development will also reduce drastically the negative effect of EXRV on economic growth. Policy that will diversify more of remittance which is on the increase to the nation now from consumption to investment in agric and agro allied industries should be put in place. In this way the remittance will have direct impact on economic growth in Nigeria. Finally government through monetary and fiscal policy should place stricter control on the activities of the bureau de change so as to curtail the overbearing influence of the mafia in the sector.

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Assessment of *Plasmodium falciparum* RNA pseudouridylate synthase (putative) as novel drug target

Aliyu Muhammad+(3, 5, 6), Solomon Rotimi+ (2, 3), Oyelade Jelili (1, 3), Itunuoluwa Isewon (1, 3), Barbara Di Ventura (6, 7), Roland Eils (6, 7), Michael Lanzer (8), Benedikt Brors (4) and Ezekiel Adebiyi (1, 3, 4)

1. Dept. of Computer and Information Science, Covenant University, Ota, Ogun State, Nigeria.

2. Dept. of Biological Sciences, Covenant University, Ota, Ogun State, Nigeria.

3. Covenant University Bioinformatics Research (CUBRe), Covenant University, Ota, Ogun State, Nigeria.

4. Dept. of Applied Bioinformatics, German Cancer Research Centre (DKFZ), Heidelberg, Germany.

5. Department of Biochemistry, Ahmadu Bello University (ABU), Zaria, Nigeria

6. Roland Eils group, BioQuant, Im Neuenheimer Feld 267, 69120 Heidelberg, Germany

7. Dept of Theoretical Bioinformatics, German Cancer Research Centre (DKFZ), Heidelberg, Germany.

8. Department of Infectious Diseases, Parasitology, Heidelberg University Medical School, Im Neuenheimer Feld 324, 69120 Heidelberg, Germany

+ Joint first author.

Abstract— **Malaria is a major public health problem associated with high mortality, morbidity rates and undue economic burden in sub-Saharan countries. Presently, every year, 300 to 500 million people suffer clinically from malaria and 90% of them in sub-Saharan Africa. About 1.5 to 3 million people die of malaria every year and 85% of these occur in Africa. One child dies of malaria somewhere in Africa every 20 second, and there is one malarial death every 12 sec somewhere in the world. This is also a damaging economic burden for these sub-Saharan Africa countries as huge work force time and resources are expended for treatment. Plasmodium falciparum (hence forth Pf) is the most severe of all the human malaria parasites. This organism is continuing to develop resistance to all known drugs and therapeutic regime. One of the mechanisms of resistance in Pf is the modification of the drug target. Hence, it is expedient to continuously discover novel drug targets in Pf and to discover or develop new drugs against such targets. Drug-able signaling pathways have been shown to have inherent mechanism capable of deterring drug resistance. Using computational techniques, we have identified some proteins in the signaling pathways of Pf as putative targets for anti-plasmodia drug. RNA pseudouridylate synthase, which also plays a key role in RNA synthesis and ribosomal function, is one of such proteins. Initial virtual screening of this enzyme against drug and chemical databases has been performed to identify compounds that can inhibit this enzyme. This led us to compounds which inhibit nucleotide metabolism. This is a work in progress whose current state is hoped for presentation at this conference. In order to determine the identified compounds IC50, the identified compounds will be screened in vitro against the enzyme. We have currently completed the establishment of the enzyme functionally expression in E. coli and purification. Thereafter, the drugs will be screened for their anti-plasmodia activity using cultured Pf and the IC50 for each drug will be determined. In order to assess their safety, the selectivity index of compounds that showed in vitro anti-plasmodia activity will be determined using human cultured cell lines. The last stage of this study will involve screening the compounds in an in vivo mouse model of malaria. It is hoped that the result of this study will prove this enzyme as a novel target for antimalarial drug. And provide as input, critical drug targets in to our established Structure Based Drug Design (SBDD) pipeline.**

Keywords: Drug design, Plasmodium falciparum, RNA pseudouridylate synthase, drug target, Virtual Screening, anti-plasmodial

I.   INTRODUCTION

Malaria has been reported to be one of the major causes of death worldwide, with more than 90% in Africa alone. In 2013, an estimated 128 million people were infected with Plasmodium falciparum in sub-Saharan Africa at any one time. In total, 18 countries account for 90% of infections in sub-Saharan Africa; 37

million infections (29%) arose in Nigeria and 14 million (11%) in the Democratic Republic of the Congo, the two countries with the highest numbers of infections [1]. These may clearly pose a major obstacle to sustainable development [2]. In Sub-Saharan Africa, malaria is directly responsible for one in five childhood deaths and acts in synergisms with other illness such as respiratory infections which cause even higher proportion of childhood morbidity and mortality [3].

Plasmodium parasites have been implicated to be the underlying genesis of the disease, among which five species that infect humans have been reported [4]. One of them which is Plasmodium falciparum, the main species associated with complicated malaria cases such as black water fever [5]. Quite unfortunate, this organism is continuing to develop resistance through a biochemical modification of the drug target to all known drugs and therapeutic regime. This necessitate continuously search for the novel drug targets in an attempt to develop new drugs against them. The toxicological implication of the currently available and commercialized antimalarial drugs is another issue of major concern [6].

The conversion of uridylate to pseudouridylate occurs in all three domains of life and is the most common posttranscriptional modification of RNA [7]. This is being carried out by RNA pseudouridylate synthase, an enzyme that basically modifies some specific uridylate residues along the T- arm stem loop, anticodon stem loop of transfer RNA vis-à-vis during the splicing of pre-messenger RNA at the critical levels of posttranscriptional modification, relative to gene ontology. Certain critical aspartic acid residues have been reported to be the main actors when it comes to catalytic activity RNA pseudouridylate synthase [7]–[9].

Drug-able signaling pathways have been shown to have inherent mechanism capable of deterring drug resistance. Using computational techniques (see details under the "Materials and methods" below), some proteins have been identified in the signaling pathways of Plasmodium falciparum as putative targets for anti-plasmodia drug. RNA pseudouridylate synthase, which also plays a key role in RNA synthesis and ribosomal function, is one of such proteins.

Initial virtual screening of this enzyme against drug and chemical databases has been performed to identify compounds that can inhibit this enzyme. This led us to compounds which inhibit nucleotide metabolism. This is a work in progress whose current state is hoped for presentation at this conference. In order to determine the identified compounds IC50, the identified compounds will be screened in vitro against the enzyme. We have currently completed the establishment of the enzyme functionally expression in E. coli and purification. This is being reported in this write up. In a future work: The drugs will be screened for their anti-plasmodia activity using cultured Pf and the IC50 for each drug will be determined. In order to assess their safety, the selectivity index of compounds that showed in vitro anti-plasmodia activity will be determined using human cultured cell lines. The last stage of this study will involve screening the compounds in an in vivo mouse model of malaria. It is hoped that the result of this study will prove this enzyme as a novel target for antimalarial drug. And provide as input, critical drug targets in to our established Structure Based Drug Design (SBDD) pipeline.

II. MATERIALS AND METHODS

A. Computational Analysis

We begin this section by illustrating the success in our earlier computational analysis and then introduce the computational analysis that suggested RNA pseudouridylate synthase, on some signaling pathways, as a viable and novel antimalarial drug target.

In Fatumo et al. [10-12], a computational method (Choke Point Analysis (CPA)) and pathway deviation analysis investigating the topology of biochemical metabolic networks [13-14] was developed to mine new essential enzymes serving as potential drug targets in the most deadly malaria parasite, Plasmodium falciparum. With this method, we predicted a refined list of drug targets of which one was validated experimentally using 6-diazo-5-oxonorleucine (DON) in Prof. Michael Lanzer's laboratory at the University of Heidelberg, Germany, proving effective clearance of P. falciparum infected
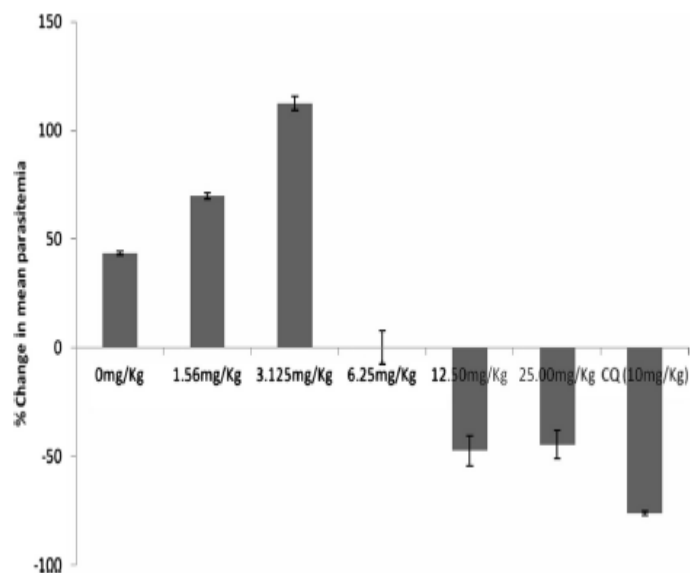
human blood cultures[15]. Specifically, we performed a half maximal inhibitory concentration (IC50) study and found that DON showed excellent antimalarial activity in-vitro when applied against P. falciparum Dd2 (3-4 x e-7 M, Fig. 1a). We performed positive control experiments using quinne and chloroquine. Quinne and chloroquine showed a slightly better dose response of 9.2 x e-08 and 4.7 x e-08 M, respectively (Fig. 1b). This success recorded in the in-vitro experiments above was confirmed by an in-vivo study observing P. berghei infected mouse models (at Covenant University (CU)'s biological laboratory)[15]. Also specifically, we performed a mouse model study. P. berghei infected mice were injected intraperitoneally with DON dissolved in normal saline and parasitemia was observed 24 and 72 h after treatment. Fig. 2 below shows the results for 24 h. 24 h after treatment, 50% reduction of P. berghei was observed when administrating 12.5 mg/kg DON, and even 80% reduction 72 h after treatment. At low concentrations (<6 mg/kg), we observed an increase of parasitemia after 24 h. DON treated mice survived whereas all non treated mice died due to infection.
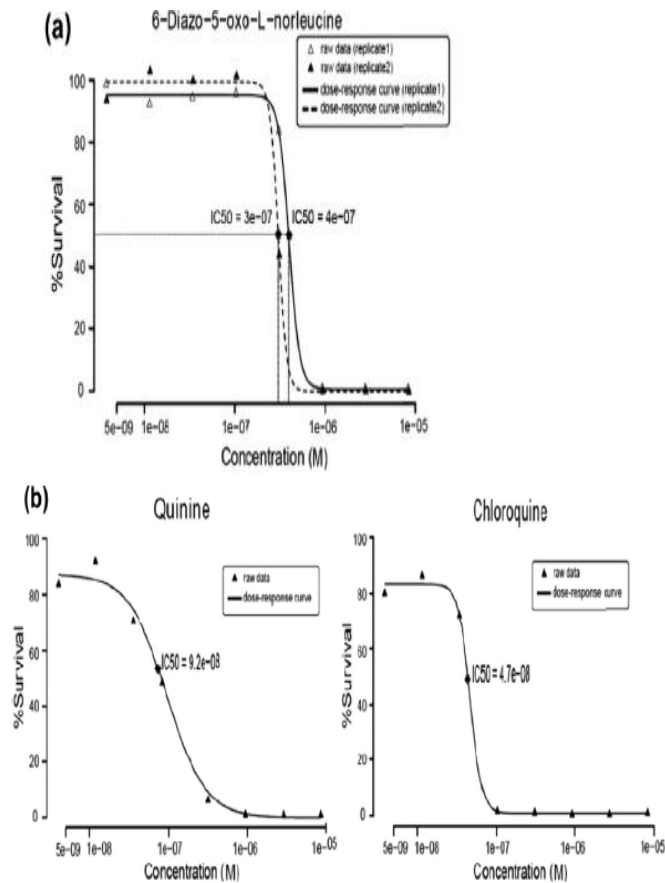
Fig 1. The IC$_{50}$ results of a) DON and b) quinne and chloroquine as positive controls.

However DON is rather toxic and mutagenic, and hence can only be applied with care. Hence, further drug targets and drugs need to be exploited. The results obtained have been successful on one of the enzymatic sites listed in [10], and it demonstrates that the computational method works, that is, the predicted sites on the malaria parasite proved to be effective as drug targets. Benefits from this kind of work include that we may be able to produce novel antimalarial drugs, whose biological mode of action can be determined accurately [11] and obtained antimalarial drug target site upon which a powerful structure based drug design (SBDD) pipeline can be build.

In a previous study, Oyelade et al.[16], we have constructed a protein–protein interaction network from the protein–protein interaction data obtained from the work of LaCount et al. [17]. Their results comprise 2846 interactions between 1308 proteins of P. falciparum in its intra-erythrocytic cycle. In addition to the protein–protein interaction data, the transcriptional data from Le Roch et al. [18] and Bozdech et al. [19] were integrated to weigh the interaction reliabilities, depicted by the edges of the interaction graph. These probabilities were calculated under the logistic distribution given three variables, namely (i) the number of times an interaction between two proteins was observed, (ii) the Pearson correlation of expression measurements for the corresponding genes, and (iii) the proteins' small world clustering coefficient [20]. We analyzed the resulting network using a linear-time algorithm for finding paths in a network under newly formulated biologically motivated constraints.

Among others, we predicted a signaling pathway that may have been responsible for signaling the start of the invasion process of the Red Blood Cell (RBC) by the merozoites. The pathway is in line with earlier evidence that the RBC invasion required the cleavage of a surface protein on the RBC by a parasite serine protease [21]. All of the extracted signaling pathways (whose weight and hypergeometric p-values are both less than 0,05) by Oyelade et al. are presented in Tables 2-8 of the supplementary materials associated with the paper, with a snapshot of these results presented in Tables 1a-1e within the body of the paper and highlighted as red in Tables 2-8. It is also important to note that all these pathways are extracted bearing in mind certain identified classes of signal transduction pathways, namely, phosphatidylinositol cycle, calcium signaling, calcium modulated protein kinase, cyclic nucleotide dependent, cell cycle kinases, novel FIKK kinases proteins and proteins not known to belong to any signal transduction pathways. The readers are directed to Oyelade et al. for more details.

Dastidar et al.[22] in their work about the involvement of P. falciparum protein kinase CK2 in the chromatin assembly pathway identified and listed in their Table 1, potential interactors in the nucleosome assembly and regulation pathway. We found that three of these proteins take part in some predicted signaling pathways of Oyelade et al [16] in Tables 2-8. These are extracted and listed in Table 1a below.

TABLE IA. PREDICTED MINIMUM PATHWAYS (POTENTIAL SIGNAL TRANSDUCTION PATHWAYS) BY Oyelade et al.[16] INVOLVING POTENTIAL INTERACTORS: PFL0185c, PF10_0232, and PFF1185 FROM TABLE 1 OF Dastidar et al [22].

Name	Minimum path	p-value	Details of genes	
			Genes IDS	Products
Cell Cycle	**PF10_0272**--->PFL0185c	0.009	**PF10_0272** PFL0185c	60S ribosomal protein L3, putative Nucleosome assembly protein 1, putative
FIKK	PFA0130c ---> PFE1590w ---> PF10_0232	0.009	PFA0130c PFE1590w PF10_0232	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 Chromodomain-helicase-DNA-binding protein 1 homolog, putative
	PFA0130c ---> PFE1590w ---> PF10_0232--->**PF11_0506**	0.036	PFA0130c PFE1590w PF10_0232 **PF11_0506**	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 Chromodomain-helicase-DNA-binding protein 1 homolog, putative Antigen 332, DBL-like protein
	PFA0130c--->PFE1590w--->PF10_0232--->PFL1705w	0.039	PFA0130c PFE1590w PF10_0232 PFL1705w	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 Chromodomain-helicase-DNA-binding protein 1 homolog, putative RNA binding protein, putative
	PFA0130c--->PFE1590w--->PF10_0232--> PF14_0644	0.039	PFA0130c PFE1590w PF10_0232 PF14_0644	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 Chromodomain-helicase-DNA-binding protein 1 homolog, putative conserved Plasmodium protein, unknown function
	PFA0130c-->PFE1590w-->PFF0920c-->PF10_0232	0.036	PFA0130c PFE1590w PFF0920c PF10_0232	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 conserved Plasmodium protein, unknown function Chromodomain-helicase-DNA-binding protein 1 homolog, putative
Unknown genes	PFA0125c--->PF08_0034-->PF10_0232--> PF11_0504	0.029	PFA0125c PF08_0034 PF10_0232 PF11_0504	erythrocyte binding antigen-181 histone acetyltransferase GCN5, putative Chromodomain-helicase-DNA-binding protein 1 homolog, putative Plasmodium exported protein (hyp11), unknown function
	PFA0125c-->PF08_0034-->PFI1715w-->PF10_0232-->PF11_0504	0.046	PFA0125c PF08_0034 PFI1715w PF10_0232 PF11_0504	Erythrocyte binding antigen-181 histone acetyltransferase GCN5, putative Plasmodium exported protein ,unknown function Chromodomain-helicase-DNA-binding protein 1 homolog, putative Plasmodium exported protein (hyp11), unknown function
Calcium Signaling	PFF1185w---> PF11_0142 ---> PF11_0239--->**MAL13P1.206**	0.037	PFF1185w PF11_0142 PF11_0239 **MAL13P1.206**	Smarca -related protein ubiquitin domain containing protein calcium-dependent protein kinase, putative Na+ -dependent Pi transporter, sodium-dependent phosphate transporter
	PFA0130c--->PFE1590w--->PFF1185w--->PF13_0036	0.036	PFA0130c PFE1590w PFF1185w PF13_0036	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 Smarca -related protein DNAJ protein, putative
	PFA0130c-->PFE1590w-->PFF1185w	0.007	PFA0130c PFE1590w PFF1185w	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 Smarca -related protein
Unknown	PFA0125c-->**PFE0570w**-->PFE1590w--> PFF1185w-->**PF11_0277**	0.042	PFA0125c **PFE0570w** PFE1590w PFF1185w **PF11_0277**	Erythrocyte binding antigen-181 RNA pseudouridylate synthase, putative early transcribed membrane protein 5, ETRAMP5 Smarca -related protein conserved Plasmodium protein, unknown function

Column one indicates the name of the signaling pathway, the second column shows minimum paths extracted, while optimizing the identified number of proteins in the pathway under consideration. The third column shows the weight p-value and column four detailed the products (from plasmodb) of the proteins in the identified potential signaling pathways.

To validate the drug-ability of the predicted signaling pathways (in Oyelade et al [16]), we next compared their corresponding genes to all transcripts of the human genome using BLAST [23]. We produced in Table 1b below, genes with no significant homologies (all E-values > 0.01). Please note that the BLAST program used the new gene IDs for P. falciparum, we therefore linked these back to their old gene IDs as we have employed above.

It is interesting to note that a drug-able site: PF11_0506, was found on the signaling pathway (in the FIKK family) we predicted in Oyelade et al. that ends up on a chloroquine resistance marker protein. This site automatically provided us with avenue to interfere with this pathway and possibly reverse P. falciparum from resistant to chloroquine to sensitive phenotype. Another interesting drug-able signaling pathway is the last one in Table 1a with drug-able sites: PFE0570w and PF11_0277. It will be worthwhile validating the malaria chemotherapy basis of these two signaling pathways via the IC50 experiments as we did in Plaimas et al.[15].

TABLE 1B. DRUG-ABLE SITES ON THE PREDICTED SIGNALING PATHWAYS IN TABLES 2-8 OF Oyelade *et al*.[16].

Previous Gene IDs	New Gene ID	Human homologs	E-value
MAL4P1.18,	PF3D7_0402000	XP_005 254442.1	1.2
PFD0090c	PF3D7_0511500	AAS45 544.1	7.9
MAL5P1.115,	PF3D7_0515000	XP_005 263522.1	0.45
PFE0570w	PF3D7_0527500	AAA35 607.1	0.035
MAL5P1.150,	PF3D7_0612100	BAG57 085.1	0.016
PFE0750c	PF3D7_0613800	XP_005 262249.1	0.17
MAL5P1.274,	PF3D7_0616200	AAI006 71.1	0.15
PFE1370w	PF3D7_0621800	AAC26 849.1	0.31
MAL6P1.304,	PF3D7_0625200	CAA77 670.1	0.067
PFF0590c	PF3D7_1027800	BAC04 338.1	1.8
MAL6P1.287,	PF3D7_1110400	NP_004 710.2	0.041
PFF0670w	PF3D7_1121600	XP_005 250006.1	0.43
MAL6P1.264,	PF3D7_1126700	XP_005 264475.1	0.13
PFF0785w	PF3D7_1149000	AAN86 964.1	5.7
MAL6P1.210,	PF3D7_1239800	XP_006 721356.1	4.8
PFF1050w	PF3D7_1335100	AAC50 693.1	3.1
MAL6P1.176,	PF3D7_1339700	AAT37 906.1	0.37
PFF1220w	PF3D7_1340900	EAW54 242.1	6.6
PF10_0272	PF3D7_1351000	BAB71 006.1	0.021
PF11_0111	PF3D7_1427900	NP_219 481.1	0.092
PF11_0224	PF3D7_1448500	NP_057 467.1	0.031
PF11_0277,	PF3D7_1466300	EAW78 270.1	1.1
PF11_0278	PF3D7_1471100	BAB15 533.1	0.52
PF11_0506,			
PF11_0507			
MAL12P1.384,			
PFL1930w			
PF13_0197			
MAL13P1.202			
MAL13P1.206			
MAL13P1.256			
PF14_0257			
PF14_0463			
PF14_0632			
PF14_0678			

We next use Table 1b results to re-characterized our results in Tables 2-8 of Oyelade et al. This is presented in the supplementary material (SM). We listed for each protein in Table 1b, all signaling pathways (they participated in) of all groups of proteins as we have in Tables 2-8. This gave us 23 Tables: Table "PFD0090c", etc. The green color in the 3rd column indicated that this pathways has been listed before for another protein(s). Doerig et al.[24] gave a brief on the biochemical characterization of P. falciparum cell cycle regulators. These included the Calmodulin-dependednt kinase (CDK)s, their likes and the cyclin-like proteins. On the 19th and 20th of November, 2014, doing a wild search with the words "Calmodulin" and "cyclin-like" on the PlasmoDB, we got respectively 115 and 8 proteins. Looking for this in Table 1d above, we found only 3 proteins (highlighted in red) from the "Calmodulin" group. We then searched for these 3 proteins from these 23 Tables. We highlighted them in red and we hypothesized them as important drug-able signaling pathways as these are needed for the control of the cell proliferation in P. falciparum. A very interesting one of the 23 Tables is Table "MAL13P1.202". We re-produced this in Table 1e below:

TABLE 1E.

And a very interesting signaling pathway of the ones listed in Table 1e above is the one highlighted in blue in the last two columns.

Gene ID	Name	Minimum path	p-value	Details of genes	
				Genes IDS	Products
MAL13P1.202	Cyclic Nucleotide	PFB0190c--->PFC0435w--->PFE0660c --->PF10_0254--->MAL13P1.202	0.033	PFB0190c PFC0435w PFE0660c PF10_0254 MAL13P1.202	conserved Plasmodium protein, unknown function conserved Plasmodium protein, unknown function purine nucleotide phosphorylase, putative conserved Plasmodium protein, unknown function conserved Plasmodium protein, unknown function
		PFC0435w--->PFE0660c --->PF08_0129--->PF11_0111--->MAL13P1.202	0.028	PFC0435w PFE0660c PF08_0129 PF11_0111 MAL13P1.202	conserved Plasmodium protein, unknown function purine nucleotide phosphorylase, putative serine/threonine protein phosphatase, putative asparagine-rich antigen conserved Plasmodium protein, unknown function
		PFC0435w--->PFE0660c--->PFL2520w--->MAL13P1.202	0.016	PFC0435w PFE0660c PFL2520w MAL13P1.202	conserved Plasmodium protein, unknown function purine nucleotide phosphorylase, putative reticulocyte-binding protein 3 homologue conserved Plasmodium protein, unknown function
		PFC0435w--->PFE0660c--->MAL13P1.202	0.009	PFC0435w PFE0660c MAL13P1.202	conserved Plasmodium protein, unknown function purine nucleotide phosphorylase, putative conserved Plasmodium protein, unknown function
		PFB0190c--->PFC0435w--->PFE0660c--->MAL13P1.202		PFB0190c PFC0435w PFE0660c MAL13P1.202	conserved Plasmodium protein, unknown function conserved Plasmodium protein, unknown function purine nucleotide phosphorylase, putative conserved Plasmodium protein, unknown function
		PFC0435w--->PFE0660c--->PF08_0129--->MAL13P1.202	0.016	PFC0435w PFE0660c PF08_0129 MAL13P1.202	conserved Plasmodium protein, unknown function purine nucleotide phosphorylase, putative serine/threonine protein phosphatase, putative conserved Plasmodium protein, unknown function
	FIKK	PFA0130c--->PFE1590w--->PFL2520w--->MAL13P1.202	0.036	PFA0130c PFE1590w PFL2520w MAL13P1.202	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 reticulocyte-binding protein 3 homologue conserved Plasmodium protein, unknown function
		PFA0130c--->PFE1590w--->MAL13P1.202	0.007	PFA0130c PFE1590w MAL13P1.202	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 conserved Plasmodium protein, unknown function
		PFA0130c--->PFB0190c--->PFE1590w--->MAL13P1.202	0.039	PFA0130c PFB0190c PFE1590w MAL13P1.202	Serine/Threonine protein kinase, FIKK family, putative conserved Plasmodium protein, unknown function early transcribed membrane protein 5, ETRAMP5 conserved Plasmodium protein, unknown function
		PFA0130c-->PFE1590w-->PF08_0129-->MAL13P1.202	0.036	PFA0130c PFE1590w PF08_0129 MAL13P1.202	Serine/Threonine protein kinase, FIKK family, putative early transcribed membrane protein 5, ETRAMP5 serine/threonine protein phosphatase, putative conserved Plasmodium protein, unknown function
	Unknown genes	PFA0125c--->PFE0570w-->PFE1590w-->PF11_0277-->MAL13P1.202	0.036	PFA0125c PFE0570w PFE1590w PF11_0277 MAL13P1.202	erythrocyte binding antigen-181 RNA pseudouridylate synthase, putative early transcribed membrane protein 5, ETRAMP5 conserved Plasmodium protein, unknown function conserved Plasmodium protein, unknown function

This occurred in two other Tables of the 23 Tables. This pathway suggested another drug-able site: MAL13P1.202. The other two (sites) as indicted in this pathway have been found in two other pathways we have mentioned above.

We took interest in the 4 enzymes in bold above and look up literature on them. We found the following:

SN	Protein	Function	
1	MAL13P1.202	Conserved Plasmodium protein. Unknown function but expressed during blood stage of plasmodium	
2	PF11_0506 antigen 332, DBL-like protein (Pf332)	Immunological determinant Important for parasite invasion and survival in erythrocyte. Hence, good drug target. No literature on it has drug target	No experimentally determined structure available in pdb. Most structurally similar proteins are 1zro and 4qex with 36.5 identity.
3	**PFE0570w**	**RNA pseudouridylate synthase, putative. Catalysis the single nucleotide modification in RNAs necessary for RNA folding and function especially in rRNA. It's inhibition will alter protein sysnthesis. Hence, good drug target. No literature on it has drug target.**	**No experimentally determined structure available in pdb. Most structurally similar protein 2GML 31% identity.**
4	PF11_0277	Conserved Plasmodium protein. No known function. No literature on it has drug target	No experimentally determined structure available in pdb. No experimental determined structure. Most structurally similar proteins are 1f5n and 1dg3 with 20.7 identity.

From personal communication with Prof Dr Marcel Deponte, we arrived at starting further analysis on the RNA pseudouridylate synthase (putative). Since we found no PDB structure available for the protein, we build denovo structures for it as the following: We broke the protein sequence into domains using the EMBL INTERPRO protein sequence analysis and classification program. We arrived at 5 domains and then produced denovo structures for

theses domains using the I-TASSER protein Structure and Function prediction (http://zhanglab.ccmb.med.umich.edu/I-TASSER/). For the first domain, we used the Molegro Virtual Docker to set up a virtual screening and the SDF file for the ligand was obtained from zinc.docking.org. The substrate is Uracil. We found that there are 7 analogues of Uracil that binds better to the predicted structure than Uracil itself. Interestingly, one of them has a reported antiplasmodial activity [25].This initial finding gave us hope in our on-going search for other inhibitors. Currently we are continuing this virtual screening to obtain other inhibitors.

B. RNA pseudouridylate synthase functional expression in *E.coli* and purification

Optimization and Amplification of RNA Pseudouridylate Synthase Gene

The *Plasmodium falciparum* 3D7 strain purified genomic DNA (gDNA) was collected from Prof. Dr. Michael Lanzer's Laboratory, ImNeuenheimer Feld 324, University of Heidelberg, Heidelberg, Germany. After several attempts, the polymerase chain reaction (PCR) was carried out on the RNA pseudouridylate synthase gene (1:10 dilution) for 30cycles at 95°Cfor 10mins, 95°C for 45secs, 53°C for 45secs, 68°C for 2mins and 68°C for 10mins. The block temperature was 4°C. The forward and reverse primers with BamH1 and Not1 restriction sites used (at 1µM) were 5´-TTTTGGATCCATGTTTTTATTAACACATAACATAAA-3´ and 5´-TTTTGCGGCCGCTTAAAAAAAATATTCGTTGGGCATT-3´, respectively.

C. Purification of Polymerase Chain Reaction (PCR) Product

The PCR products were resolved on 1% agarose gel electrophoresis at 135V for 30mins (Fig. 3). The fragments were either purified from the gel using QIAquick gel extraction kit, Qiagen or from the whole PCR mix using QIAquickPCR purification kit, Qiagen, in accordance with manufacturer's instructions.

D. Cloning of RNA Pseudouridylate Synthase Gene

The RNA pseudouridylate synthase gene was cloned into a pet28a vector using BamH1 and Not1 sites. The ligation was overnight at 16°C using 1:3 and 1:5 backbone: insert ratio. This was followed by transformation into Top10 competent cells and plating on kanamycin plates. The plates were later incubated overnight at 37°C (please see Fig. 4 for the overnight plates).

E. Colony Polymerase Chain Reaction (PCR)

The colonies were picked and subjected to PCR (30 cycles) using OneTaq quick load polymerase at 94°C for 5mins, 94°C for 30secs, 47°C for 1min, 68°C for 2mins and 68°C for 5mins. The block temperature was 4°C. The forward and reverse primers used (at 1µM) were 5´-TTTTGGATCCATGTTTTTATTAACACATAACATAAA-3´ and 5´-GCTAGTTATTGCTCAGCGG   -3´, respectively. The PCR products were resolved on 1% agarose gel electrophoresis at 135V for 30mins, and the potential right clones were identified (Fig. 5).

F. Minipreps and Sequencing

The LB media containing kanamycin (50µg/ml) was inoculated with the potential clones and allowed to grow overnight at 37°C. Thereafter, the plasmids were isolated and purified using QIAprep

spin miniprep kit, Qiagen, in accordance with manufacturer's instructions. Subsequently, the plasmids were sent for sequencing at GATC Biotech sequencing company, Heidelberg, Germany, using Sanger's method (please see attachments for the results).

G. Expression and Purification

Vector containing gene of interest was transformed into *E.coli* cells (Rosetta) and expressed for 12-16hrs at 37°C with vigorous shaking using ZYM-5052 autoinduction medium supplemented with kanamycin (50μg/ml). The cells were harvested at 4,000 rpm for 20mins at 4°C, quick frozen, and stored at -80°C. For purification of the protein (enzyme), the cell pellet was thawed and resuspended in lysis buffer containing 50mM KPi pH 8.0, 300mM NaCl, 10mM imidazole and protease inhibitor tablet (1:50ml of lysis buffer). This was followed by sonication (100% power, for 6mins with 30secs waiting time in between. The membranes and cell debris were removed by centrifugation for 30mins at 20, 000 rpm. All subsequent steps were performed at 4°C inside the cold room. Further steps were carried out using Bio-scale mini profinity cartridge (Ni charged column), Bio-scale mini Bio-Gel p-6 desalting cartridge and Bio-Rad profinity Immobilized metal affinity chromatography (IMAC) machine in accordance with manufacturer's instructions. The composition of buffers used include: wash buffer (50mM KPi pH 8.0, 300mM NaCl, 20mM imidazole and 10% glycerol) elution buffer (50mM KPi pH 7.5, 300mM NaCl, 500mM imidazole and 10% glycerol) and storage buffer (50mM Hepes-KOH pH 7.25, 150mM KCl, 10% glycerol and 0.1mM EDTA). The eluent was then subjected to size-exclusion chromatography by gel filtration using storage buffer and Superdex 200 101300 GL column as mobile and stationary phase, respectively. The filtration was done on AKTA start instrument according to manufacturer's instructions (Fig. 6). The purity of the protein was further confirmed on 10% SDS-PAGE which invariably revealed a single band with a size corresponding to that of RNA pseudouridylate synthase (Fig. 7). The concentration of the protein was 0.67mg/ml, and stored at -800C.

F. Sequencing of Purified Protein by Mass Spectroscopy

To identify the nature of the purified protein, a gel of the purified protein with a single band in colloidal coomassie staining was submitted for sequencing at ZentrumfürMolekulareBiologie der Universität Heidelberg, room 401, ImNeuenheimer Feld 282, Heidelberg, Germany. The results were retrieved and presented in Table 2 with some proteins that shared less significant percentage similarity with the sample of purified protein submitted. By implication, this might require further validation via testing the functionality of the protein.

III. RESULTS

1.695 bp
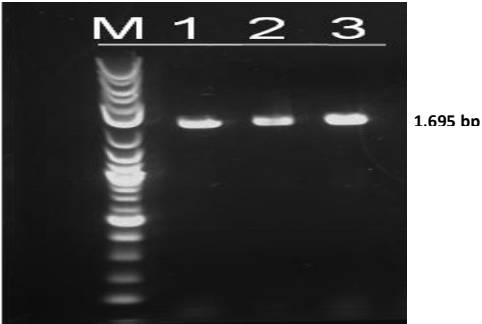
Fig. 3: Resolved PCR products on 1% agarose gel electrophoresis. M: marker, lane 1-3: RNA pseudouridylate synthase gene amplified fragment.
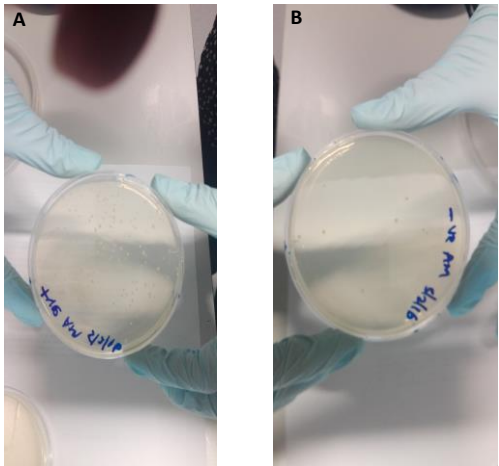
Fig. 4: The overnight incubated plates at 37^{0}C. A: positive plate having both backbone (vector) and insert; B: negative plate having only backbone.
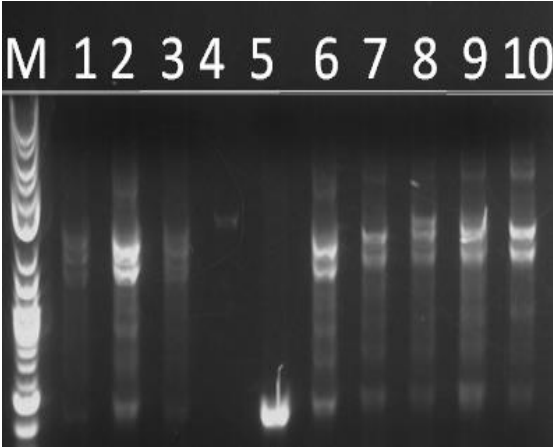
Fig. 5: Resolved colony PCR products on 1% agarose gel electrophoresis. 1,695 bp M: marker, lane 4 (potential right clone containing RNA pseudouridylate synthase gene).
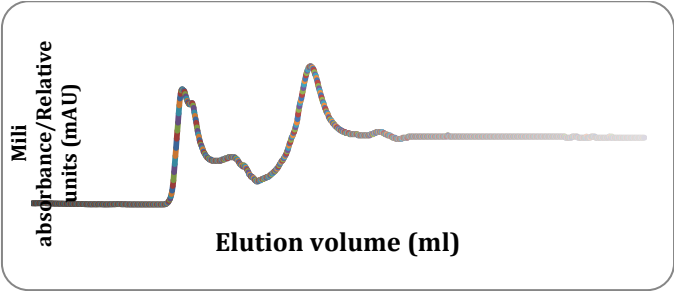
Fig. 6: The elution profiles of the purified protein after size exclusion chromatography (gel filtration).
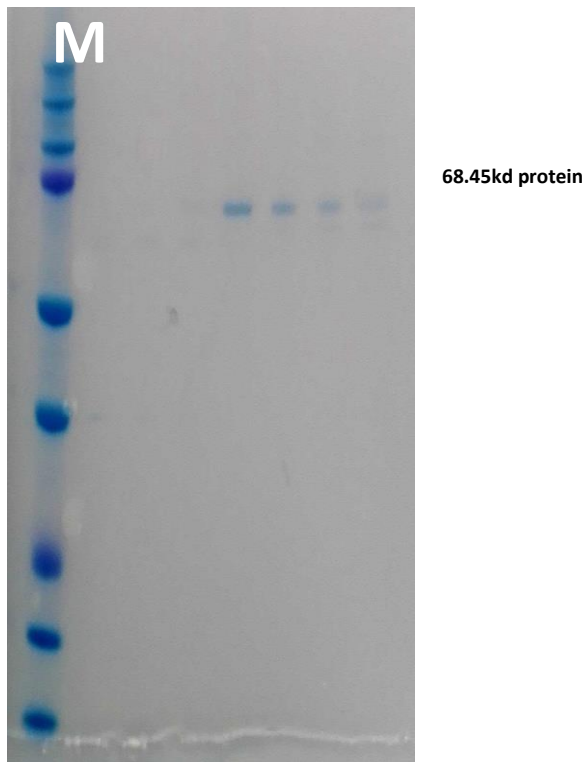
68.45kd protein

Fig. 7: Purified RNA pseudouridylate synthase protein. M: marker, lane 1: Eluent A9, lane 2: Eluent A10, lane 3: Eluent A11, lane 4: Eluent A12 corresponding to 68.45kD after gel filtration.

TABLE II. PROTEINS THAT WERE IDENTIFIED FROM MASS SPECTROSCOPY ANALYSIS WITH PERCENTAGE COVERAGE OF THE FRAGMENTS GENERATED FROM THE SAMPLE OF PURIFIED PROTEIN SUBMITTED

S/N	Proteins with similar fragments	Percentage(%) coverage of fragments
1	Bifunctionalpolymyxin resistance protein ArnA	64
2	Keratin, type I cytoskeletal 9	18
3	Keratin, type II cytoskeletal 1	36
4	Keratin, type I cytoskeletal 10	25
5	Keratin, type II cytoskeletal 2 epidermal	25
6	Trypsin	8
7	Chaperone protein HtpG	30
8	Chaperone protein DnaK	29
9	30S ribosomal protein S1	21
10	Threonine--tRNA ligase	8
11	Keratin, type II cytoskeletal 5	10
12	Keratin, type I cytoskeletal 14	9

IV. DISCUSSION AND CONCLUSION

The increasing failure of the present antimalarial drugs is an alarming signal necessitating the development of novel drugs and identify novel drug targets in Pf. We have identified RNA Pseudouridylate Synthasein Pf and successfully carried out a functional cloning of its open reading frame in E. coli. The molecular weight of the protein expressed by E. coli is similar to that of *plasmodium* RNA Pseudouridylate Synthase. Our finding is consistent with that of Njuguna et al [26]. The biochemical impairment in ribosomal activity via inhibition of this enzyme is expected to manifest as decreased translational fidelity in Pf. [27]. Ribosomes play a critical role in protein synthesis, hence, in fast growing organisms like blood stage Pf, characterizing and inhibiting enzymes associated with ribosomes is highly promising as drug targets. It is important to note that RNA Pseudouridylate Synthaseis for the first time completely expressed in *E. coli* and purified. This is an important step to be able to establish its 3D structure via X-ray crystallography or NMR and the assessment of this protein as a novel drug target. For the establishment of its 3D structure, we are working on two proteins in this direction, that included the one studied in this paper, via a PhD research work in collaboration with the Institute of Pharmacy and Molecular Biotechnology (IPMB), Heidelberg University, Faculty of Biochemistry, Tuebingen, University and the department of Biochemistry at the Cambridge University.

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Electioneering Campaigns, Solid Waste and Sustainable Physical Environment in Nigerian Cities: A Case Study of Lagos Metropolis

Professor Debora A. Egunyomi
adeolagoodwill@yahoo.com
Department of Adult Education
Faculty of Education
University of Ibadan, Ibadan, Nigeria

Kofo A. Aderogba (PhD)
kofoaderogba@yahoo.com
Department of Geography & Environmental Management
Tai Solarin University of Education
Ijagun, Ijebu-Ode, Nigeria

Abstract: This work has studied the waste generated in the 2015 general election as well as the consequences, and made recommendations for a sustainable physical environment. Lagos Metropolis was used as a case study. 50 major streets and roads of the Metropolis were toured. Photographs of portraits, logos, billboards and handbills were taken. Internet browsing was carried out, interview were conducted with 2 chieftains each of 3 of the 29 political parties, and 3 Managers of 3 of the renowned printing companies that printed for the parties were interviewed. The investigators joined campaign trails and observed the display of campaign materials. Maps, charts, and tables were used for data analysis and presentation. Photographic shots taken were well represented. Degradable and non-degradable waste were generated: printing papers, clothes, fliers and billboards, party uniforms and attires, souvenirs, etc. made of wood, nails, iron rods, metal sheets, plastics, synthetic fibres, gum and yarn etc. were abandoned in the physical environment after the elections. The Metropolis had additional 31,020 kg undesirable material which became instruments of soaring and unabated environmental pollution, erosion blockage, hideouts for destitute and disease vectors. They made the once scenic environment ugly. Electoral programmes and policies should incorporate guidelines on the type of campaign materials and their likely impact on the physical environment. Politicians and the electorate also require adequate education.

Keywords: Political activities, solid waste, sustainable physical environment, Lagos Metropolis.

Introduction

Electioneering campaigns, that is, drives for votes and supports of electorate by political parties have always been part of politics [1]. The history of political thought and politicking can be traced back to early antiquity, with seminal works such as those of Plato *Republic*, Aristotle *Politics* and Confucius [1, 2]. *Politics* (from the Greek *politikos*, meaning "of, for, or relating to citizens") is the practice and theory of influencing other people. More narrowly, it refers to achieving and exercising positions of governance - organized control over a human community, principally a nation and or its major political divisions. It is the study or practice of the distribution of power resources within a given community (a hierarchically organized population) as well as the interrelationship(s) between communities and groups of people.

A variety of approaches are employed in politics. These include promoting one's own political views among people, negotiation with other political actors, formulating policies, making laws, and exercising power, as well as competition against opposition [3, 1, 4]. It is exercised on a wide range of social levels, from clans and tribes to sovereign states and international institutions. Often, it is said that politics is about power; and a political system is a framework which defines acceptable political methods within a given society [5, 3]. These authors are of the view that politics refers to the

operation of constitutional system of government and publicly defined institutions and procedures. Thus, political parties, public policy or discussions about war and foreign affairs would fall under the category of *Formal Politics*. On the other hand, *Casual Politics* is understood to refer to forming alliances, exercising power and protecting and advancing particular ideas or goals - generally, anything affecting one's daily life, such as the way an office, company or household is managed, or how one person or a group exercises influence over another. *Casual* (*Informal*) politics is typically understood as everyday politics, hence the idea that "politics is everywhere," and "every man is a political animal" [5, 3, 2]. In both scenarios, a government is formed to run the affairs. Often, it is usually competitive to select and or vote into power the persons that will be in government. Electioneering processes and the intricacies of the processes and procedures for putting persons into political offices are beyond the scope of this work, but it is sufficient to know that resources, animate and inanimate, are expended and massive waste habitually results.

In the course of electioneering campaigns in Nigeria, as it is in other communities and nations, for electing individuals and groups to fill positions into elective offices, there is typically an enormous display of electioneering campaign materials to canvass for votes and to get the electorate convinced of the capability and or worth of a candidate over different contesting individuals and parties. But the quanta of campaign materials seem to be too weighty and abnormally massive in Nigeria, particularly in the last general election. Solid waste was hugely and enormously generated; and an unprecedented increase in the quantity and spread was experienced.

Hitherto, an appraisal of municipal solid waste in Lagos Metropolis was done and non-conformity of urban dwellers with waste management policies and practices were identified [6, 7]. It is averred that the challenges of urban waste in Nigeria can only be effectively addressed through private sector participation [7, 8]. In the conclusion of a study, it is recommended that outsourcing of waste disposal for sustainable waste management at Agege Local Government Area of the Metropolis may be the best practice [9]. Earlier, some scholars dwelt on issues and problems of solid waste with particular emphasis on "Sustainable Private Sector Participation (PSP) in Solid Waste Management" [10, 11]. Both works recommended strategies, programme and policies towards sustainable management of waste. But no heed has been paid to their recommendations. An outline of how to include the concept of waste and waste management in school curricula so as to create an awareness in schoolchildren about waste - to catch them young - using Lagos as a case study is the focus of the others [12]. But the challenges of waste and its management have kept on erupting and exacerbating in different dimensions in a way that it has become monstrous to metropolitan governments and urban dwellers in many developing countries [13, 14, 15]. However, in a succinct style, how such waste could be preserved, recycled and reused and or generally turned to wealth, and or minimized have been systematically outlined by a number of scholars too [16, 17].

More recently, there were studies of waste dumps in Lagos metropolis; and plastic waste in Nigeria [18, 19, 20, 21]. The

consequences of poor management have been appalling and call for urgent attention [20, 6]. Notwithstanding, all of the works have not touched on waste that results from political campaigns and related activities. For instance, Aderogba's works on Christmas waste dwell on celebration waste, whose content/composition, volume, spread and concentration differ significantly from waste due to political activities. Hence, the need for this research.

The paper has examined waste generated during the electioneering campaign in 2014/2015. Lagos Metropolitan Area is used as a case study, and the 2015 general election was the focus. This paper did not touch on money wasted. Neither did it concern itself with the loss of lives and property. Also, the economic advantages that may have resulted were not considered.

Lagos Metropolis

Lagos was originally inhabited by the Aworis, a sub-group of the Yoruba of West Africa (Nigeria). They were conquered by the Benin Empire, and the island became a Benin war-camp called "Eko" under Oba Orhogba of Benin in the 15th Century. The residents still use the name Eko to refer to Lagos, which means "lakes" given to the settlement by the Portuguese. It was following its early settlement by the superior Awori and its conquest by the Benin warlords that the area came to the attention of the Portuguese in the 15th century [22]. The remainder of modern-day Nigeria was seized in 1887, and when the Colony and Protectorate of Nigeria was established in 1914, Lagos was declared its capital, and continued as such after the independence from Britain in 1960. Along with migrants from all over Nigeria and other West African nations were the returnee ex-slaves known as Creoles, who came from West Indies, Brazil, Sierra Leone and other countries. All these contributed to the modernization of Lagos.

Rapid growth and development throughout the 1960s and 1970s as a result of economic boom in Nigeria prior to the Civil War were experienced with a population explosion, unplanned economic growth, and massive rural-urban migration. This caused the outlying towns and settlements to develop rapidly, thus forming the *Greater Lagos Metropolis* seen today [23]. See also Fig. 1 (a) to (e): Lagos in early 1929; urbanized centres; and selected major areas of interest [22, 23]. On 14 November 1991, the city was stripped of its status when the Presidency and other federal government agencies were relocated to the purpose-built Federal Capital Territory (FCT), Abuja.

[a]

[b]

[c]

[d]

[e]

Fig. 1: [a]Aerial views of Lagos in 1929; [b] Map of Lagos major areas; [c] Lagos Skyline as seen from the harbour near Victoria Island;(d) Toll gates and roads on the Lekki-Ẹpẹ Expressway,and [e] Two of the Four Stadia - TeslimBalogun and National Stadia.

The amalgamation can simply be referred to as Lagos Metropolitan Area. (See Fig. 1 [b]). She is nicknamed *Lasgidi* with the slogan *Eko o ni 'baje*. The origins of Lagos are still seen in the layout of the LGAs which display the unique identities of the cultures that created them. See Table 1 showing the 16 Local Government Areas by land area, population size; and density. The total land mass is 999.60 km^2 with a total population of 7,937,932 people and a density of 7,941 persons per km^2 (see Table 1).

Table 1: The 16 Local Government Areas of Metropolitan Lagos

Local Government Areas	Land area (in km²)	Population (2006 Census)	Density (per km²)
Agege	11.2	459,939	41,071
Ajeromi-Ifelodun	12.3	684,105	55,474
Alimosho	185.2	1,277,714	6,899
Amuwo-Odofin	134.6	318,166	2,364
Apapa	26.7	217,362	8,153
Eti-Osa	192.3	287,785	1,496
Ifako-Ijaiye	26.6	427,878	16,078
Ikeja	46.2	313,196	6,785
Kosofe	81.4	665,393	8,174
Lagos Island	8.7	209,437	24,182
Lagos Mainland	19.5	317,720	16,322
Mushin	17.5	633,009	36,213
Ojo	158.2	598,071	3,781
Oshodi-Isolo	44.8	621,509	13,886
Somolu	11.6	402,673	34,862
Surulere	23.0	503,975	21,912
Metropolitan Lagos	999.6	7,937,932	7,941

Source:National Population Commission (2006). *Results of 2006 Head Count and Population Census*. Abuja: National Population Commission.

According to the National Population Commission (2006), the population is over 5.00% of the national population.The Metropolis contains 88.00% of the population of Lagos State including the semi-rural areas.; and among this proportion were the electorate for the 2015 general election in the Metropolis in particular, and the state and the nation by extension. She covers about 37.00% of the land area of the entire Lagos State which is home to 85.00% of the all-inclusive population of the entire State. It is the most populous city in Nigeria, the second fastest growing city in Africa, and the seventh fastest in the world [24, 25]. The United Nations [25, 26] also affirm that the Metropolis, with the present rate of growth may soon become the third largest mega city in the world, that is, after Tokyo in Japan and Bombay in India. The density depicts certain

spatial distinctions: the highest concentrations were found at Apapa, Ajegunle, Mushin, Agege and Alimosho; and the least were at Victoria Island and Ikoyi. About 45.00% of Nigeria's electricity generated and about 50.00% of petroleum products are consumed in Lagos Metropolis [6, 27, 28]. There is a huge spectrum of wealth distribution among the people that reside in the Metropolis. It ranges from the wealthy to the poor. She has attracted youth and families seeking better living standard from all other parts of Nigeria, the West African sub-region and beyond.

Today, the word *Lagos,* most often, refers to the urban area called "Metropolitan Lagos" in Nigeria. The Metropolis hosts about 176 foreign embassies as well as the headquarters of international organizations, trade unions, non-profit organizations, lobbying groups, and professional associations [22, 25]. To sum it up, while distinguishing between the core economic activities of the different areas, it is asserted that Apapa is the home of modern ports of Lagos, Eti-Osa is the home of the largest business centres, and Lagos Island is the historical centre and commercial core of the Metropolis [28].

Undoubtedly, the Metropolis is not only significant politically, socially, economically and diplomatically to Lagosians, the state and Nigeria in general, but also to the world in many respects. Therefore, with the multiplicity of functions and multi-various social and economic activities, waste is bound to be generated in kinds and in large quantities too. However, this should not be to the detriment of the dwellers and the environment. The emphasis of this work is on a single but significant segment of waste in Lagos, namely waste generated from electioneering campaigns by political contestants in the 2015 general elections.

Methodology

50 major streets and roads of the Metropolis were toured between January 2014 and May 2015 when the electioneering campaign posters, flags and pamphlets were posted on different surfaces: walls of buildings, fences, culverts and bridges, existing bill boards, bus stops, waste bins, electric poles, trunks of ornamental plants, bodies of vehicles, road signs, etc. Internet browsing was extensively carried out. Every day, for six months – 1st October, 2014 to 27th March, 2015, three national dailies (*The Guardian, Vanguard and Punch)* were perused, and the number of pages on political campaigns for each paper for each day was reckoned. A questionnaire that contained 16 questions was administered to 70 residents of the Metropolis that were randomly selected irrespective of educational qualification, religion, political inclination and profession, but none of them was less than 40 years old, and both males and females were included in the sample. In-depth interviews were conducted with 2 chieftains each of 3 of the 29 political parties in the State. The State Resident Electoral Commissioner was interviewed and he provided some salient data and information. 3 Managers of renowned 13 printing companies that printed for the parties were interviewed. The All Progressives Congress (APC) held a one-million-man rally on Saturday 7th March, 2015. The rally started by 8:00am (local time) in Lagos. It began from Maryland through Allen Avenue and ended at Alausa, behind the Ikeja City Mall. The investigator, joined the campaign trail and observed the display of campaign materials. A

number of photographic shots of billboards, handbills, portraits, logos etc. were taken, and these were well represented in the findings. The material waste was classified into degradable, non-degradable and others. The likely consequences on the environment in the Metropolis were measured with 14 pre-determined answers. Qualitative Content Analysis was applied for data analysis and presentation [29]. Maps, charts, and tables of percentiles, and Likert scales were used for data analysis and presentation. The paper is devoid of detailed explanations of the fray and frenzy that attended the outcome of the elections, though it is constrained to touch tangentially on the attitudes of the politicians.

Findings

The first ever recognized and registered political party in Nigeria was the Nigerian National Democratic Party (NNDP), founded by Herbert Macaulay in 1923. But the NNDP and National Council of Nigeria and Cameroons/National Council of Nigerian Citizens (NCNC) existed between 1960 and 1966 [7]. With the demise of the First Republic, these became extinct. The Second Republic (1979-1982) had six political parties. The abortive Third Republic had just two political parties twisted by the then military government: National Republican Convection (NRC) and Social Democratic Party (SDP). Between 1996 and 1998, there were seven (7) registered political parties among which were National Democratic Coalition (NADECO), Democratic Party of Nigeria (DPN) and Justice Part (JP). Currently, in the Fourth Republic, there were 29 registered parties. These include Peoples Democratic Party (PDP), and the main opposition, All Progressives Congress (APC). Aggressive campaigns, and use of fliers and

posters were engaged in by all of them [30]. The political offices that were scheduled for the 2015 general elections were the Presidency, Senate, House of Representative, Governorship and the State House of Assembly. Altogether, in the metropolis, there were 94 positions being contested for by over 420 candidates.

Historically, common to all general elections and political parties in Nigeria and elsewhere is the electioneering campaigns that usually precede the exercise [4, 3]. Also associated with it are campaign materials [1, 31]. In Nigeria, these have not been uncommon, and have been experienced in various dimensions, but the 2015 elections took a different form. The rest of this paper examines the quantum and kinds of materials used by or on behalf of the over 395 candidates.

The Independent National Electoral Commission (INEC) is the government organ saddled with the responsibility of conducting the elections. It had at its disposal enormous resources including;Information kits for the 2015 General Election, manual for Election (2015), basic Security arrangement for election duties, Political Parties Code of Conduct, Permanent Voters Cards (PVC) for the electorate, Electronic Card Reader Machines, Trained and trainable electoral officers, and Others.

In addition, there were considerable campaigns and appeals on radio, television and newspapers to individuals, groups and organizations to support and guard against violence, but turn out en masse to vote for candidates of their choice.

The 2015 elections were scheduled to hold on 8th and 22nd March, 2015 for the Presidential and National Assembly seats, and the gubernatorial and State Houses of Assembly respectively, but the dates were later shifted in

order to give the Independent National Electoral Commission (INEC) time to adequately prepare. The two streams of elections were eventually held on 28th March and 11th April, 2015.

The deployment of massive logistics – materials and machines – resulted in the generation of enormous waste. There was rancour but also peace talks were held between the parties, their chieftains and especially their flag bearers. For instance in a peace meeting, AkinwunmiAmubode and Jimi Agbaje - the gubernatorial candidates of the most prominent parties, the APC and PDP, both expressed commitment to the promotion of peaceful participation before, during, and after the elections and also agreed to accept the outcome of the polls, whatever it may be and to seek redress for any perceived injustice through legal and legitimate means. In respect of the peace meeting alone, huge materials were expended: billboards, handbills, fliers, party uniforms and attires, umbrellas, brooms, etc.

Fig. 2: Portraits of Jimi Agbaje and AkinwumiAmbode of the PDP and APC respectively after signing the Peace Pact

Fig. 2 shows the portraits of the two most prominent gubernatorial candidates, those of the APC (AkinwumiAmbode) and the PDP (Jimi Agbaje), that is, among the several portraits and other campaign items applied just at the accord meeting. There were also floods of flags, portraits of individual and party chieftains

strategically mounted on walls, fences, electric poles, tree trunks, vehicles and other objects pasted and hung to showcase the accord for peaceful elections only.

Waste Materials: Apart from formal and informal verbal speeches, in churches and mosques, and among youth and community leaders and the elite, and through communications service providers, radio and television stations, there were fliers, handbills, billboards, house to house campaigns with souvenirs and other items that were ostentatiously and massively pasted, stapled and pinned while others were just hung and or placed at strategic locations, sometimes, through animated billboards to woo the electorate. All party houses/offices in the Wards, and at the State Headquarters were adorned with portraits of contenders from the Presidential/Vice Presidential candidates to the Senatorial, Gubernatorial, House of Representatives and state Houses of Assembly candidates.

The materials were made of metal rods, bolts and knots, nails, washers, metal sheets, cardboard papers, printing sheets of varied grams, plastics, clothes, concrete poles of various sizes and shapes, wood and planks, thread and yarn, gum and starch and others. In weight, concrete poles-the heaviest- were estimated to be about 2,960 kg, followed by metal rods (2,880 kg) and plastic materials (2,320 kg). The least in weight were cello tapes and masking tapes (500 kg), foil (110 kg), thread and yarn (100 kg), and gum/starch (220 kg). Table 2 shows the quantum by type, weight and relative proportion of one to the others. In other words, within the period, the Metropolis added additional 31,020 kg undesirable materials around the houses, along the roads, on the walls and fences of buildings, etc. Concrete

poles accounted for 9.54% of the total, and metal rods, nail washers, bolts and nuts, put together, were as much as 9.29%, gum and starch (0.71%) and foil (0.36%). Thread and yarn (0.32%) were the least in proportion. The challenge is that the usage and usefulness of these materials were transient as – almost immediately after, the elections they were discarded and abandoned.

Table 2: Election Materials- Wastes by Type and Estimated Quantity in the Metropolis

Items Type	Estimated Quantity ('000 Kgs.)	% Proportion
Metal Rods, Nails, Washers, Bolts & Nuts	2.88	9.29
Metal Sheets	2.14	6.90
Cardboard sheets	1.84	5.93
Printing Paper	2.11	6.80
Plastic Materials	2.32	7.48
Clothes	2.21	7.12
Banners (Cloths)	1.91	6.16
Polyester sheets	1.84	5.93
Cello tapes and Masking Tape	0.50	1.61
Concrete poles	2.96	9.54
Gum/Starch	0.22	0.71
Tinfoil	0.11	0.36
Wood & Planks	1.94	6.25
Particle Boards	2.01	6.48
Paints and Chalk	0.92	2.97
Thread & Yarn	0.10	0.32
Foods & Snacks	1.08	3.48
Drinks & Beverages	2.31	7.45
Others (Specified)	1.62	5.22
Total	31.02	100.00

Source: Field Work

Between 1st October, 2014 and 27th March, 2015, three national daily newspapers were perused; and the number of pages in political campaigns on each paper for each day was not less than 14. It was more than 18 pages on some days for some papers. Newsprint for the period that was devoted to electioneering campaigns was conservatively estimated to be about 2,860 kg.

*Types of Waste:*The waste in its various forms, colours and makes, was posters, handbill, portraits, paintings, and other forms on available surfaces except where the concern had written *POST NO BILLS*. Otherwise, all major roads, streets, crescents and lanes were inundated with all manners of these. In some instances, all spaces on the walls and fences of any street, road, crescent, lane or public walls were covered over, see Fig. 3, [a] to [l]. They are a sample of photograph of the different presidential candidates and their running mates, gubernatorial candidates of Lagos State, and the logos of the two most prominent political parties (PDP and APC), all displayed within the Metropolis. The posters were not been arranged in any particular order.

[a]

[b]

[c]

[d]

[e]

[f]

[g]

[h]

Fig. 3: [a] GoodluckEbele Jonathan of PDP; [b] Muhammadu Buhari of APC; [c] Jimi Agbaje of PDP; [d] AkinwumiAmbode of APC; [e] and [f] APC and PDP Logos; [g] Muhammadu Buhari/YemiOshinbajo; and [h] Portraits of GoodluckEbele Jonathan/Mohammed Namadi Sambo.

Each candidate had as many as 19 different kinds of their portrait. No candidate had less than 7. There was none of the commissioned printing firms that expended less than 22.22 kgs of printing materials (paper, ink, binding materials etc.). The sizes of the portraits ranged from 0.2 x 0.2 m to 2.0 x 16.0 m with the names of the contenders and the inscriptions of their respective party names and abbreviations – the broom and the umbrella as well as those of candidates of other parties.

Some other handbills were as small as the size of complimentary cards. There were souvenirs – bags, purses/wallets pencils, biros,

exercise books, note pads, plastic plates, jugs, drinking glasses, dishes, baseball caps, brooms, umbrellas, diaries, wall clocks, table clocks, T-shirts, key holders, weighing machines and others. Most prominent among them were those of the All Progressives Congress (APC) and the People's Democratic Party (PDP), but all of them had an array of colours that were beautifully combined. The APC's logo has a green-white-blue background with a broom on the white background, and a red base. The group also adopted "Justice, Peace and Unity" as its motto, and "Change" as its slogan; see Fig. 3 (i). On the other hand, the PDP has an umbrella with Green, White and Red colours as the background, and on each colour segment of the umbrella, the inscription, P, D and P and or the slogan, "Power to the People" is the slogan (see Fig. 3 [j]). All other political parties similarly have fliers, posters, uniforms, costumes, souvenirs, logos, slogans and colours by which they identify themselves.

(a)
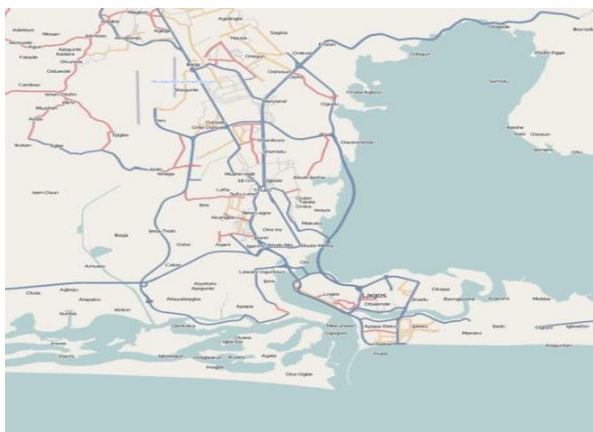
(b)
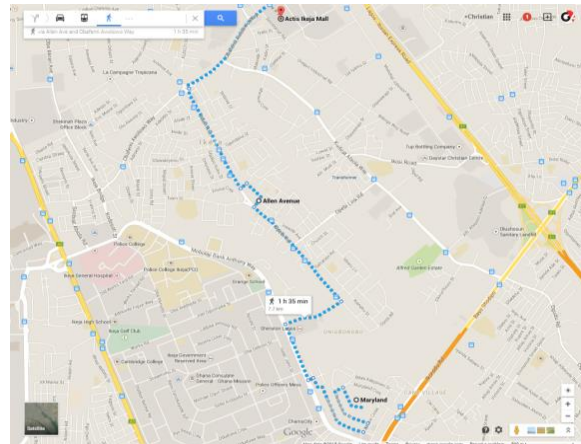
Fig. 4: (a). Map of major road links in greater Lagos; and (b) Route through which an Opposition Party toured with massive campaign items during an Electioneering Campaign on 7th March, 2015.

Fig. 4 [a] is map of major roads, streets, crescents and lanes that were emblazoned with posters, billboards, etc.; and Fig. 4 [b] is the route of the mega rally that was carried out by one of the political parties on 7th March, 2015 respectively. The rally that started by 8:00am from Maryland through Allen Avenue and ended at Alausa behind City Hall lasted almost eight hours. There was also a massive display of campaign materials on vehicles of all brands and makes, walls of buildings, electricity poles, commercial sign posts, road signs, motorcycles, tricycles and others. A considerable amount of fliers were given out as the campaign trail moved from Maryland to Alausa. Some of the flyers and the handbill were chunked out indiscriminately onto the roads and streets. This is not peculiar to one political party but all, that is, during campaign in particular.

The material items were not arranged in any particular order, and neither was any set allowed to stay for up to three days before being defaced or pasted over with fresh ones of the same candidates or of different candidates of other parties. The opposition destroyed and

defaced the portraits of their opponents. Sometimes, posters were pasted in layers of up to 10 in some instances.

Typically the Lekki - Epe Expressways, the Third Mainland Bridge, Lagos - Badagry Expressway, and Mushin Isolo and ApapaIsolo Expressways and other highways were massively deployed on both sides of the highways. The materials were also made of iron rods, washers, nails, electricity cables, and pieces of wood, plastics, planks, clothes and cloths, plastic materials, degradable and non-degradable types. Where it was dual carriageways, the road divides were equally tremendously posted over with the materials. There was scarcely any space, road, street or lane without portraits and fliers in huge quantities. Indeed, at each electioneeringcampaign and mere gathering of the politicians, there were great loads of printed materials.

*Structure, Pattern and Trend of the Waste:*The waste were classified into three: degradable, non-degradable, and others. Only 43.10% were degradable (wood, paper, planks, palm fronds, etc.). 56.40% (plastics, iron rods and nails, etc.) were non-degradable, but 0.50% could not easily be classified by this work. Table 3 shows the spatial pattern of the quantum and concentration of all the waste (degradable, non-degradable and unclassified) by Local Government Area. It was found that this was most substantial at Alimosho (2,980 kg) followed by Shomolu (2,830 kg), Surulere (2,620 kg) and Apapa (2,600 kg). There was nowhere it was less than 1,710 kg, (see Table 3). The total for the Metropolis is 31,020kg. The average level of waste concentration was lowest in Agege, Ajeromi, Ifelodun, and IfakoIjaye Local Government Areas only; but high in

EtiOsa, Lagos Island, Lagos Mainland and Surulere Local Government Areas. It was rated medium on the average in the others, namely Alimosho, AmuwoOdofin, Apapa, Kosofe, Mushin, Ojo, Oshodi-Isolo and Shomolu Local Government Areas, (see Table 3).

Table 3: Spatial Pattern and concentration of the Waste by Local Government Areas

Local Govt. Area	Estd. Quantum of Waste ('0 kg)	Ave. Levels of Concentration
Agege	2.41	Low
Ajeromi-Ifelodun	1.85	Low
Alimosho	2.98	Medium
Amuwo-Odofin	1.71	Medium
Apapa	2.60	Medium
Eti-Osa	1.82	High
Ifako-Ijaiye	1.80	Low
Ikeja	2.31	High
Kosofe	2.32	Medium
Lagos Island	2.05	High
Lagos Mainland	2.01	High
Mushin	2.21	Medium
Ojo	2.01	Medium
Oshodi-Isolo	2.21	Medium
Somolu	2.83	Medium
Surulere	2.62	High
Metropolitan Lagos	31.02	Medium

Source: Field Work
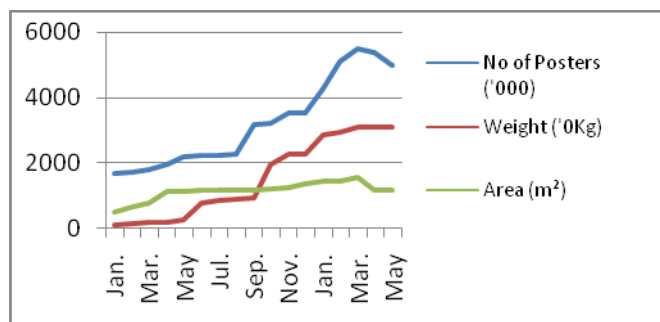
Fig. 5: Trend of Area of Coverage, Weight and Number of Posters (January 2014 to May 2015)

Fig. 5 shows the trend by area of coverage, weight and number of posters, handbills and others in the 17 months between January 2014 and May 2015. The total estimated area of coverage in January, 2014 was about 500 m^2. It increased to over 1,590m^2 in March, 2015 though it started waning from that month. The decline continued until May, 2015. The number of posters was 180,000 in January 2014, but increased gradually over the period to over 480,000 in March 2015; and by May 2015, the number started plummeting, to about 400,000, that is, when the elections had been over, posters, fliers etc. were no longer used; and the existing ones had started fading off.

The estimated weight displayed a similar trend: It was about 10,700 kg in January 2014. It increased to 29,260 kg in February 2015 and to 31,021 kg in March; see Fig.5. These figures were confirmed with the estimates and actual amount of printed work done by principal printing companies that worked for the political parties and their agents.

Poor Management and Consequences: Immediately after the elections (11th April, 2015), in a matter of days, the campaign materials were no longer in use. There was no need for them again. They thus became waste - political waste, an aftermath of elections. But how were they managed? Table 4 shows how.

Table 4: How the Waste was managed

Method of Disposal	No. of Respondents	Percentage
Cleared and Kept	2	2.86
Collected and Re-used	1	1.43
Collected and Burnt/Disposed of	6	8.52
Kept as Adornments	19	27.14
Abandoned	70	100.00
All of the Above	41	58.57
None of the Above	0	0.00
Others (Specified)	3	4.27

Source: Field Work

A respondent picked more than one of the pre-determined responses (8). 55.71% kept them as an adornment. 2.86 % cleared and kept them. But only an insignificant proportion 1.43% collected and re-used the materials, probably directly and or re-cycled. All the respondents, 100.00% agreed that the waste were generally abandoned and allowed to fade away as time passed by, Table 4.

There were unprecedented increases in waste generated in the months of December 2014 to March 2015 when the campaigns were fieriest. Importantly, the World Health Organization (WHO) [32], United Nations (UN) [25, 26] and environmentalists have consistently warned against the implications of printing material waste in the environment of man [25, 28, 33]. The materials printed and generated were not just mere degradable substances but also non-degradable, toxic and some carcinogenic. Like what may be called traditional waste, it results in a gangrenous and unsustainable physical environment. The quantity and the density were highest in the high densely residential areas where handbills were chunked out and freely distributed unsolicited; as well as in those places where there were enough spaces to paste and display fliers and install billboards of various sizes and shapes. Unfortunately, they also turned out to be subject of admiration to ordinary folks.

After the elections, along streets, roads, expressways, crescents, lanes and even along

pathways, the materials overshadowed and surpassed normal commercial billboards and road signs. Walls, gates, and fences of political offices at the party wards, constituency and State headquarters offices were awash with portraits of the different contestants, and of course, the logos of the respective political parties also.

The materials became instruments of soaring and unabated environmental pollution, erosion blockages, hideout for destitute and breeding ground for disease vectors. Above all, the waste turned the scenic environment horrendously ugly.

Incidentally, none of the resources available to the INEC was scheduled for, and or meant to take care of the waste; and neither were there any policy statements and or programmes that anticipated the management of the waste resulting from electioneering campaigns. It was weird, and embarrassing to the urban dwellers and probably to the Metropolitan, local and state governments.

There is indeed a policy whereby the Lagos State Government, like some other States, restricts residents to their homes for three hours (between 7a.m. and 10a.m.) every last Saturday of the month to clean their environment. However, the exercise may have been quite inadequate to cope with the enormity and extent of election materials waste generated, even if waste close to residential buildings was taken care of in such exercises. Despite that, while delivering judgment in a suit filed by a human rights lawyer, a judge held that "the policy of restricting the movement of citizens during the monthly environmental sanitation exercise was unlawful and illegal, because, he said, there was no law in force in the state by which any citizen could be kept indoors compulsorily." An

excerpt from the newspaper report says that [33]:

The court found that the 1999 Constitution grants freedom of movement to every citizen, and such freedom cannot be taken away by executive proclamation in the absence of any law to that effect. [It] found that there is no regulation in force presently in Lagos State, which authorizes the restriction of movement of citizens, on the last Saturday of the month, for the purpose of observing environmental sanitation. The court therefore voided the power of the state government and its agents to arrest any citizen found moving between 7a.m. and 10a.m. on the last Saturday of every month when the environmental sanitation exercise is observed.

In other words, not even the monthly environmental exercise can tackle the waste generated in this way. A resident of Mushin, a suburb of the Metropolis lamented that:

No other adverts [billboards] surpasses them in number, spread, and aesthetics .... The APC, PDP, Labour, ADC, KOWA ....all have what it takes to put up the best billboards for the campaign... on the pages of newspapers, on radio, television and so on; in every nook and cranny, a candidate is represented by over 10 posters of different kinds strategically placed. Some were operated and controlled electronically. Rain has come; see the gutters filled; the drainage channels are filled already. Those on the walls shall be washed down. It is nothing but floods that will follow .... nobody thinks of removing any, ... everywhere is littered and remains unkempt, dirty and filthy. During future elections, INEC may have to make it as part of the regulations that political parties make arrangements to clear the rubbish .... or governments (Metropolitan, State or Federal) will accept the responsibility. ....

During electioneering campaigns, waste abound and there were no policies nor programmes to take care of them. The consequences of poor disposal were challenging.

Table 5: Consequences of Poor Disposal

Consequences	No. of Responses	% of Total Responses
Competes with	61	87.14

Commercial Adverts		
Impedes driving on Highways	58	82.86
Creates Human Traffic at Busy Spots	52	74.29
Becomes a Breeding ground for disease vector	30	42.86
Becomes a breeding ground for Vermin, Rodent, etc.	38	54.29
Becomes a Hideout for Destitute and Hoodlums	41	58.57
Hinders Free flow of Traffic	52	74.29
Dirties the Environment	68	97.14
Creates Unwholesome Scenery	64	91.43
Blocks Drains	66	94.29
Leads to Social Adversities	44	62.86
Has Economic Advantages	47	67.14
No Effect	2	2.86
Others (Specified)	38	54.29

Source: Field Work.

On the consequences for the physical environment, each respondent picked more than one choice. Only 2.86 % picked "No Effect." All other statements: "Competes with Commercial Adverts" (87.14 %), impedes driving on Highways" (82.86 %), "Creates Human Traffic at busy Spots" (74.29 %), "Becomes a breeding ground for Vermin, Rodents, etc." (54.39 %), "Becomes a Hideout for Destitute and Hoodlums" (58.57 %), "Hinders Free Flow of Traffic" (74.29 %), "Dirties the Environment" (97.14 %), "Creates Unwholesome Scenery" (91.43 %), "Blocks Drains" (94.29 %), "Causes Social Adversities" (62. 86 %) and "Others (Specified)" (54.29 %) were well assented to as being consequences of poor management of the election materials waste. (Table 5). However, 67.14% affirmed that the waste had some economic advantages. Further discussion on that viewpoint is beyond the scope of this work. But, the implication is for the governments and people of the Metropolis and of the state in general to earnestly proffer solutions to occasional waste such as that of political electioneering found in every nook and cranny of the Metropolis during electioneering campaigns.

Discussion, Conclusion and Recommendation

The work has established that political solid waste were spontaneously and enormously generated during the campaigns for the last 2015 general elections, more than the Metropolis had ever experienced. The physical environment suffers the adversities. The menace will repeat as often as there are general elections in the Metropolis. This is not peculiar to Lagos Metropolis but also in all the cities and towns of Nigeria. There is no adequate machinery for storage, collection and disposal. It is important therefore that adequate measures are put in place to ensure sustainable environment before, during and after elections in the metropolis in particular and generally in all Nigerian cities and towns.

Special management of political solid waste and other kinds particularly by recycling and turning them to wealth is desirable for sustainable environment and economic

advantages, (not only in the Metropolis but also in other developing climes around the globe). INEC has a prominent role to play in this respect: It must stipulate the maximum amount of materials that may be printed; and also stipulate that the display must be orderly and restricted; and that concerted efforts must be made to remove the items after the exercise, that is, for proper disposal. Green campaign should be encouraged. INEC may alternatively take it upon itself to clean up and properly dispose of the materials. In that case, the candidates and or their political parties may be made to pay for such task ahead of registration. INEC would then put in place a machinery for cleaning up after the exercise. Research and development may be encouraged and supported by governments and political parties towards turning such special waste to wealth. Adequate education of politicians and the electorate alike on waste generation, its management as well as the consequences of poor disposal is thus imperative.

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Propagation Model Optimization based on Measurement from Macrocell sites in Ikorodu-Epe, South-Western Nigeria

Augustus Ehiremen Ibhaze
Department of Electrical and Information Engineering
Covenant University, Ota, Ogun state, Nigeria
Email: ehiremen.ibhaze@covenantuniversity.edu.ng

Aderemi Aaron-Anthony Atayero
Department of Electrical and Information Engineering
Covenant University, Ota, Ogun state, Nigeria
Email: atayero@covenantuniversity.edu.ng

Simeon Olumide Ajose
Department of Electrical and Electronics Engineering
Bells University of Technology, Ota, Ogun state, Nigeria
Email: solumideajose@gmail.com

Francis Enejo Idachaba
Department of Electrical and Information Engineering
Covenant University, Ota, Ogun state, Nigeria
Email: francis.idachaba@covenantuniversity.edu.ng

Abstract - **To engage any nation in wealth creation, human capacity development and improved standard of living, the need arises to install trendy technological innovations and efficient infrastructures such as reliable and efficient telecommunication systems. This paper therefore, investigates large scale propagation models used to predict the mean signal strength for an arbitrary transmitter-receiver separation distance with the aim of improving the telecommunication system infrastructure which will engender sustainable infrastructure and technology. The study has been conducted in an urban settlement in the Ikorodu – Epe region to develop and optimize a suitable propagation model based on the existing propagation models. The proposed propagation models are the Free Space Path Loss Propagation Model, Okumura – Hata Model, COST 231 Model, SUI Model and Ericsson Model. The optimized COST 231 model showed better performance and is proposed for propagation prediction involving such terrain. Root Mean Square Error (RMSE) statistical tool was used to achieve the optimization.**

Keywords: Propagation; sustainable development; capacity development; wealth creation; infrastructure, path loss.

I. INTRODUCTION

A major determinant for sustainable development of any nation can be attributed to deliberate efforts in ensuring technology integration and infrastructural implementations. While national wealth follows directly a number of indicators such as economic metrics, standard of living of the populace, national policies across sectors, technology transfer and integration among others, connecting with global wealth can only become a reality by integrating national processes through the interconnecting strands of globalization resulting from the ever growing technological innovations of information communication technology.

To ensure sustainable development, nations must engage in maintaining and improving the existing infrastructural base while innovatively developing new and more efficient techniques in handling human activities. An easy approach to this will be capacity development which will lead to wealth transfer such as knowledge, technology, capacity, capability to mention a few.

As the population of any nation increases, the need for infrastructural expansion arises since the capability of existing infrastructure has no capacity to cater for the ever growing subscribers. This has a direct implication on the quality of service of subscriber dependent infrastructures like the wireless mobile communication systems. It has been asserted that high population growth has implication on the improvement of community infrastructural needs [1]. Although deficient and inefficient infrastructures have become the bane of developing nations, policies have been prepared despite the challenges of insufficiency and poor quality of service [2, 3, 4, 5]. Despite policy making, the continuous existence of a thing can only be traceable to its creation and continuous improvement else it goes extinct. Further to this, this work seeks an approach to improving the wireless mobile communication infrastructure.

The importance of mobile communication in nation building and sustainable development is not far-fetched as it interconnects all other strands of the society. It has provided the platform through which we execute business ideologies, transfer initiatives, engage wireless broadband activities, communicate and even globalize. The flip side to the enormous benefits provided by wireless mobile communication network is its prevalent poor quality of service, increasing number of dropped calls, blocked calls and even handover issues which can be attributed to poor planning

and integration. To alleviate this challenge, path loss prediction is carried out to measure the signal strength with respect to the coverage distance so as to help develop an appropriate model for both planning and integration.

II.   PROPAGATION MODELS

Propagation models are mathematical tools used for the planning, design and implementation of wireless mobile networks [6]. These models could be empirical; based on measured data or deterministic based on specified parameters of antenna height, transmitter-receiver distance etc, or stochastic based on a series of random variables [7, 8]. Some of the existing models which have been well validated are the free space path loss propagation model [9], Okumura-Hata model [10, 11], COST 231 model [12], Stanford University Interim model [6] and the Ericsson model [13]. While these models were built based on the characteristic of the terrain in which the signal strength was measured, prediction errors are inevitable when such models are used to predict the signal strength of a particular terrain with absolute diverse characteristics in comparison with the original terrain. To make these models suitable for other terrain, it is required that the models be optimized relative to the terrain of interest so as to better predict the signal strength which will engender efficient wireless mobile communication infrastructure.

III.   RESULTS

Received signal strength was measured from the existing base stations around Ikorodu Epe and its Environs in Lagos state, south-western Nigeria using TEMS investigation tool [14]. Measured data was compared with existing models to investigate the model that predicts the signal strength with a fairly good approximation. The outcome of the existing models is shown in Fig. 1.

Fig.1 Comparison Existing Propagation Models

To obtain a better approximation, measured data is compared with the existing models as shown in Fig.2. It is observed that the COST 231 provides a better fit for the measured data.
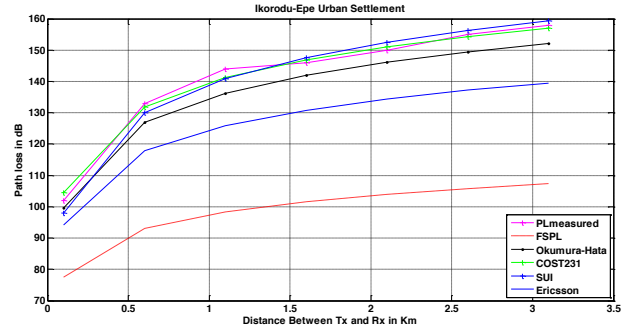
Fig. 2 Comparison of Measured data with Existing Models

Considering the error relative to the fitting, optimization of the COST 231 model will provide an absolute model for error-free prediction in the terrain. This will help in minimizing the number of dropped calls, blocked calls and even interference issues, thereby optimizing the network. This approach to sustainable technology will help in preserving the existing technological infrastructure while preparing it for future expansion, innovation and integration. Using the Root Mean Square Error (RMSE) statistical tool to optimize the COST 231 model, we have:

$$PL_{COST231(OPT)}(dB) =$$
$$46.3 \; + \; 33.9 \; log10 \; (f) - 13.82 \; log10 \; (ht) - a(hr)$$
$$+ \; [44.9 - 6.55 \; log10 \; (ht)] \; log10 \; (d) \; + \; C \; + \; RMSE \quad (1)$$

By using a third degree polynomial for the curve fitting between the measured data and the COST 231 model, we have:

$$f(x) = \; p_1 x^3 + p_2 x^2 + p_3 x + p_4$$

Coefficients (with 95% confidence bounds):

p_1 = 0.0002449 (-0.0006288, 0.001119)
p_2 = -0.1004 (-0.4473, 0.2466)
p_3 = 14.58 (-30.82, 59.98)
p_4 = -604.9 (-2558, 1349)

(2)

Considering a 95% confidence bound relative to the curve fitting, the resulting outcome of the optimized COST 231 is shown in Fig. 3
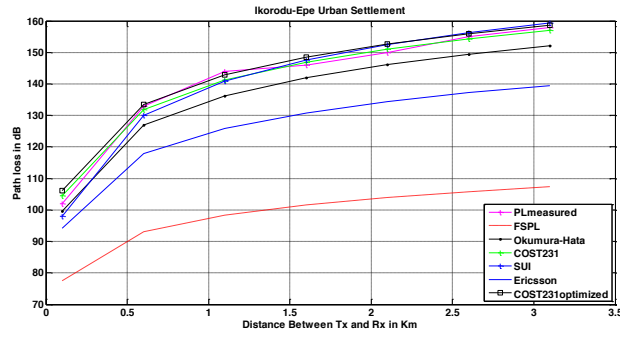
Fig. 3 Comparison of Measured data with Optimized COST 231 Model and other existing models

$$f(x) = p_1 x^3 + p_2 x^2 + p_3 x + p_4$$

Coefficients (with 98% confidence bounds):
  p_1 = 0.0002449 (-0.0006288, 0.001119)
  p_2 = -0.1006 (-0.4484, 0.2472)
  p_3 = 14.64 (-30.97, 60.25)
  p_4 = -609.3 (-2576, 1358)   (3)

Further to the application of the RMSE statistical tool, using the third degree polynomial for curve fitting between the measured data and the optimized COST 231 model, the confidence level of the curve fitting increased from 95% to 98% as given by Eq. 3 which is a clear indication of the impact of the optimized COST 231 model.

I.   CONCLUSION

This paper presents a modified propagation model for the prediction of radio frequency signals using root mean square error statistical tool. The optimized COST 231 model can be used for the planning, design and optimization of the existing and intending mobile infrastructure which will improve the quality of service of the wireless mobile network infrastructure. This will reduce the possibilities of dropped calls, blocked calls, missing neighbors, update failures, handover and interference issues. The improvement in quality of service that will arise from the use of this model will engender sustainable development. Since the telecommunication infrastructure acts as a central hub interconnecting all other strata of the nation's organisms, its proper functioning will reduce down-time at all levels of transactions over the mobile network which will definitely improve return on investments.

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Comparative Analysis of Adsorption of Methylene Blue Dye Using Carbon from Palmkernel Shell Activated by Different Activating Agents

Sanni, S.E, Adeeyo, O.A, Efeovbokhan V., Ojewumi, M., Ayoola , A., Ogunbiyi, A.
Department of Chemical Engineering
Covenant University, Ota, Nigeria
adexz3000@yahoo.com

Emetere, M.E.
Department of Physics
Covenant University,
Ota, Nigeria

Abstract— **Activated carbon was produced from palm-kernel shell using NaOH and KOH solutions as the activating agents. The same was tested to determine its adsorptive capacity and efficiency using methylene blue solution. Particle sizes of the produced carbon were in the range of 600 – 2000 μm. The adsorption process was carried out at two different temperatures using methylene blue as adsorbate. It was observed that adsorption of methylene blue dye using carbon activated impregnated with KOH gave better result than with NaOH. Based on the adsorption parameters obtained, the process was found to be better described by the Freundlich adsorption isotherm.**

Keywords— *Activated carbon; palm-kernel shell; adsorptive capacity; efficiency; activating agents*

I. Introduction

Activated carbon is a carbonaceous amorphous material which is synthesized from specific raw materials and active reagents. Its adsorptive property is due to the presence of micro porous structures which are responsible for its good adsorption capacity, high surface reactivity and specific surface area [12],[8]. Various adsorbents exist but the evolvement and preference of activated carbon over other adsorbents is due to its low cost and wide range of applications such as water purification, decaffeination, decolourization of liquids, sewage treatment and gas purification. Activated carbons are of two types. The first is the granular class characterized by an average particle size in the range of 1.0 to 5.0 mm [5]. Due to their particle sizes, they are preferable for gas adsorption. They are also used for water treatment, deodorization and separation of components of flow systems [13]. Powdered activated carbon being the second class, are of smaller particle size relative to the granular activated carbon. The particle size is smaller than 200 mesh (74 μm). They appear as fines and are not commonly used in water treatment plants because as a large amount of waste water is passed through the filter bed, some of the particles pass along thus contaminating the water to be treated. The production of activated carbon is either a two-step process, i.e. carbonization followed by physical activation or a single-step carbonization and chemical activation. Carbonization process helps to increase the carbon content of the precursor by thermal means which occurs in the absence or little amount of oxygen in order to avoid complete combustion whereas, in chemical activation, the carbonized material is impregnated with a certain ratio of chemicals called activating agents which modifies and improves the pore structure of the charcoal as well as its adsorptive properties. Materials such as wood, peat, lignite and coal can be used in producing activated carbon because of their high carbon contents and due to their inherent surface functional groups which help to improve the surface chemistry of the carbon thereby enhancing its adsorptive capacity. Materials with very high lignin content have macro pores e.g. grape and jatropha seeds. Nut shells and woods are of highly cellulosic with less amounts of lignin. They are micro porous which makes them suitable for use in the production of activated carbon. The selection of solid wastes as precursors for activated carbon depends on their potentials for obtaining high quality activated carbon, the presence of minimum inorganic substances, raw materials storage life, volume and cost of raw materials [3]. The total amount of inorganic constituents associated with activated carbon is usually in the range of 0.3-0.6 % of the total composition and vary from one carbon source to another depending on the source of raw materials and activating agents added during the production process. As a byproduct of carbon synthesis is ash which if not controlled, reduces the overall activity of activated carbon as well as the efficiency of regeneration. Recently, exploration of the use of biomass as a source of carbon for the production of activated carbon has become a great feat. These materials are wastes from domestic places, industries and farmlands which include coconut shells, palm kernel shells, sawdust and rice husks. Biomass residue from palm oil industries are also a good source fuels/renewable energy. With an increase in the number of oil palm industries, these biomass resources are also on the increase, as is evident in countries like Malaysia, Indonesia and Thailand. Palm kernel shells are the residues left after extraction of the kernels from the shells of the palm fruits. As an agricultural waste, palm kernel shell has been reported to have same calorific characteristics as coconut shell. Due to its high density, high carbon and low ash content, palm kernel shell is used as a precursor for the manufacture of activated carbon [11]. Activated carbon can be produced from carbon-rich low-cost agricultural by-products such as wood, shells of fruits and other raw materials [10]. In addition, because of their availability in large quantities, agricultural by-products are

used to prepare activated carbon. Furthermore, the disposal of these waste materials constitutes nuisance to the environment and poses serious health risks to the inhabitants. Also, water from breweries and textile industries may contain heavy metals like copper, zinc and dyes which are also harmful/poisonous and if consumed could lead to increased mortality. Dyes are carcinogenic and highly toxic, thereby posing health hazards and environmental problems to living organisms [1]. Dyes in water give out a bad colour and can cause diseases like haemorrhage and severe skin irritation. They prevent the process of photosynthesis in plants by preventing sunlight from penetrating the surface of dye contaminated water in contact with any green plant [6]. Urine contains compounds such as urea, chloride, sodium, potassium and creatinine which add up to 5 % with the remaining 95 % being water. The water in urine can easily be exacted and purified by using activated carbon which also removes the odour, colour and taste of urine, thus making it fit for drinking. The accumulation of biomass around drainage systems could result to stagnancy of water, a breeding place for mosquitoes which are carriers of plasmodium and precursors for malaria. Various techniques that have been used to produce clean water include sedimentation, reverse osmosis and absorption [15] but due to the high maintenance/equipment costs and the routine involved in their operations, adsorption using activated carbon is widely preferred. Activated carbon is used as an adsorbent in water systems due to its high porosity and large surface area. The most commonly used activated carbon is that produced from coconut shell using Phosphoric acid as the activating agent. Micro-pores have been reported as being majorly responsible for adsorption by adsorbents because they possess molecular dimensions hence, a solute molecule will readily penetrate into a pore having a particular diameter [14]. According to [8], a carbonation process entails the pyrolysis of the precursor material at a temperature of 600 – 1200 ˚C in an inert atmosphere consisting of nitrogen or argon. It is usually carried out in a rotary kiln; the basic microstructure of the char with micro-porosity is formed around 5000C. Hence, the reason for the choice of temperatures in this research i.e. 600-800oc. However, they confirmed the discontinued use of ZnCl2 because of its bad environmental impact. Activation time and temperature effects were studied for the carbonization process and properties of activated carbon. It was found that the activation times normally used were from 1 hour to 3 hours for palm kernel and coconut shells but as time and temperature increased, the percentage yield decreased gradually and the BET surface area also increased [17]. In order to expand the supply of activated carbon, other low cost agricultural waste such as palm kernel shell products have been explored and are found suitable for the production of activated carbon. In addition, not much work is made available on the production of activated carbon from palm kernel shells using Sodium hydroxide relative to Potassium hydroxide. However, this paper compares activated carbon formed by actions of NaOH and KOH on a desired raw material (palm kernel shell) for the adsorption of a textile dye. The adsorptive capacity of the activated carbon produced was determined by varying the particle size. The effect of particle size on adsorption rate of the activated carbon was also studied.

Adsorption is a process that occurs when a gas or liquid solute attaches or cling onto the surface of a solid usually known as the adsorbent, forming a molecular film known as the adsorbate [7]. It is a surface phenomenon leading to the attachment of one substance to another. The efficiency of different activating agents such as NaOH and KOH on different particle sizes of carbon has been evaluated. This is aimed at encouraging waste-to-wealth management in prospective countries, improving their nations' economies by providing job opportunities and avoiding the cost of maintenance of process equipment used in wastewater treatment. Particle size of activated carbon may or may not have negligible influence on the total surface area available for adsorption depending on the number of micro-pores present, which may not change largely with the particle size. The only difference may then be in the contact time between the larger and smaller particle sizes for adsorption to occur due to effects of diffusion. For smaller activated carbon particles, equilibrium is more easily achieved because of their ability to reduce internal diffusion and mass transfer limitation of the adsorbate on the surface of the adsorbent. Smaller carbon particles have a greater surface area to volume ratio making them more accessible to diffusion or adsorption. Smaller sized particles of a given mass of carbon have a greater surface area to volume ratio than larger particles of same mass. This paper looks into the effect of particle size on the adsorption capacity of the produced adsorbent by keeping the adsorption time constant.

II. methodolgy

The sourced raw material and production processes are discussed here.

A. Materials Used

Chemicals used include hydrochloric acid of 1 M concentration, sodium hydroxide pellets, 40 g, 36 g potassium hydroxide and 10 g of methylene blue powder and distilled water.

B. Apparatus Used

Whatmann's 2V filter paper- 18cm diameter, litmus paper, automatic sieve shaker, furnace (Carbolite), alsin crucibles, 70 g & 270 g, Oven, UV- Spectrophotometer, weighing scale, 250mL beakers, Erlenmeyer flasks, 250ml, Büchner funnel, petri dishes

C Procedure

The palm kernel shells were collected and cleaned to remove impurities. They were then dried in the oven at 105 0C for one hour. The shells were crushed with a mortar and further ground with an electric grinder. The ground particles were then screened using Matest-Treviolo automatic sieve shaker (Italy) to obtain samples of four different particle sizes in the range of 600 μm ⌐- 2 mm. Each sample was then introduced into the furnace and allowed to char for 1hour at a temperature of 600 0C to enrich the carbon content and to initiate pore formation in the samples. The charred product was allowed to cool down to room temperature. NaOH and KOH were separately introduced to the samples as activating agents i.e. to each sample weighing 20 g, 30 cm3of 1.0 M

solution of the activating agents were mixed in separate beakers. The contents of the beakers were thoroughly mixed and allowed to soak for 24hours before being transferred into crucibles which were transferred into an oven at varying temperatures of 600 0C to 800 0C at 20 minutes time interval. The product was allowed to cool to room temperature and washed with distilled water using a Buchner funnel. The samples were further dried in the oven at a temperature of 105 0C for 2 hours. After drying, the samples were kept in air-tight containers for characterization.

B. Determination of Physico-Chemical Properties

I Moisture content

For analysis of the moisture content of the carbon sample, ASTM D2867-70 was used. 1.0 g of activated carbon sample was put into a crucible and weighed. The crucible was placed in an oven at 150 0C for 3 hours. It was allowed to cool in a dessicator to ambient temperature and then weighed. The percentage moisture content was calculated from (1).

$$M_c = 100 * [(B - F)/B - G]$$
(1)

Where:

Mc = moisture content of activated carbon; B = mass of crucible with lid plus original sample in grams (g); F = mass of crucible with lid plus dried sample in grams (g); G = mass of crucible with lid in grams (g)

II Ash content

Here, the ASTM D2866-70 was used: 1.0 g of dried carbon was weighed, placed in a crucible and transferred into the furnace at 650 0C for 3hours. The crucibles were allowed to cool and then put in a dessicator for further cooling to ambient temperature for 1 hour. The dried carbon was weighed and the ash content was calculated from (2).

$$A_c = 100 * [(F - G)/B - G]$$
(2)

Where:

A_c = ash content of activated carbon; G = mass of empty crucible plus dried sample in grams (g); F = mass of crucible plus ashed sample in grams (g); A_c = mass of crucible plus dried sample in grams (g); **C** Methylene Blue Adsorption

Methylene blue is a basic organic dye with a molecular formula of $C_{16}H_{18}N_3CIS$ and a molecular weight of 319.85 g/gmol. Powdered Methylene blue was used as the adsorbate. 1 g/L stock solution of methylene blue dye was prepared by dissolving 1.0 g of dye powder in 1.0 L of distilled water. Adsorption tests were conducted by weighing 2.0 g of activated carbon and adding it to 25 mL of 1000 mg/L methylene. blue solution. The mixture was shaken for 24 hours, it was then filtered and the residual concentration of methylene blue was measured at a wavelength of 665nm using an UV/Vis Spectrophotometer (Genesys 10S) hence, the final concentration of methylene blue was determined

D Calibration Curve

calibration curve was used to determine the finalconcentration of dye present in the solution. Different concentrations of methylene blue solution were prepared in mg/l. Absorbance of the methylene blue solution was measured at a wavelength of 665nm; various masses (0.1g, 0.5g, 1.0g, 1.5g and 2.0g) of activated carbon were mixed with aqueous solution of methylene blue at 8000C with average particle size of 600μm. The mixture was thoroughly agitated with a mechanical shaker to improve the efficiency of adsorption. The adsorption capacity for each of the masses was calculated while keeping all other conditions constant.

E Carbon Dosage

0.1 g, 0.5 g, 1.0 g, 1.5 g and 2.0 g carbon particles of 600 μm size were each mixed with some quantity of aqueous methylene blue solution at 800 ^{0}C. The mixture was agitated using a mechanical shaker in order to improve their adsorption efficiencies. The adsorption capacity of each of the separate mixtures was then determined with other conditions constant.

III RESULTS AND DISCUSSION

Table 1 shows the recorded moisture and ash contents of the activated carbon produced.

Table 1: Physico-chemical properties of palm kernel shell activated carbon

Moisture Content (g/g)	Ash Content
10.0	3.3

In order to ensure some degree of accuracy, an average of two runs were performed. Absorbance data was recorded using the UV/Vis Spectrophotometer (Genesys 10) at a wavelength of 665 nm. Using data in Table 2, a calibration graph was obtained by plotting the absorbance of known concentrations of methylene blue solution.

In Table 2, it could be seen that the absorbance of the methylene blue increased with increased concentrations of methylene blue solution i.e. the lowest absorbance, 0.689 was obtained at 0.5 mg/L and the highest absorbance value, 4.893 was recorded at the highest concentration 500 mg/L of

methylene blue – which agrees with the Beer-Lambert's law. Fig.1 below is the absorbance curve for methylene blue solution.

Concentration (mg/L)	Absorbance
0.5	0.689
1	0.735
3	0.897
5	1.034
10	1.859
30	2.456
50	2.968
120	3.488
200	3.877
375	4.500
500	4.893

Table 2: Concentration and absorbance of methylene blue

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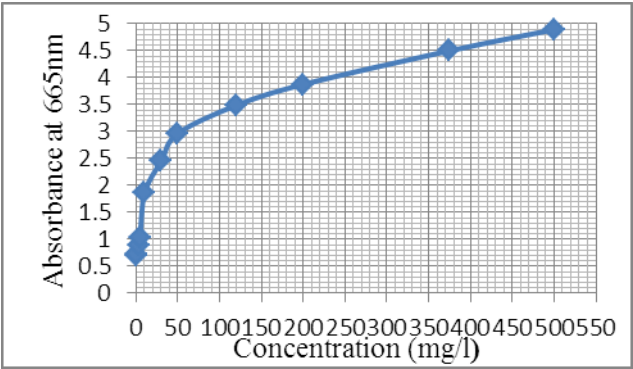
Fig.1: Absorbance of methylene blue at different concentrations

From the absorption curve in Fig.1, as observed from the absorbance spectrum of methylene blue solution, at the specified light wavelength of 665 nm for which the absorbance of methylene blue solution was observed on the spectrophotometer, the absorbance of methylene blue solution increased at high concentrations of the solution.

A. *Effect of Temperature and Particle size*

From literature, since the activity of KOH begins at about $700^{o}C$, temperatures below and above this value were chosen for this investigation in order to determine its effect when used as an impregnating agent between the upper and lower limits i.e. below and above the critical temperature. Temperature variation with adsorption of methylene blue by different activating agents was investigated. The results are as shown in Tables 3 and 4 for the effect of temperature on the rate of adsorption using NaOH and KOH as activating agents for the produced carbon respectively. The amount of methylene blue adsorbed was calculated using (3).

$$Q_s = \frac{C_o - C_s}{m}$$
(3)

Table 3: Effect of Temperature on adsorption with NaOH as activating agent

Table 3, shows the adsorption capacity of activated carbon for different particle sizes in the range of 600 - 2000 μm at two different temperatures (i.e. 600 and $800^{o}C$) with recorded final concentrations of the solution in the adsorbent. At 600 ^{o}C, for a particle size of 600 μm, the final concentration of the solution was found to be lowest with an absorbance of 1.0. Other absorbance values recorded were 1.154, 1.219 and 1.239 for particle sizes of 850, 1000 and 2000 μm. At a higher temperature, say 800 ^{o}C, lower size particles, recorded higher concentrations of adsorbed methylene; this was also in accordance with the decrease in final concentrations of the solution i.e. 4, 6, 6.5 and 8.0 mg/L which correspond to adsorbed methylene concentrations of 498, 497, 496.8 and 495 respectively. However, it can be seen that an increase in temperature (i.e. by about 200 ^{0}C improved the actual adsorption power of the activated carbon.

B. *Effect of Temperature on Adsorption*

Table 4: Effect of temperature on adsorption with

Temperature (^{0}C)	Particle size (μm)	Absorbance	Final Concentration (mg/L)	Methylene Blue adsorbed (mg/L)
600	600	1.000	5.000	497.5
	850	1.154	6.500	496.8
	1000	1.219	7.000	496.5
	2000	1.239	9.000	495.5
800	600	0.956	4.000	498.0
	850	1.163	6.000	497.0
	1000	1.217	6.500	496.8
	2000	1.227	8.000	496.0

KOH as activating agent

Temperature (^{0}C)	Particle Size (μm)	Absorbance	Final Concentration (mg/L)	Methylene Blue adsorbed (mg/L)
600	600	0.937	5.000	497.5
	850	1.149	6.000	497.0
	1000	1.197	6.500	496.8
	2000	1.212	7.000	496.5
800	600	0.889	2.000	499.0
	850	1.153	6.100	497.0
	1000	1.195	6.300	496.9
	2000	1.209	6.500	496.8

In Table 3, with NaOH as activating agent and for particle size in the range of 600 – 2000 μm, the absorbance values at 600 ^{0}C varied from 1 – 1.239 for particle sizes, and varied between 0.956 – 1.227 for 600 – 2000 at 800 ^{o}C while in table 3.4, the adsorbed methylene blue concentrations were between497.5 – 496.5 mg/L at 600 ^{0}C, and 499 – 496.8 mg/L, at 800 ^{0}C, for the same particle sizes considered. By comparing the adsorbed methylene blue values in Tables 3 and 4, it is clear that KOH is a better activating agent than NaOH as the concentration of adsorbed methylene blue was lower with NaOH than with KOH as activating agent. This can be drawn from the fact that Potassium is higher up than sodium in the electrochemical series of metals. The results in Tables 3 and 4 are in agreement with the observations of other researchers. However, considering the concentrations of adsorbed methylene blue in Tables 3 and 4, it could be seen that there is difference in corresponding values of absorbed methylene blue hence, the higher the absorbance of the activated carbon, the lower the concentration of methylene blue adsorbed and vice versa.

The adsorption capacity of the activated carbon was calculated from (4) using data in Table 6.

$$q_e = \left[\frac{(C_o - C_e)}{W}\right] * V$$

(4)

In Table 5, with NaOH as activating agent, the adsorption capacity of the activated carbon increased for smaller particles than for larger particles at 600 ^{0}C i.e. considering the particle sizes between 600 and 2000 micrometer, it can be deduced

that for particles of size 600 μm, the adsorption capacity (i.e. 12.438 mg/g), is higher than 12.419 mg/g, 12.413, and 12.388 mg/g for particles of size 850 μm, 1000 μm and 2000 μm respectively. These values show that the adsorption capacity for particles of size 850 μm is higher than the adsorption capacity for 1000 μm and vis-à-vis. At 800 ^{0}C, the adsorption capacities obtained were 12.450 mg/g, 12.425 mg/g, 12.419 mg/g and 12.400 mg/g for particles of size 600 μm, 850 μm, 1000 μm and 2000 μm respectively. This is due to the increased surface area to volume ratio of the smaller particles relative to the larger ones. Comparing the absorption capacities for the particles at 600 and 800 ^{0}C, it can be deduced that increase in temperature improved the adsorption capacities of the particles. The variation of adsorption capacity versus particle size at different temperatures with NaOH as activating agent.

Table 5: Effect of particle size on adsorption with NaOH as activating agent

Temperature (^{0}C)	Particle Size (μm)	Final Concentration (mg/L)	Adsorption Capacity, qe(mg/g)
600	600	5.000	12.438
	850	6.500	12.419
	1000	7.000	12.413
	2000	9.000	12.388
800	600	4.000	12.450
	850	6.000	12.425
	1000	6.500	12.419
	2000	8.000	12.400

C. *Effect of Particle Size on Adsorption*

In Table 6, at a 600 ^{o}C, with KOH as activating agent, the adsorption capacities recorded for the carbon particles, showed that for particle sizes of 600, 850, 1000 and 2000 μm, the corresponding adsorption capacity (12.438 mg/g) for a particle size of 600 μm is higher than the adsorption capacity (12.425 mg/g) for 850 μm particles, and higher for particles of size 850 μm than the adsorption capacity (i.e. 12.419 mg/g) for particles of size 1000 μm and higher for 1000 μm than

for 2000 μm particles with adsorption capacity value of 12.413 mg/g). The same trend can be seen in the calculated adsorption capacities i.e. 12.475, 12.426, 12.421 and 12.419 mg/g for particle sizes of 600, 850, 1000 and 2000 μm respectively. By comparing adsorption capacities of the particles at different temperatures (i.e. 600 and 800 ^{0}C), the

Temperature (^{0}C)	Particle Size (μm)	Final Concentration (mg/L)	Adsorption Capacity, q_e (mg/g)
600	600	5.000	12.438
	850	6.000	12.425
	1000	6.500	12.419
	2000	7.000	12.413
800	600	2.000	12.475
	850	6.100	12.426
	1000	6.300	12.421
	2000	6.500	12.419

CONCLUSION

Palm kernel shell is a good raw material from which an effective adsorbent can be made for the removal of methylene blue dye in aqueous solution. The use of KOH as activating agent generated more pore sites which resulted in increased capacity and hence gave a better performance than NaOH. Also, the final/residual concentration of the methylene blue solution decreased with increased carbon dosage. In preparing activated carbon for adsorption purposes, it is important to take into consideration, the effect of particle size as smaller particles have better performance than larger sized particles which is also a measure of their efficiency of adsorption. Thus, the lower adsorption efficiencies were peculiar to larger particles because of the fewer adsorption sites formed as a result of the surface area available for adsorption which in turn results in a higher residual concentration of methylene blue solution. The maximum adsorption capacity Q_m for monolayer was calculated to be 9.3371 mg/g, at the higher of the two temperatures i.e. at 800 ^{0}C with a particle size of 600 μm using KOH as activating agent. Furthermore, based on the calculated values of 1/n, the Freundlich isotherm gave a better description of the adsorption process than the Langmuir's which gave a value of 1/n > 1.

NOMENCLATURE

Symbol   Designation

value increased from: 12.435 to 12.475 mg/g, 12.425 to 12.426 mg/g, 12.419 to 12.421 mg/g and 12.413 to 12.419 mg/g for particles of size 600, 850, 1000 and 2000 μm respectively. Furthermore, the adsorption capacity values at 600 μm were the highest as compared with other adsorption values for particles of other sizes. Variations in adsorption capacity of carbon activated with KOH versus particle size at different temperatures.

Table 6: Effect of particle size on adsorption with KOH as activating agent

D. *Efficiency of Activated carbon*

E. *AdsorptionIsotherm*

X — mass of solute adsorbed per unit mass of adsorbent (mg/g)

X_m — maximum monolayer adsorption capacity mg/g

b — adsorption constant L/mg

C_e — equilibrium concentration of solute after adsorption mg/L

q_e — solute adsorbed per unit mass of adsorbent mg/g

K — adsorption constant

n — intensity of adsorption

M_c — moisture content of activated carbon

B — mass of crucible with lid and dry sample (g)

F — mass of crucible + lid + dry sample g

G — mass of crucible with lid and dry sample (g)

A_c — ash content

Q_s — quantity of methylene blue adsorbed per liter (l^{-1})

C_o — initial concentration of methylene blue (mg/l)

C_s — final concentration of methylene blue (mg/l)

M — mass of ash content used (g)

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Achieving Sustainable Food Security in Nigeria: Challenges and Wayforward

Amaka G. Metu, Kenechukwu O. Okeyika and Olisa D. Maduka
Department of Economics,
Nnamdi Azikiwe University,
Awka, Nigeria.
ag.metu@unizik.edu.ng, ko.okeyika@unizik.edu.ng

Abstract—One of the goals of Nigeria's agricultural development policy is to ensure that the nation produces enough food and less dependent on importation so as to ensure adequate and affordable food for all. Using descriptive statistics, this study is an attempt to evaluate food security situation in Nigeria from 1991 to 2015. The paper shows that there is a shortfall in domestically produced food in Nigeria because the growth in the population of Nigeria is at the rate of 3.2% while the growth in food production has been less than one. This shows that demand for food (population) is greater than the supply (agricultural production) because of factors such as inconsistent government policies, environmental degradation and non-sustainable agricultural production. The paper also shows that Nigeria depends so much on food importation. To achieve sustainable food security in Nigeria, the paper recommends an improvement in environmental management in other to increase agricultural productivity.

Keywords—availability; environment; food security; sustainable.

I. INTRODUCTION

Sustainable food security is an access by all people at all times to enough food for an active healthy life at present plus the ability to provide enough for future generation. Issues on food security was brought to lime light in 1974 during the world food conference when it downed on the governments that nations all over the world needs to strategize on how best to improve agricultural production so as to match the per capita needs of the population. Ban Ki Moon, the UN Secretary-General at a World food summit in Rome in 2009, warned that six million children die of hunger every year; 17,000 die of starvation every day and by 2050 the world will need to feed two million more mouths. This has rekindled the idea of achieving sustainable food security in all countries of the world including Nigerian.

Nigeria is blessed with abundant natural and human resources, but despite its significant natural resources, majority of the citizens are living below the poverty line. For instance according to WDI, (2015), an estimated 60% of Nigerians live on less than US$1.25 per day. Nigeria was also ranked 91stout of a total of 104 counties on the 2015 Global Hunger Index and 153rdout of a total of 187countries on the 2012 UNDP Human Development Index. Malnutrition and hunger which is linked to poverty have been ravaging most developing countries and affecting their productive capacity. Classifying Nigeria as one of the poorest countries testifies to our failure to achieve our

development policy as well as national food security. It once more awakened the government to the realities on ground, that is, the need to achieve the first sustainable development goal of no hunger before the year 2030.

World Bank (2012) estimates the population of Nigerian to above 160 million people, the largest in Africa almost accounting for 47% of West Africa's total population. As the population increases, the country's demand for food increases, while the ability to produce food diminishes because pressures from the growing population in form of desertification, climate change and erosion are also impacting on the already diminishing resources and further threatening food production.

Food security involves access and availability of food stuff, stability of supplies and the quality of the diet (Honfoga & Van den Boon, 2003). According to FAO, International Fund for Agricultural Development (IFAD) and World Food Programme (WFP) (2013), Nigeria have an energy intake of 1730Kcal and an average protein supply of 64g capita per day far below the 2500 – 3400Kcal minimum recommended daily intake per day. This shows that Nigeria is facing the challenge of unbalanced diet leading to various deficiency symptoms. Also among the 109 countries assessed by Global Food Security Index (GFSI) (2015), Nigeria is 91stwith 37.1 score based on indices of affordability, availability, quality and safety.

One of the goals of Nigerian's agricultural development policy is to ensure that there is enough food reserve at household, state and federal government levels to forestall any threat to the level of food security. Since domestic agricultural production has failed to meet up with the increasing demand for food, the government had to spend on importation to feed her teeming population. For instance, food import increased from 19.9% in 2000 to 30.6% and 22.7% in 2011 and 2012 respectively while food export is barely 5.3% of merchandise (World Development Indicator, 2016).

The second sustainable development goal of zero hunger incorporates the need to achieve food security and improved nutrition, promote sustainable agriculture, ending rural hunger, empowering small scale farmers especially women, ensuring healthy lifestyle by 2030. The Nigerian government is working assiduously to achieve these goals.

The main objective of this paper is to evaluate food security situation and the challenges of achieving sustainable food security in Nigeria. To achieve this objective, the paper is divided into subsections. Following the introductory overview

is theoretical literature review. The third section discusses food production, food supply and nutritional status in Nigeria while section four discusses challenges to achieving sustainable food security in Nigeria. Section five is way forward for achieving food security and conclusion.

II. THEORETICAL LITERATURE REVIEW

Sustainable food security has been defined in various ways by different scholars. According to WHO (1995)and FAO, et al. (2013) food security is access to the food needed by all people to enable them live a healthy life at all times. A country is said to be food secured when there is access to food of acceptable quantity and quality consistent with decent existence at all times for the majority of the population (Reutlinger, 1985; Idachaba, 2004). This means that food must be available to the people so as to meet the basic nutritional standard needed by the body. But it should be noted that availability of food does not mean accessibility to food. Availability depends on production, consumer prices, information flows and the market dynamics.

World Bank (1986) defined sustainable food security as an access to enough food for an active, healthy life at present as well as ability to provide enough in the future. Abudullahi (2008) defined sustainable food security as when people have physical and economic access to sufficient food to meet their dietary needs for a productive healthy life at present as well as in the future. This definition outlines some indices for measuring the extent or degree of food security to be achieved by any country and the indices are adequate national food supply, nutritional content, accessibility, affordability and environmental protection.

Absence of food security is food insecurity; food insecurity on the other hand represents lack of access to enough food and can either be chronic or temporary. Adeoti (1989) opine that chronic food insecurity arises from lack of resources to acquire and produce food thereby leading to persistent inadequate diet. FAO (2010) refers to food insecurity as the consequences of inadequate consumption of nutritious food bearing in mind that the physiological use of food is within the domain of nutrition and health. When individuals cannot provide enough food for their families, it leads to hunger and poor health. Poor health reduces one's ability to work and live a productive healthy life. Poor human development destabilizes a country's potential for economic development for generations to come (Otaha, 2013).

According to FAO, et al. (2013), the core determinants of food security are availability, accessibility, utilization and stability.

Food Availability:- Availability of food plays a conspicuous role in food security. Having enough food in a nation is necessary but not adequate to ensure that people have satisfactory access to food. Over the years, population has increased faster than the supply of food thus resulting in food unavailability per person.

Food Accessibility: - The ability to have access to food depends on two major conditions: - Economic access and physical access. Economic access depends on one's income, the price of food and the purchasing power of the people. Physical access depends on the availability and quality of infrastructure needed for the production and distribution of food. Lack of economic access to food is as a result of the increase in the rate of poverty.

Food Utilization: - Food utilization is measured by two outcomes indicators which reflect the impact of inadequate food intake and utilization. The first outcome is measured by under-five years of age nutrition level while second measurement is quality of food, health and hygiene. According to FAO measuring the nutritional status of under-five years of age is an effective approximation for the entire population. The indicators for the measurement of under-five years of age are wasting (too thin for height); underweight (too thin for age) and stunting (too short for age).

Most times, progress in terms of having accessing to food is not always accompanied by progress in the utilization of the food. A more direct indicator of food utilization is underweight because it shows improvement more promptly than stunting and wasting whose improvement cantake a longer time to be noticeable. Since 1990, the prevalence rates of under-five stunting and underweight have declined in some developing countries, while some countries still report a prevalence rate of 30% or more and WHO categorizes this as being high (WHO-UNICEF, 2011).

Stability: - Stability has to do with exposure to short-term risks which have a way of endangering long-term progress. Key indicators for exposure to risk include climate shocks such as droughts, erosion and volatility in the prices of inputs for food production. The world price shocks leads to domestic price instability which is a threat to domestic food producers as they stand the chance of losing invested capital. Nigerian farmers are mainly smallholders farming mainly for subsistence, this makes it difficult for them to cope with changes in the prices of inputs, and it also lowers their ability to adopt new technologies thereby resulting in reduced overall production. Changing weather patterns as a result of climate change have played a part in reducing food supply, for instance flood in the southern parts of the country and drought in the northern parts leads to substantial losses in production and income.

The interplay of all these variables determines whether an individual, household, state or nation is food secured or not. This is because sustainable food security at the household level does not guarantee sustainable food security at the state or national level.

The theoretical framework is based on Malthus theory on population, Thomas Malthus in his writing in the 18th century warned that global population would exceed the earth's capacity to grow food. Malthus suggested that population grows in geometrical progression while food production grows in arithmetical progression. Despite having been largely debunked, this theory has remained prominent in the discourse regarding hunger, the world's population carrying capacity and the need for increased agricultural technology. Malthus argument was a warning about population increase especially among the poor because he described the poor as breeding too rapidly and depriving the rest of the population of food; famine was seen as a natural defense against overpopulation. In the Nigerian situation, current production of food is far below the

population requirement. Therefore, food distribution continues to be a problem in solving food security in Nigeria.

III. FOOD PRODUCTION, FOOD SUPPLY AND NUTRIENT STATUS IN NIGERIA

An incisive discussion on the demand for food, supply of food as well as the nutrient status will give a better understanding of food security situation in Nigeria. A food secured situation is said to exist when the demand side is balanced with the supply side, anything contrary suggests food insecurity (Egbuna, 2001).

Nigeria produced all its food needs and surpluses for its agro-industries in the 1970s and showed remarkable trend that Nigeria was, and could remain self-sufficient in terms of the food requirements for its citizens and for exportation. In recent years, there is low agricultural productivity in Nigeria, the expected yields from crops, soils, rivers, lakes, livestock and forests are far below potentials. Even with low productivity in agriculture, a significant proportion of the output is lost or wasted during storage and transportation. There is lack of efficient and effective storage facilities to preserve the produced foods; also the roads are so bad that most of these foods are lost before they get to the consumers.

From Figure 1, food production index and population growth in the period under review shows an increasing trend, but the rise in population is faster than the rise in food production. Food production, a proxy for food supply of food increased from 48.23 in 1990 to 114.93 in 2013;while the population, a proxy for food demand increased from 98.08 million in 1991 to 177.82 million in 2014.Nigeria food equation is not balanced because the demand for food is rising faster than the supply of food. This shows that Nigeria is not food secured in terms of availability.
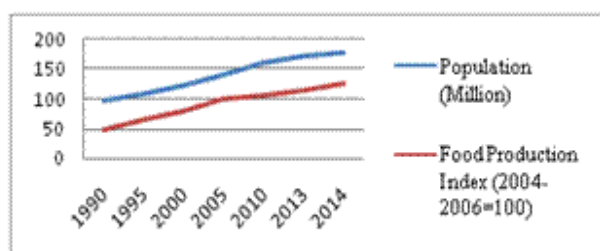
Source: World Development Indicator (2016)
Fig. 1. Demand for and Supply of Food in Nigeria (1990 -2014)

The inability of food supply to match up with demand is attributed to low productivity in agriculture leading to a shortfall in domestically produced food in Nigeria. To supplement the shortfall in domestic food production, Nigeria depends so much on food importation as shown below.

Table 1 presents the increase in food import. Percentage of food import increased from 1.6% in 1991 to 30.6% in 2011 and decreased to 17.8% in 2013 while food export also witnessed an improvement between 2012 and 2013. This may be attributed to different agricultural policies/schemes established by the government. But the gap between food import and food export is a clear indication that domestic agricultural

production is not sufficient for the domestic food needs as well as raw materials for our industries.

TABLE 1. Value of Import and Export of Food in Nigeria (%) (1991-2013)

Year	1991	1996	2001	2006	2011	2012	2013
Import (% of Merchandise)	1.6	17.5	21.7	18.0	30.6	22.7	17.8
Export (% of Merchandise)	1.5	1.7	0.0	0.1	1.8	5.3	5.1

Source: WDI, (2016)

Depending so much on food importation is not good for any economy, it could only lead to vulnerability and in case of down turn in the economy as we are expressing recently, the country will be left with no option than to depend on food aid and further exposing the country to a chronic food insecure situation.

Since 2000, the prevalence of undernourishment in Nigeria has been decreasing even though the country did not achieve the millennium development goal of eradicating poverty and hunger in 2015. The downward trend in the prevalence of undernourishment maybe attributed to the improvement in food production during the period.

Table 2 shows that the proportion of undernourished in total population decreased from 20.8 million in 1992 to 8.9 million in 2008 and increased again to 11.9 million in 2015. The quality of the diet of the nation shows an imbalance as a result of heavy dependence on root crops, tubers and cereals. Major contribution to availability of food does not come only from agricultural crops, fisheries and forest products also have high nutritional content. Forest foods and aquatic animals are highly nutritious and can be used as supplement for food lacking essential vitamins and minerals. It is estimated that between 15% and 20% of animal protein consumed is derived from aquatic animals (FAO, et al., 2013). In Nigeria, forest foods constitute an important share of our diets such as nuts, wild animals and insects, but over dependence on wood as fuel for cooking and preserving food leads to deforestation thereby worsening the food availability situation in the country.

DES derived from cereals, roots and tubers increased from 113% in 1992 to 123% in 2015 indicating an improvement in dietary supply. The minimum dietary energy requirement increased from 1710Kcal in 1992 to a paltry 1730Kcal in 2008 yet far less than 1800 Kcal (7500KJ) average minimum daily energy requirement per person as recommended by FAO, et al. (2013). The current calories value can be attributed mainly to carbohydrate consumption. Other food values such as proteins, vitamin and minerals fall far below the component directory requirements.

TABLE 2. Minimum Dietary Energy Requirement (DER), Share of Dietary Energy Supply (DES) and Prevalence of Undernourishment in Nigeria (1992 – 2015)

Year	Minimum DER (Kcal)	DES (%)	Prevalence of undernourishment (%)	Number of people undernourished (million)
1992	1710	113	17.9	20.8

1997	1720	118	11.2	13.2
2002	1720	121	9.0	11.2
2008	1730	126	5.7	8.9
2015	n.a	123	7.3	11.9

<div align="right">Source: WDI, 2016</div>

Although the government is trying to meet the sustainable development goal of no poverty in 2030, with an increase in GDP from $369.1 in 2010 to $ 568.5 in 2014; 60% of the population still lives on less than $1.25 a day (WDI, 2014). Government expenditure on health has not been encouraging, as poor people are mostly the ones accessing government health facilities. For instance, expenditure on health as a percentage of GDP in Nigeria decreased from above 7% in 2003 to 3.88% in 2013.

In terms of food utilization, Nigeria has not performed very well. NDHS, (2013) reports that37% of Nigerian children are stunted, 29% are underweight while 18% are wasted and out of these percentages that are stunted and underweight, more reside in the rural areas than in the urban areas, precisely 43% and 26% respectively. All these are signs of acute and chronic malnutrition caused by high poverty rate in the country. High poverty rate as well as poor sanitation leads to poor nutrition.

There are also regional differences in nutrition outcomes across the country, for instance, Adamawa state has an absolute and food poverty rate of 74.2 and 55.4 respectively, while Anambra state has 56.8 and 34.2 respectively (NBS, 2010). Different ethnic disturbances in different parts of the country have all disrupted food production and supply in the country. The prevalence of food insecurity can be said to be predominant in the rural areas than in the urban areas but with differences across states and regions.

IV. CHALLENGES OF SUSTAINABLE FOOD SECURITY IN NIGERIA

Poverty is the major problem of food accessibility, availability and utilization. Poverty leads to insufficient income needed to meet household basic need. There are also other political and socioeconomic problems leading to food insecurity and these are discussed below:

A. Government Policy:

Nigeria depended so much on agricultural productivity for its revenue until the exploration of oil in 1970s. The oil boom led to the negligence of the non-oil sectors especially the agricultural sector which used to be the major source of revenue for the country. The attention given to agriculture reduced drastically, farming reduced drastically, farmers needs were not attended to and the worst of all was that research and development in the sector slowed down causing a stagnation in food production.

Government policies with regard to agricultural production were rapid with plans hastily put together and little or no participation from those who are engaged in agricultural productivity. Moreover, policy change that championed increased incentive for local farmers for improved local food productions were neglected. Urban and community farming and even home gardening were no longer encouraged as land agents made it too difficult for people to obtain land for building as well as for agricultural productivity.

B. Agricultural Practices:

The type of farming system prevalent in Nigeria is the traditional subsistent farming. This system is characterized by use of simple farm tools, small farm holdings, restricted access to credit facilities and low agricultural inputs, inadequate storage facilities, insecure markets for post-harvest products and exploitation of farmers by the middlemen. In terms of technology, Nigeria is still lagging behind when compared to other nations in Europe and Asia. Due to poverty and illiteracy, farmers do not have access to modern communication system with which they can access information regarding new technologies. Also there are few extension officers to transfer new technology to the farmers. Funding for agricultural research is still low in Nigeria. Also heavy importation of food crops affects productivity of local farmers because the small farmers cannot compete with the imported crops.

C. Population Increase:

The demand for food exceeds the supply of food because the rate of growth of population is higher than the growth in agricultural productivity. Also the large population continues to relocate to the urban areas in search of white collar jobs which do not exist. This youth rural-urban drift makes it difficult for the country to be food secured.

D. Environmental Issues:

Flood, drought, desertification are environmental issues affecting availability of food in Nigeria. Climate change affects food supply through loss of farmland, fluctuating food prices, increases in food borne illnesses and other food utilization issues (GCF, 2016).The recent environmental degradation through deforestation and flooding has wide negative implication for food production. For instance, in 2012 the country witnessed an unprecedented rainfall as a result of extreme weather. The rainfall resulted in severe flooding causing loss of agricultural crops, live stocks and human lives. According to Metu, Kalu and Ezenekwe (2015), the estimated loss of the country's GDP was worth N2.6 trillion. In the same period, share of agriculture value added to total GDP declined from 23.89% in 2010 to 22.05% in 2012 (WDI, 2014). Other environmental factors that may affect food security includes soil degradation, soil pollution and deforestation. Also air and water pollution from industrialization threaten both human and natural resources to an extent that food securities capabilities are damaged.

E. Corruption:

Corruption in Nigeria has been on the increase leading to money budgeted for public utilities being siphoned for private use. This leads to decay in infrastructure especially rural infrastructure where majority of the farmers live and operate from. For instance, we have seen situations where money meant for importation of fertilizers are siphoned.

V. WAY FORWARD TO ACHIEVING SUSTAINABLE FOOD SECURITY IN NIGERIA.

It should be noted that food production is only a means to an end. Solution to achieving sustainable food security must include reduction in the level of poverty because income must be improved to enable people meet the basic necessities of life, including food. However, reduction in poverty level takes a long time to be achieved; therefore, immediate solvable solutions must be taken and they include the following:

A.   Improved Agricultural Productivity:

Different projects/schemes have been established by different governments in the country in order to improve agricultural productivity, but they have failed because poor policy implementation. Agricultural productivity can be improved through encouragement of research. Research Institutes should be funded so as to encourage innovation and participatory research. Through research, foreign technology can be modified and applied in Nigeria. Inorganic fertilizers and chemicals can be replaced with alternatives such as cow waste and composite manure which are environmentally friendly. Also extensions services should be encouraged and strengthened because through the extension services new technology can be transferred to the farmers.

There should be storage facilities to enable farmers store their post-harvest crops. Farm products are perishables; farmers are forced to sell their products so quickly thereby making revenues that do not meet their daily need. The storage facilities can help them preserve their products before taking them to the market for sale. The storage facility will also help provide enough food reserve for the country.

B.   Agricultural Biodiversity:

Improved agricultural biodiversity through improved agricultural practices will also increase food supply. Large scale farming involves planting one type of crop on a large piece of land, but with improved farming different genetically improved crop types and species may be planted on a piece of land. Mono-cropping also exposes crops to both pests and diseases and also increases the use of organic fertilizers and pesticides that erode soil biodiversity. In other to achieve sustainable food security, Nigeria farmers as well as government should embrace this modern food production technique that comes in form of agricultural biodiversity aimed at increasing livestock and crop production.

C.   Environmental Management:

Efforts to increase productivity have led to pressure on natural resources as well as environmental damage. There should be effective management of the environment by reducing the rate of deforestation. Trees should be planted as often as possible especially in the desert. Providing habitat for agricultural pests and increasing resilience to shocks and long-term climate change can help in the improvement and management of natural resources. Tree planting should be encouraged because forest trees outside the forest helps in protecting soil and water resources, promotes soil fertility and provides protection from extreme weather events.

D.   Policy Changes:

Sustainable food security can be achieved if the government adopts inclusive growth in its development efforts. Development should be participatory and environmentally friendly. People-Centered agricultural development puts the farmers first and attacks poverty with opportunities and education. It requires involving the rural people in decision making stages of agriculture productivity. The inability of government to involve these sets of people in defining and designing projects has led to the failure of some of these projects. There should be well designed social protection systems -such as risk insurance scheme and community empowerment- to help households sustain their resilience to shocks.

VI.   CONCLUSION

This paper is an attempt to evaluate food security in Nigeria. The factors responsible for food insecurity are also discussed as well as recommendations proffered for ensuring food security in Nigeria. Achieving sustainable food security means ensuring continuous access to food both quantity and quality for the present generation as well as the future generations. Nigeria is food insecure just like most sub-Saharan African countries because food production falls below the demand for food even though the government tries to supplement through importation of food.

The major challenge of food security in Nigeria is poverty. Poverty reduces the purchasing power of the people making it difficult for them to acquire their daily minimum requirement of food. Other causes of food insecurity are environmental factors, inconsistent policy pronouncement, unsustainable agricultural productivity and underdeveloped infrastructural facilities, especially in the rural areas. The situation is not insurmountable. The paper recommends intensive promotion of research which will help to increase food production, environment friendliness as well as policy change in order to achieve sustainable food security.

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Evaluation of Universal Design Compliance at the Main Entrance of Selected Public Buildings in Covenant University, Ota, Ogun State, Nigeria

Anthony Babatunde Sholanke, Albert Babajide Adeboye, Adedapo Adewunmi Oluwatayo, Oluwole Ajala Alagbe

Department of Architecture,
Covenant University,
KM 10, Idiroko Road, Cannan Land,
P.M.B 1023, Ota, Ogun State, Nigeria.
anthony.sholanke@cu.edu.ng
tundesholanke@gmail.com

Abstract— **Provision of easy access to public facilities and environments for everyone is crucial in the development of a sustainable community. However, it is observed nationwide that public buildings and environments are not easily accessible to people with disabilities largely due to a combination of design inadequacies. It is against this backdrop that this study evaluated the compliance of the main entrance of selected public buildings in Covenant University in Ota, Ogun State, Nigeria to universal design, with a view to improve access for people with mobility impaired disabilities. The study adopted a mixed method research approach and collected data using observation guide. Data were analyzed by content analysis and presented by descriptive approachusing tables and percentages.Result showed that majority of the main entrances of the public buildings evaluated were not fully universal design compliant, thus making accessibility for people with disabilities difficult. The study recommends that the university should make appropriate efforts to ensure non-discrimination on the basis of disability in providing access to facilities, buildings and environment as the institution matches towards achieving her vision of becoming one of the top ten Universities by 2022. The outcome of the study will be useful toresearchers, policy makers and building industry professionals on issues relating to universal design concept in the built environment.**

Keywords— *Accesibility; People With Disabilities; Public Buildings; Universal Design; Nigeria.*

I. INTRODUCTION

The provision of adequate accessibility features for everyone to effectively use public facilities and environments is crucial in the development of a sustainable community. However it has been observed that in many communities public facilities, services and environments are not easily accessible to people with disabilities. Studies have revealed that people with disabilities are usually marginalized through inaccessible facilities, services and physical infrastructures [1], [2], [3], [4] and [5]. Such anomaly is what has brought about disability laws in many countries, aimed at integrating people with disabilities back into the main stream of social, political and economic life.

Apart from disability laws, accessibility design standards and concepts have also been developed over the years to help provide equal opportunities for people with disabilities alongside people without disabilities. Notably among these concepts is Universal Design (UD), "a concept from the field of Architecture" [6] that seeks to produce products, buildings and environments that are accessible and usable by everyone on equal terms. Universal design is an approach to make products and the built environment usable by the broadest group of users' possible. It is an all-inclusive design concept anchored by seven principles developed by The Center for Universal Design in North Carolina State University in the United States of America. These principles include: equitable use; flexibility in use; simple and intuitive use; perceptible information; tolerance for error; low physical effort; and size and space for approach use [7], [8] and [9].[10] posited that universal design principles can be used to evaluate buildings for clarity and ease of movement to safety during times of emergencies. He added that it is a useful tool for evaluating and designing buildings to better support the emergency evacuation needs of individuals with disabilities. [11] posited that the principles could be regarded as one component of a quality-assurance process of functionality, from the start of the project to the final result.

Covenant University in Ota, Ogun State, Nigeria is one of the leading higher institutions in Nigeria. According to the latest Webometrics ranking web of universities in the World of January 2016, Covenant University is ranked as the Best Private University and Second Best University in Nigeria [12]. One of the University's goals is to be one of the top ten universities in the world by the year 2022. In attaining this goal, it is imperative that the university's buildings, facilities and environment are of world class standard. This implies that its facilities and built environment should be of international standard, easily accessible and effectively usable by everyone on equal terms, in line with the globally accepted principle of universal design.

It is against this backdrop that this study evaluated the compliance of the main entrance of some purposively selected

public buildings in Covenant University to the universal design principles. This is done with a view to improve access in the institution, in order to properly situate the university's buildings in the best position to align with her vision of being one of the top ten higher institutions in the world by 2022. The scope of this study is limited to the main entrance of the following purposively selected public buildings: Senate; College of Science and Technology; Library; Chapel; and Cafeteria-2.

II. LITERATURE REVIEW

The term "universal design" was first used by a USA designer and architect, Ronald L. Mace in the mid-1980's to describe the concept of designing all products, buildings and the environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability or status in life. Mace was a wheelchair user who challenged the conventional way of designing products and the built environment for the average user group and laid the foundation for an all-inclusive approach that targets everyone.

The emergence of universal design in architecture and design fields did not occur in isolation. [13]reported that the concept had its beginnings in demographic, legislative, economic, and social changes among older adults and people with disabilities throughout the 20th century. [14]also noted that universal design emerged from slightly earlier barrier-free concepts, the broader accessibility movement, adaptive and assistive technology and also seeks to blend aesthetics into these core considerations.

The Center for Excellence in Universal Design defined universal design as "the design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size, ability or disability" [15]. The aim of universal design is to develop theory, principles and solutions to enable everybody to use the same physical solutions to the greatest extent possible, whether they are buildings, outdoor areas, means of communication or household goods. Its objectives include: to integrate core principles of universal design to improve livability and quality of life for everyone; to reduce physical and attitudinal barriers between people with and without disabilities; to make provisions that will enable people with disabilities to participate fully in social life on equal terms with people without disabilities; and to make simple every part of our daily activities by providing a usable community to everyone by producing buildings, products and environments that are inherently accessible to children, older people, people without disabilities, people with disabilities and people with special needs. The concept targets all people of all ages, sizes and abilities.

The planning through the implementation of ergonomics while at the same time considering the unique requirements of the various people living with disabilities such as children and the elderly, is also referred to as universal design [16] and [17]. The authors argued that universal design is a useful tool for evaluating and designing buildings to better support the emergency evacuation needs of individuals with disabilities. [17]submitted that the understanding of the average males and females' human forms in the relationship with their built environment is known as ergonomics. Particularly, it is viewed as the number of open space required for people to perfectly achieve their responsibilities. Traditionally, the philosophies of ergonomics were built by the military with the aim of manufacturing better and efficient weapons. These philosophies were crafted for able bodied people. Though, when these philosophies were implemented to industrial commodities, they appeared to be perfect for the minority [16].

The definition of universal design by The Center for Universal Design in North Carolina State University is accompanied by a set of principles widely acknowledged as the seven (7) principles of universal design. These principles are: 1. *Equitable use* (the design is useful and marketable to people with diverse abilities); 2. *Flexibility in use* (the design accommodates a wide range of individual preferences and abilities); 3. *Simple and intuitive use* (use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level; 4. *Perceptible information*(the design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities); 5. *Tolerance for error* (the design minimizes hazards and the adverse consequences of accidental or unintended actions); 6. *Low physical effort* (the design can be used efficiently and comfortably and with a minimum of fatigue); and 7. *Size and space for approach and use*(appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility) [7], [8], [9].

Based on the definition of universal design and its seven principles, The Center for Universal Design also sets up five instructive points relevant for architecture and the design process. These points include: the building should be of equitable use and accessible for everybody; the building and its design should be easy to understand and to use by all people; the design of the building should demand low physical effort, and be used efficiently and with a minimum of fatigue; the whole building or project should be designed for use by all people, regardless of users' body size, posture or mobility; and the building's use of materials and the indoor climate should not lead to uncomfortable conditions.

The principles of universal design can feed into the planning, design and construction processes to support quality of life. The principles are useful for guiding and influencing the design process, influence and acknowledge the signaling of more usable products and environments, and to evaluate existing Architecture. The principles are broader than those of accessible and barrier-free designs.

III. METHODOLOGY

A case study research method was adopted in collecting data from five (5) purposively selected institutional buildings in Covenant University in Ota, Ogun State, Nigeria for the research. The selected buildings were appraised based on their degree of compliance to the seven principles of universal design. Result was reported using descriptive statistics with the aid of tables and percentages.

IV. FINDINGS AND DISCUSSIONS

Accessible buildings and environments guidelines require that adequate provisions be made for people with disabilities to gain easy access to use buildings right from the site boundary and car parks. To this end, car parking spaces and pedestrian walkways leading to the main entrance of the selected public buildings for this study were also evaluated. Other accessibility features influencing mobility at the main entrance of the public buildings identified and evaluated by this study include: entrance porch, entrance steps, entrance ramps, floor finishes and entrance doors.

Tables I to VII show a breakdown of how the seven accessibility features identified comply with the Seven Principles of Universal Design. In each of the Tables, "Yes" indicates compliance of the accessibility features with the Universal Design Principles the table represents, "No" signifies none compliance and "-" indicates accessibility features not provided for.

TABLE I.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE ONE – EQUITABLE USE

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	No	No	No	No	No
2.	Pedestrian Walkway	-	No	No	No	No
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	Yes	Yes	Yes
5.	Entrance Ramps	No	-	No	-	-
6.	Floor Finishes	Yes	Yes	Yes	Yes	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	Yes
	% of Compliance to UD Principle One	4/7 57%	4/7 57%	4/7 57%	4/7 57%	4/7 57%

Table I indicates that all the buildings' main entrance accessibility features have an above average compliance rate of 57% with UD Principle One, as each of the buildings having five out of the seven features complying with UD Principle One.

TABLE II.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE TWO – FLEXIBILITY IN USE

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	No	No	No	No	No
2.	Pedestrian Walkway	-	No	No	No	No
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	No	No	Yes
5.	Entrance Ramps	No	-	Yes	-	-
6.	Floor Finishes	No	Yes	Yes	No	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	No
	% of Compliance to UD Principle Two	3/7 43%	4/7 57%	4/7 57%	2/7 29%	3/7 43%

Table II indicates that the Senate, Chapel and Library

buildings' main entrance accessibility features compliance rate to UD Principle Two are below average. The Chapel building has the least compliance rate of 29% with only two out of the seven features complying with UD Principle Two. The Senate and Cafeteria-2 buildings both have three out of the seven features complying with UD Principle Two, which represents 43% compliance rate. The CST and Library buildings with four out of the seven features complying with UD Principle Two have the highest compliance rate of 57% each, which is above average.

TABLE III.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE THREE – SIMPLE AND INTUITIVE USE

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	Yes	Yes	Yes	Yes	Yes
2.	Pedestrian Walkway	-	Yes	Yes	Yes	Yes
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	Yes	Yes	Yes
5.	Entrance Ramps	Yes	-	Yes	-	-
6.	Floor Finishes	Yes	Yes	Yes	Yes	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	Yes
	% of Compliance to UD Principle Three	6/7 86%	6/7 86%	7/7 100%	6/7 86%	6/7 86%

Table III indicates that the compliance rates of the main entrance accessibility features of all the buildings with UD Principle Three are high. The Library has the highest compliance rate of 100% with all its seven features complying with UD Principle Three. While all the other buildings have six of the seven features complying with UD Principle Three, representing 86% compliance rate.

TABLE IV.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE FOUR – PERCEPTIBLE INFORMATION

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	Yes	Yes	Yes	Yes	Yes
2.	Pedestrian Walkway	-	Yes	Yes	Yes	Yes
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	Yes	Yes	Yes
5.	Entrance Ramps	Yes	-	Yes	-	-
6.	Floor Finishes	Yes	Yes	Yes	Yes	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	Yes
	% of Compliance to UD Principle Four	6/7 86%	6/7 86%	7/7 100%	6/7 86%	6/7 86%

Table IV above indicates that the compliance rates of the main entrance accessibility features of all the buildings with UD Principle Four are also high. Again, the Library has the

highest compliance rate of 100% with all its seven features complying with UD Principle Four, while all the other buildings have six out of the seven features complying with UD Principle Four, representing 86% compliance rate.

TABLE V.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE FIVE – TOLERANCE FOR ERROR

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	Yes	Yes	Yes	Yes	Yes
2.	Pedestrian Walkway	-	No	Yes	Yes	Yes
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	No	No	Yes
5.	Entrance Ramps	No	-	Yes	-	-
6.	Floor Finishes	No	Yes	No	Yes	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	No
	% of Compliance to UD Principle 5	4/7 57%	5/7 71%	5/7 71%	5/7 71%	5/7 71%

Table V above indicates that all the buildings main entrance accessibility features compliance rate to UD Principle Five is above average. Apart from the Senate building that has four out of the seven features complying with UD Principle Five, representing 57% compliance rate, all the other buildings have five out of the seven features complying with UD Principle Five, representing 71% compliance rate.

TABLE VI.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE SIX– LOW PHYSICAL EFFORT

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	Yes	Yes	Yes	Yes	Yes
2.	Pedestrian Walkway	-	Yes	Yes	Yes	Yes
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	Yes	Yes	Yes
5.	Entrance Ramps	Yes	-	Yes	-	-
6.	Floor Finishes	Yes	Yes	Yes	Yes	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	No
	% of Compliance to UD Principle Six	6/7 86%	6/7 86%	7/7 100%	6/7 86%	5/7 71%

Table VI above indicates that the compliance rates of the main entrance accessibility features of all the buildings to UD Principle Six are also high. Again, the Library has the highest compliance rate of 100% with all its seven features complying with UD Principle Six. The Senate, CST and Chapel buildings have 86% compliance rate each, with six out of the seven features complying with UD Principle Six, while Cafeteria-2 has the least compliance rate of 71%, with five out of the seven features complying withUD Principle Six.

TABLE VII.   MAIN ENTRANCE ACCESSIBILITY FEATURES DEGREE OF COMPLIANCE WITH UNIVERSAL DESIGN PRINCIPLE SEVEN – SIZE AND SPACE FOR APPROACH AND USE

No	Accessibility Features	Senate	CST	Library	Chapel	Cafeteria-2
1.	Parking	Yes	Yes	Yes	Yes	Yes
2.	Pedestrian Walkway	-	Yes	Yes	Yes	Yes
3.	Entrance Porch	Yes	Yes	Yes	Yes	Yes
4.	Entrance steps	Yes	Yes	Yes	Yes	Yes
5.	Entrance Ramps	No	-	Yes	-	-
6.	Floor Finishes	Yes	Yes	Yes	Yes	Yes
7.	Entrance Doors	Yes	Yes	Yes	Yes	Yes
	% of Compliance to UD Principle Seven	5/7 71%	6/7 86%	7/7 100%	6/7 86%	6/7 86%

Table VIIindicates that the compliance rates of the main entrance accessibility features of all the buildings to UD Principle Seven are also high. Again, the Library has the highest compliance rate of 100% with all its seven features complying with UD Principle Seven. The CST, Chapel and Cafeteria-2 buildings have 86% compliance rate each, with six out of the seven features complying with UD Principle Seven, while the Senate building has the least compliance rate of 71%, with five out of the seven features complying with UD Principle Seven.

V.   CONCLUSION AND RECOMMENDATIONS

This study identifies seven important accessibility features that affect users' mobility from the main entrance of a public building. The features include: parking; pedestrian walkways; entrance porch; steps; ramps; floor finishes; and entrance doors. The study also revealed that none of the case study buildings' main entrances is fully universally designed. The result of the research is consistent with other studies that have found that the built environment is generally inaccessible to the physically challenged. This negates the focal point of universal design, which is to produce buildings and the environment that are accessible and usable to everyone on equal terms.

The study recommends that the University should begin to make efforts to ensure nondiscrimination on the basis of disability in providing access to use facilities, buildings and environment in the institution.Efforts should be made to renovate accessibility features in the university to make them all-inclusive in nature. Among the important findings from this study is that appropriately introducingdropped kerbs, ramps, handrails, non-slippery floor finishes and beveled door thresholds where necessary, will be a starting point towards fully implementing the concept of universal design in the built environment ofthe university.

Other recommendations include conducting training workshops for projects supervision/monitoring teams and workers on universal design, formulating guidelines to implementing universal design principles and criteria in all future projects of the university and ensure strict compliance to the guidelines. Relevant departments of the university should also incorporate universal design in their curriculums. This will help to ensure that future designers and builders of

the built environment are trained and grounded in the universal design concept. To build a sustainable learning environment, it is imperative that all hands should be on deck to ensure that facilities, buildings and environment are produced with features that make them easily accessible for use by everyone on equal terms, in line with the universal design concept.

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How do Students Perceive their Employability Readiness?

TheCase of Architecture Students

[1]Adedapo Oluwatayo
Department of Architecure,
Covenant University, Ota, Nigeria

[2]Akunnaya Opoko
Department of Architecure,
Covenant University, Ota, Nigeria

[3]Isidore Ezema
Department of Architecure,
Covenant University, Ota, Nigeria

[4]Osmond Iroham
Estate Management Department,
Covenant University, Ota, Nigeria

Abstract—**There are often claims that graduates are not employable and some scholars have posited that this is the major cause of the high rate of unemployment in many countries. There are indications in literature of the parameters by which employability can be measured. These measures of employability have been investigated from the point of view of employers and they represent the areas employers would use as criteria for selection of prospective employees. The question however is: how do the students perceive their preparedness for the workforce, in terms of their employability readiness? This is the question that this paper seeks to address in a survey of architecture students in Nigeria. Architecture students are investigated because it has often been alleged that formal education does not prepare persons in this course of study sufficiently for the world of work. The results suggest areas that the students are not so confident of their preparedness. Recommendations are made for the training of architects to enhance their employability.**

Keywords—*Architecture Students, Employability, Nigeria, Perception of employability*

I. INTRODUCTION

Higher education is often seen as a stepping stone to a good job. It has however often been alleged that the University does not produce job-ready graduates. Even with courses that are often considered as vocational, like architecture, employers still note that they have to re-train fresh graduates to make them fit for practice. Brown et al. [1] noted that a degree confers little positional advantage in the job market. This suggests the relevance of other skills apart from the technical skills, which the degree attests to. Several studies on employability are often based on data from the point of view of employers. Very few studies exist that considers the point of view of the students. In this study therefore, an attempt is made to fill this gap by investigating the perception of employability readiness of students of architecture. Architecture presents an interesting context as the course is often hands-on, with students challenged with projects and assignments, which are simulations of real industry projects. Although anecdotal evidence suggests that employers are often satisfied with the technical skills of the students, there are other skills that are important to stand out as the most likely candidate for a job. Employability, according to Yorke [2] is "*a set of achievements, skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy*" [2].

The aim of this study is to investigate the perception of employability-readiness of architecture students. A study of this nature is important as it provides insight into the areas that students do not feel competent to face the job market. These are areas that institutions may assume they have handled in the curriculum, but may not have been adequately addressed.

II. LITERATURE REVIEW

Although employability is a concept which came into use several years ago, there has been an increasing interest in graduate employability of recent. One of the reasons for this is need to make graduates who are meant to be skilled in particular areas more relevant to real life practice. The studies in this area have identified skills, which may not necessarily be restricted to particular professions, which promote graduate employability. These skills were broadly subdivided into core skills; key skills; common skills; transferable skills; essential

skills; functional skills; skills for life; generic skills and enterprise skills. In recent literature however, employability skills have been investigated under subsections such as information technology proficiency, oral and written communication, number skills, and technical competency, among others [3].

To the employer graduates who are proactive are more sought after [4]. These scholars opine that today's employer look out for skills such as critical thinking, ability to work in teams, and proficiency in communication, when they employ fresh graduates. In fact, critical thinking is believed to foster innovation [5, 6]. Other aspects that these employers look out for include ability to adapt to workplace culture, This is probably why the National Institute of Adult Continuing Education (NIACE) in 1982 suggested that employability may be more of a social construct with diverse aspects.

Rothwell and Arnold [7] identified seven factors that impact on students' employability skills. These include academic performance, confidence, ambition, and perception of student's university brand. Other factors are reputation of university, status of field of study and student's awareness of opportunities in the labour market.

Employability goes beyond skills that enable a graduate gain employment after graduation [2]. Hillage and Pollard [8] observed that it also encompasses skills that make it possible for a person to move easily within the labour market as well as make a success of a particular job. Although Brown, Hesketh, and William [1]criticised this view, noting that the local, national and international labour markets do matter, one would however not that within the same country or industry, some graduate tend to be more employable than others.

Employers are said to value the skills which makes one applicant appeal more as the most likely candidate than other [9]. These skills include those are technical and those that are more or less relational. The technical skills include knowledge of the business, problem solving, ICT knowledge, literacy and numeracy skills relevant to the post, while the relational skills include team working, as well as good interpersonal and communication skills. In addition however, employers also look out for self-management, which is evident in motivation, commitment and tenacity displayed by a job candidate. It also entails ability not just to use own initiative but also to follow instructions. To develop these skills, UKCES[9] suggest that university students should be made to engage in extra-curricular as well as internship programmes.

Universities all over the world always strive to demonstrate that their graduates can fit into the job market. Educators therefore strive to get the message across that learning enhances life chances in a variety of ways, it is undeniable that pressure from government and regulators, as well as fee-paying students and their families, requires increased clarity about the ways in which the curriculum helps develop the skills and

competencies needed in the world of work.

This is in the light of the fact that employability is about much more than simply getting a job after one finishes studies. It is about achievements, understanding and personal attributes. It is also about the students' self-image. These are attributes that it would take more than lecture to develop.

III. RESEARCH METHODS

For the purpose of this study, questionnaires were administered to 154 students of architecture in Covenant University, a University in Nigeria. Students at the final undergraduate year and the Masters students were sampled in the study. Self-administered questionnaires were used in obtaining the data. Data was obtained on the respondents' profiles, their view on their overall preparedness for the job market and their views on their levels of employability skills already acquired. This was done on a scale of 1 to 5, where "1" represented "Not prepared at all", while 5 represented "Highly prepared".

TABLE I. RESPONDENTS' PROFILE

Respondents' profiles	Categories	Percentage (%)
Sex of respondents	Male	64.4
	Female	35.6
Ages of respondents	14-16yrs	1.0
	17-19yrs	30.6
	20-21yrs	50.3
	above 21yrs	18.1
Extent to which students perceived their training has prepared them for the job market	Not prepared at all	2.6
	To a little extent	20.7
	To some extent	51.8
	To a large extent	24.9
Students' level of confidence that they will be employed to practice architecture on graduation	Not confident at all	3.1
	Little confident	7.3
	Somewhat Confident	17.3
	Confident	41.9
	Highly confident	30.4

Of the number of questionnaire administered, 115 were returned and usable. This represented a response rate of 74.7% (Table I). Most of the respondents were male (64.4%), with about half aged between 20 and 21 years. About three-quarter (76.7%) of the students believed that their study has prepared them to some or a large extent for the job market. Similarly,

72.3% of the students are confident that they will be employed to practice architecture on graduation.

IV. RESULTS AND DISCUSSION

The results in Table II show that the students believe that they are best prepared for teamwork and self-motivation. Their problem-solving, creativity, personal organisation and decision-making skills also appear to be rated high. However, the students do not appear to be very comfortable with the levels of leadership, project management and management skills. It is even more surprising that the students perceived least preparedness on subject knowledge or technical skills related to architecture. It appears the students still feel there is a lot more to be learnt. A closer look at the data however show that most of the students who rated their preparedness in terms of technical skill low were those at the final undergraduate level. This is probably as a result of the curriculum that limited the more of the practice-focused courses to the postgraduate levels.

It is however interesting to note that the teamwork skill of the students was perceived as the most developed skill. The curriculum of the school also needs to be reviewed to cater more for the development of leadership, entrepreneurial and management skills.

TABLE II. RANKING OF STUDENTS' PERCEIVED PREPAREDNESS FOR THE JOB-MARKET

Employability skills	Mean	Std. Deviation
Teamwork	4.1959	.87734
Self-motivation	4.1134	.95902
Problem solving	4.0876	.88015
Creativity	4.0777	.93495
Personal organization	4.0773	.86928
Decision-making	4.0155	.86889
Ability to design and conduct investigation	3.9741	.89230
Oral communication	3.9536	1.03459
Computer literacy, advanced IT/software skills	3.9534	.92585
Numerical reasoning	3.9053	.94364
Critical thinking	3.9021	1.03598
Written communication	3.8953	.97847
Information Technology	3.8705	.98890
Entrepreneurial skills	3.8394	1.05084
Leadership skills	3.8238	1.01553
Project Management	3.8144	1.06601
Management skills	3.8031	.96425
Subject Knowledge/Technical Skills	3.7098	1.01999

V. CONCLUSION

The aim of this study is to investigate the perceived preparedness of students of architecture for the job market. The results suggest areas that areas of management and entrepreneurship are areas that the architecture schools should address. A major limitation of this study is that data was collected from only one institution. In addition, further study may use objective measures of the preparedness of the students, instead of perception adopted in this study. Technical skill development should also be an area of focus.

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Development and Evaluation of the Efficacy of a Local Probiotic in Comparison with a Commercial Probiotic in the African Catfish, *Clarias gariepinus*

Francisca George, Akinwale Akinleye, Adeoluwa Akinyemi
Department of Aquaculture and Fisheries Management
Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria
georgefoa@funaab.edu.ng

Oluwatoyin Afolabi
Department of Microbiology
Federal University of Agriculture, P.M.B. 2240, Abeokuta
Ogun State, Nigeria

Abstract - **Probiotics are mono or mixed cultures of live organisms which improve the host's health status and indigenous flora properties. The use of probiotics in enhancing growth and as replacement for synthetic growth promoters in animal health management and nutrition has been scientifically proven. This study was carried out to evaluate the intestinal flora of the African catfish, *Clarias gariepinus* for probiotic properties, develop suitable probiotic formulation/s from them; and evaluate the efficacy of the developed probiotic for promoting growth and health in the African catfish in comparison with a commercial probiotic, Mito yeast. Laboratory screening of the gut Microflora of cultured *C. gariepinus* using standard methods revealed *Lactobacillus plantarum* as a viable organism with probiotic properties. *Lactobacillus plantarum* (Accession no: KP 410238) was thereafter cultured, processed and included as supplement in the diet of *C. gariepinus* and evaluated for growth and health enhancement capability. Experimental diets (TD1, TD2, TD3, TD4) were supplemented with the developed probiotic containing *L. plantarum* (10^9 CFU/g) at 0, 0.25, 0.5 and 1% respectively, while TD5 was supplemented with 0.5% MY-500 (MitoYeast) containing *Saccharomyces boulardii* culture (2×10^9 CFU/g).**

Growth performance, measured by body weight gain, BWG; specific growth rate, SGR and metabolic growth rate, MGR; and nutrient utilization (protein efficiency ratio (PER), feed conversion ratio (FCR) and feed efficiency, FE) were significantly different ($P \leq 0.05$) in treatments with varied levels of probiotics' inclusion compared to the control diet.

Hematological effects as indicated by Packed Cell Volume, Hemoglobin, Red Blood Cell count, White Blood Cell Volume, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin Concentration and Platelet count showed an increase in fish fed probiotic-supplemented diet treatments compared to control, but the effects were not significantly different ($P \geq 0.05$), and values were within recommended levels. This suggests that the developed probiotic has no negative impact on the health status of *C. gariepinus*.

This study concludes that dietary inclusion of probiotics in *C. gariepinus* diets improved growth and nutrient utilization in the fish; and had no adverse effect on its health status. *Lactobacillus plantarum*, a naturally occurring microorganism present in the gut of *C. gariepinus* was identified and confirmed as a viable probiotic agent in the species.

Keywords- *Probiotics, fish nutrition, Growth promoter, L. plantarum, C.gariepinus*

I. INTRODUCTION

Aquaculture production have recorded a rapid growth rate of 8.9% per annum, compared to captured fishery and livestock production that grows at about 1.2 and 2.8% respectively as recorded by FAO in 2010. This appreciable increase is due to intensification of the cultured systems, continuous research and development in aquaculture systems.

In Nigeria, aquaculture production is drastically increasing and gradually becoming a means of

livelihood to average farmers because of its continuous demand by the populace, readily available market and quick economic turn over. Presently, many small holding fish farmers and those on commercial production are exploiting these merits and suitable conditions towards better production (Ozigbo *et al*, 2014).

Probiotics can be described as cultured products or live microbial feed supplement, which affects its host positively by improving intestinal balance and health status of the host (Fooks *et al*, 1999). Probiotics can further be described as pure cultures of one or more microbes included in feed that proliferate in the hosts gut, ensure balanced and beneficial microbial population and maintain a healthy status of the host animal (Simon, 2005). Due to increase in research focusing on environmentally-friendly production, there is increasing aim at exploring the possibility of probiotics effects on aquatic organisms. Most of these focused mainly on improved health aspects with little focus on its nutritional benefit (Bogut *et al*, 1998).

Recently, there are more focus on the research centered on use of probiotics in aquaculture (Ghazalah *et al*., 2010). As a result of its beneficial impacts, probiotics are now been used in aquaculture industry as a means to control diseases, improve on water quality and increase the immune system of its host (Wang *et al*., 2004). Many of the strains in use belong to lactic acid bacteria (LAB), although many other microbes belonging to other species have also been tested (Suzer *et al* 2008).

Catfish (*Clarias gariepinus)* also called African sharp-tooth catfish belongs to the family Clariidae and are found throughout Africa and part of Middle East. Their habitat includes freshwater lakes, swampy areas, rivers, and artificial habitats like oxidation ponds, earthen pond etc. (De-Graaf and Janseen 1996). Catfish is a preferred choice in the tropics because it grows fast, has ability to feed on vast agricultural by-products, hardy, tolerance to harsh water quality situations and it is more economically rewarding than tilapia as it can be sold live at the market. Based on the aforementioned qualities, catfish has become specie of choice among fish farmers in Nigeria and Sub-Sahara Africa (De-Graaf and Janseen 1996).

There is a need to evaluate the nutritional importance of probiotic inclusion in aquaculture production and development of a probiotic strains from commonly cultured fish species to enhance growth and immune system of cultured species in Nigeria (Folorunsho *et al*., 2011).This research therefore, is aiming to focus on exploring the nutritional benefit of probiotics in the tropics, using Catfish (*Clarias gariepinus*) as experimental animal. It is thus expected that a positive result from the research will help in solving issues relating to high nutritional costs in aquaculture and helps in encouraging farmers towards environmentally-friendly aquaculture production in sub-tropics and tropical aquaculture.

II   MATERIALS AND METHODS

A.   Location

The feeding trial was sited at the Hatchery unit of Aquaculture and Fisheries Management Department, Federal University of Agriculture, Abeokuta, Ogun State, South-West Nigeria with coordinate 07°13'51"N, 03°26'18"E, while the laboratory experiments were conducted at the Microbiology and Biotechnology laboratory of the institution. Further screening and analysis as regards probiotics development was partly done at the Tuberculosis Laboratory section of Sacred Heart Hospital, Lantoro in Abeokuta.

B.   Experimental Animal

A total number of 150 healthy catfish (*Clarias gariepinus*) juvenile with an average body weight of 15±0.53g were obtained from fish hatchery unit of Odeda farm Institute, Odeda, Ogun State and transported in an open 50 litres capacity plastic tank to the experiment site where it was emptied into a 200 litres plastic tank for acclimatization.

C.   Experimental Design

Selected healthy African catfish, *Clarias gariepinus,* juveniles with average weight of 15.14± 0.35g were randomly distributed at the rate of 10 fish per tank into each of the 15 experimental tanks, there are 5 treatment in triplicate. The fish were acclimatized for 14 days and fed with control diet before data collection. The fish were fed twice daily, around 9.00am and 15.00pm daily at 3% body weight. The ration was adjusted weekly with reference to new mean weights measured. There was no observed leftover feed. The fish were not fed until after the weighing and when a new feed calculation is made in other to adjust the quantity fed for each feed in correspondence to their body weight. The experiment was performed for 12 weeks after which growth parameters and nutrient utilization was accessed.

D.   Experimental Diet

A total of five isonitrogenous and isoenergetic experimental diets with crude protein levels of 40% and a calculated digestible energy level of $12kJ/g^{-1}$ according to (ADCP, 1983) were formulated. Probiotics was not included in the first diet and served as the control, while the remaining four diets were supplemented with cultured and developed probiotics containing *Lactobacillus plantarum* at 0.25%, 0.5%and 1% level of inclusion for diets DP1, DP2 and DP3 respectively while diet DP4 was formulated with inclusion of MY-500 (MitoYeast)

containing Saccharomyces *boulardii* culture ($2x10^9$ CFU/g) at 0.5% to serve as a comparative diet to the first feeding trial.

The ingredients were measured using a sensitive scale and thoroughly mixed together by hand starting with minute ingredients to ensure proper homogenization of the ingredients. The diets were then pelletized using a 2-mm pellet press after which it was sun-dried and kept in airtight containers.

E. Probiotics sample preparation

10 table-sized Catfish (*Clarias gariepinus*) were each selected from university reservoir dam and Concrete tank pond of Federal University of Agriculture, Abeokuta, Nigeria. Collected samples were killed and the gut content was removed and kept in test tube. This was later homogenized and preserved for further analysis.

F. Screening of bacteria for probiotic attributes

a. Tolerance to low pH

Isolates was grown on MRS broth (LabM) at 30°C overnight and later sub-cultured into a freshly prepared MRS broth and incubated for a day. The cultures were then centrifuged at 5000 x g for 10 min. at 4°C. The pellets was then washed in sterile phosphate-buffered saline (PBS) (Oxoid), pH 7 and re-suspended in PBS. Each strain was diluted at 1/100 in PBS at pH 2, 3 and 4. Incubation time were observed at 2, 4 and 6 h. Bacteria was later transferred to MRS broth and incubated at 37°C overnight.

b. Bile resistance

The isolates that were able to resist the adverse pH conditions were selected for bile tolerance determination. Growth was then accessed spectro-photometrically (600 nm) in MRS containing 0.3% bile salts (Sigma and catalogue no. B8381) and compared to bile salt-free MRS. Growth delay was later used to determine bile tolerance (Chabrillón *et al.*, 2006).

c. Antibacterial sensitivity

Agar well diffusion method was carried out according to a modified method of Ochei and Kolhatkar (2008). LAB was grown in MRS broth for 24hours at 37°C, afterward centrifuged at 5340Xg for 15minutes to separate the cells from the supernatant which contained the antibacterial substance. Afterward, the supernatant was filter-sterilized using a Membrane Filter, collected and stored in sterile bottles. Nutrient agar was then prepared and allowed to cool to around 45°C and seeded with test pathogenic organisms, and poured into plates and allowed to set. Five wells was then bored into the gar with the aids of cock borer of 5mm diameter, and filled with 80microlitres of the filtered supernatant. Positive and negative control wells were filled with sterile MRS broth and standard antibiotics solution of 100microlitre/ml. This was afterward incubated for 24hours at 37°C. Zones of inhibition were then measured using a vernier caliper, and any zone not up to 11mm was counted as insignificant.

d. Resistance to antibiotics

This was determined with the use of 10 different antibiotic discs (bioMérieux, Marcy-l'Etoile, France) on MRS medium. *Staphylococcus aureus* and *Enterococcus feacalis* were used as the control.

e. Haemolytic Activity of the Isolates

Freshly prepared lactobacilli broth cultures was splashed onto Blood agar plates that contains 50 ml of blood (Oxoid, Milan, Italy), and were incubated for 48 h at 30°C. The plates were then examined for α, β and γ-haemolysis signs.

G. Data analysis

The following Parameters were analyzed:
Growth Parameters and energy budget - Body weight, Body Weight gain (%) and Specific Growth Rate (SGR), Metabolic growth rate (MGR),
Nutrient Utilization - Feed conversion ratio (FCR), Protein efficiency ratio (PER)
The following formula were used for evaluation of growth parameters and nutrient utilization
BMG = Final body mass - initial body mass, BMG (%) = [(Final body mass - Initial body mass) / Initial body mass] * 100. SGR %= [(ln final body mass in g) - ln initial body mass in g) / number of trial days] * 100
MGR = (Body mass gain, g) / [{(initial body mass, g / 1000) $^{0.8}$ + (final body mass,g / 1000)$^{0.8}$}/2] / duration of the trial days (Dabrowski *et al.* 1986). FCR = dry feed fed (g)/body mass gain (g) PER = fresh body mass gain (g)/crude protein fed (g).

H. Statistical analysis

Data collected were subjected to one-way analysis of variance (ANOVA) and the significance of the differences between means was tested by Duncan's

multiple range test (P<0.05). SAS Version 9.1 (Statsoft Inc., Tulsa, USA) was used to determine the level of significance and values of expressions as means ± standard deviation.

II. RESULT

A. Growth and nutrient utilization

The result of growth performance and nutrient utilization in *C.gariepinus* juvenile fed diets with inclusion of locally developed and commercial probiotics after 12 weeks culture period is presented in table 2. There was a significant difference (P $\leq$ 0.05) with regards to body weight gain (BWG), specific growth rate (SGR), metabolic growth rate (MGR) in treatments where probiotics are included when compared with control diet. Nutrient utilization was also significantly different (P $\leq$ 0.05) with regards to protein efficiency ratio (PER), feed conversion ratio (FCR) and feed efficiency (FE).

B. Haematological parameters

The haematological parameters recorded after at the end of 12 weeks culture period are presented in table 3. Significantly (P $\leq$ 0.05), differences were observed in the haematological parameters measured between control diet and probiotic based diets. The result indicates a higher value in packed cell volume (PCV), haemoglobin (HB), red blood Cell (RBC) white cell volume (WBC); mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and platelet (PLT) when diets where probiotics is included is compared with control diet at the end of the feeding experiment.

TABLE I**:** Growth performance and nutrient utilization in *Clarias gariepinus* juveniles fed the developed probiotics experimental diets for 12 weeks.

	Control	*DP1*	*DP2*	*DP3*	*DP4*
IBW (g)	15.10 ± 0.07	14.99 ± 0.03	15.06 ± 0.16	15.17 ± 0.14	15.12 ± 0.17
FBW (g)	43.39 ± 1.32[b]	44.24± 2.0[ab]	47.78 ± 1.33[a]	52.77 ±3.99[a]	50.61 ± 1.12[ab]
BWG (%)	187.29 ± 9.86[b]	195.18 ± 14.33[ab]	217.30 ± 3.91[a]	247.90 ± 14.5[a]	234.78 ± 4.31[a]
SGR (%)	1.26 ± 0.2	1.29 ± 0.6	1.37 ± 0.2	1.48 ± 0.1	1.44 ± 0.5
MGR (g/kg$^{0.8}$/day)	0.34 ± 0.01	0.35 ± 0.01	0.39 ± 0.01	0.45 ± 0.01	0.42 ± 0.02
PER	7.83 ± 1.17[b]	7.98 ± 0.23[ab]	7.93 ± 0.33[ab]	9.38 ± 0.04[a]	9.73 ± 0.43[a]
FCR	0.32 ± 0.01	0.31± 0.02	0.30 ± 0.02	0.27 ± 0.01	0.26 ± 0.02
FE	313.15 ± 6.38	319.25 ± 17.27	319.13 ± 13.2	375.35 ± 1.54	389.37 ± 14.33

NB: IBW, Initial body weight; FBW, Final body weight; BWG, Body weight gain; SGR, Specific growth rate; MGR, Metabolic growth rate; PER, Protein efficiency ratio, FCR, Feed conversion ratio; FE, Feed efficiency. Values are mean (n = 3) ± standard deviation. For all parameters, mean values in the same column were not significantly different (p < 0.05).

Table 3: Developed probiotic diet influence on haematological parameter of C. gariepinus

	Control	DP1	DP2	DP3	DP4
PVC (%)	14.10 ± 0.02[a]	14.21 ± 0.03 [a]	14.57 ± 0.02 [a]	17.39 ± 0.03 [b]	15.43 ± 0.02 [ab]
HB (gm/100)	2.73± 0.03[a]	3.11 ± 0.02 [a]	3.48 ± 0.03 [ab]	5.91 ± 0.03 [b]	4.23 ± 0.01 [ab]
RBC (x10/ml)	1.53 ± 0.02 [a]	2.06 ± 0.02 [a]	2.17± 0.03 [ab]	2.52 ± 0.02 [b]	2.22 ± 0.03[ab]
WBC (x10/ml)	19.13 ± 0.12 [a]	21.3 ± 0.02 [a]	24.71 ± 0.02 [ab]	31.07 ± 0.02 [b]	27.23 ± 0.04 [ab]
MCV (fl)	80.72 ± 0.03 [a]	83.51 ± 0.02 [a]	91.14 ± 0.01 [ab]	103.21 ± 0.04[b]	92.28 ± 0.03 [ab]
MCH (gm/100)	34.31 ± 0.22[a]	36.14 ± 0.15 [a]	37.27± 0.19[ab]	38.41 ± 0.17 [b]	37.66 ± 0.14 [ab]
MCHC (gm/100)	40.07 ± 0.03 [a]	41.02 ± 0.03 [a]	41.72 ± 0.02 [a]	44.51 ± 0.03 [b]	43.09 ± 0.01 [ab]
PLT (x10/μl)	131.73 ± 0.04 [a]	136.41 ± 0..03[a]	142.19 ± 0.03 [ab]	178.23 ± 0.02 [b]	163.07 ± 0.02 [ab]

NB: PCV, Packed Cell Volume; HB, Haemoglobin; RBC, Red Blood Cell; WBC, White Cell Volume; MCV, Mean Corpuscular Volume; MCH, Mean Corpuscular Haemoglobin; MCHC, Mean Corpuscular Haemoglobin Concentration; PLT, Platelet

III. DISCUSSION

Probiotics are referred to as life microorganisms which once ingested in appropriate quantity, enhance its host's health status (FAO/WHO, 2007)**.** Probiotic are further regarded as living microorganisms that enhance and promote health status of their hosts by ensuring intestinal micro flora balance for optimal metabolic performance (Fuller, 1989). Recent research affirmed that probiotics inclusion in aquaculture could positively aid fish growth and cultured environments (bio-control and bio-remediation) of cultured aquatic fish (Carnevali, 2006, Al-Dohail et al, 2009 and Folorunsho et al, 2011).

This study reported a better significant growth performance in all diets supplemented with probiotics and this is similar to Al-Dohail et al (2009) who stated that growth in Catfish diet supplemented with probiotics of *Lactobacillus acidophilus* was significantly (P<0.05) higher than control diet that was not supplemented. This also conform with Carnevali et al (2006) who confirmed that sea bass juvenile growth was significantly enhanced in treated groups than the control diet with the use of *Lactobacillus delbrueckii* as a probiotic through rotifer carriers and Artemia nauplii after 70 days. This indicated an improvement in growth performance of fish and its healthy status despite the differences in the methods of inclusion and species used.

It is also worthy to note that the improvement in growth may be related to an enhancement of the microbial flora in the intestine as reported by Fuller (1989) where a significantly higher PER was reported when fish was maintained on probiotics supplements than in control group. This result was also similar to Lara-Flores et al. (2003) where it was reported that *Oreochromis niloticus* recorded better survival rate, SGR, PER and FCR parameters in treatments with *L. acidophilus* and *S. faecium*. This report in probiotic-treated group could be as a result of their increased potential to tolerate harmful conditions that fish may be exposed to in the culture tanks as affirmed by Rollo *et al*, (2006) in *Sparus aurata* (Sea bam).

The similarity in the previous studies and this present one showed a higher growth performance and feed efficiency with the use of probiotic (either commercial or developed). This could be attributed to higher nutrient digestibility, better absorption and enhanced enzyme activities which could be attributed to proper intestinal micro flora balance as reported by Fuller (1989), or exo-enzyme secretion as reported by Moriarty (1998). Comparably, Tovar-Ramirez et al (2004), Wang et al (2006) and Suzer et al (2008) reported that digestive enzyme activities are better enhanced when fish was fed with diets where probiotics were supplemented. Furthermore, improvement in growth performance and nutrient utilization could as a result of lower stressor levels in fish fed with probiotics enhanced diets. Carnevali *et al*. (2006) reported that when fish was fed a diet

supplemented with *L. delbrueckii*, there was a decrease in cortisol levels which affects the transcription of insulin-like growth factor (IGF-1) and myostatin (MSTN), which are both known to be a regulator of growth performance and in effect leads to an appreciable increase in body weight of the fish when compared with the control diet.

There was no significant difference in water quality parameters observed between the fish that fed on probiotics supplemented diets when compared with the control. This conform with the findings of Wang and Zirong (2006) who stated that there was no noticeable effects in water parameters when carp was fed *Bacillus spp* and probiotics photosynthetic bacteria. This observation on water quality indifference in this experiment could be a result of the liquid faeces which polluted the water in which the fish was raised and this probably may mask the effects on water quality from proper observation.

Haematological parameters observed in this study presents a better concentration of Hb, RBC, WBC, MCV, MCH and MCHC when compared with control diet. This observation indicates that probiotics supplemented diets were more stable health wise than control diets probably due to decrease in cortisol levels in the blood plasma as stated by Rollo *et al* (2006) in sea bream (*S.aurata*). The RBC indices like MCHC which denoted the normal corpuscular haemoglobin concentration was reported by Johnson *et al*. (2002) and George & Parker (2003), to have the mean range of 32-36g/DL and MCV of 80-100μm^{-3}. The result obtained were within range and are significantly (P ≤0.05) higher in the probiotic based treatment. This also support the facts that fish fed probiotics diets were healthier (Gabriel *et al*, 2004).

Conclusion

From the results presented in this research work, we conclude that growth performance and nutrient utilization were significantly better in treatment groups where commercial probiotics (MY-500 (MitoYeast) and developed probiotics were supplemented than in fish fed the control diet. It was also affirmed that locally developed probiotics are comparably better than commercial probiotics due to the fact that it was isolated from the intending host. Furthermore, water quality parameters observed were within same range in all treatments including control. The haematological parameters observed confirmed that probiotics are capable of improving the health

status of its host when included in their diet and this effect improved the immune systems of fish fed probiotics and thereby enhance their physiological status.

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Archival Review of The Role of the Citizens Mediation Centre in Landlord-Tenant Dispute Resolution in Lagos State, Nigeria

Kasumu, Taiwo, Onyeonoru, I.P.
Department of Sociology
Covenant University
Canaan Land, Ota, Ogun State, Nigeria

Abstract— **Millions of people in developing and developed countries use rental housing to meet their housing or business needs or as a source of income. While peaceful co-existence between landlords and tenants is the norm in some places, elsewhere, landlord-tenant relations are characterised by suspicion, mistrust, power tussle, and the struggle by each group to get the best out of the relationship at the expense of the other. This situation most times leads to disputes, which if not amicably resolved, could sour the relationship between the two parties and may degenerate into violence and breach of public peace. Although indigenous channels for resolving landlord and tenant disputes exist, lack of fairness of the mechanisms coupled with the cost, prolonged hearing and lack of privacy of the judicial forum led to the establishment of the Citizens Mediation Centre (CMC) in 1999. However, it has been observed that the CMC faces many operational challenges which have hampered its functions. These include inadequate coverage of all the local government areas in Lagos State, lack of adequate funding, inability of the Centre to engage with its target audiences, and inability of the Centre in sharing its success stories with prospective disputants. Using the Human Needs Theory, this paper argues that resolving landlord-tenant disputes in Lagos State will require parties recognising the needs of each other and striving to meet them, while at the same time, parties should recognise, respect, accept, listen to or accommodate the other party's diversities such as culture, language, values, needs and interests. The paper recommends that for a more vibrant CMC to be realised, there is need for greater funding, greater publicity of its activities, and continuous engagement with its target population.**

(*Abstract*)

Keywords— *Landlords, Tenants, Disputes, Citizens, Mediation, Centre*

I. INTRODUCTION

Rental housing is a key feature of the housing sector in many developing and developed countries, providing accommodation to millions of people for residential and commercial purposes. The rental housing markets are important and provide a genuine alternative to home-ownership, playing a balancing role between those who can own their house and those who cannot, and minimising house price pressures on mostly young, low- and middle-income households, particularly those just starting their careers (Cuerpo, Kalantaryan, & Pontuch, 2014). Rental housing has become a viable alternative to a first step into owning or buying a house and an essential housing option for the poor (Water and Sanitation for the Urban Poor [WSUP], 2013).

People rent houses for different reasons ranging from inability to own their own houses, need to stay mobile and move away when work is available elsewhere, without being tied down to a particular house; budget-friendly nature of rental housing which allows flexibility for tenants to move to cheaper housing when times are hard and to better housing, when their income increases, or through rental housing tenants save more to meet their essential needs such as food, education, medical care or emergencies (UN-HABITAT, 2011). Renting also supports those in transitory periods of their lives who are not yet ready to settle down in one place, and is convenient for those who have dependants or relatives in the villages who depend on their city earnings, while allowing those interested in buying land or building back in their villages to do so (UN-HABITAT, 2011).

On the other end of the scale, rental housing has become a viable livelihood strategy for landlords (WSUP, 2013). For these millions of people, rental housing or properties provide a significant source of income. Rental units have therefore become attractive to both tenants and landlords because the demand-side of rental properties outstrips the supply-side (Lemanski, 2009; Skuse & Cousins, 2007) due to reasons advanced thus far.

Since rental housing predominates in most societies, private-sector landlords appear to enjoy an advantage that protects, projects and advances their interests as against the interests of their tenants (UN-Habitat, 2008). This is why rental housing has been viewed as having a poor reputation and as being exploitative (WSUP, 2013). The perception of the landlord-tenant relations has been negative with many scholars suggesting a patron-client relationship where the landlord struts around as the "Lord of the Manor" (Bank, 2007; Crankshaw,

1993; Guillaume & Houssay-Holzschuch, 2002; Lemanski, 2009), offering a take-it-or-leave-it rental system that demands high rents but presents low quality rental properties with mediocre facilities (Wahab & Adetunji, 2015; Wahab & Odetokun, 2014).

The city of Lagos, Nigeria's commercial jewel, with a population exceeding 21 million residents, is an example of a state in the country suffering from shortage in housing production with the private rented sector predominating (Adelaja, 2014; Lagos State Government, 2014). According to a report, Lagos is growing at a rate of 3.2% per annum, while its urbanisation growth rate is 16% (Economist Intelligence Unit, 2012). The extent of the housing shortage in Lagos is enormous. Citing a Lagos Household Survey (2011), the Economist Intelligence Unit (2012) posits that about 72% of Lagos residents are tenants paying rent as high as 50% of their monthly incomes; while most of the existing accommodations are provided by private-sector landlords. The survey further states that only 18% owned their dwelling units while 10% are free occupants, with no rental payment.

This situation pits landlords against their tenants with each camp seeking to outwit the other. Thus, landlord-tenant relations in Lagos, a city in a developing country, are characterised by suspicion, mistrust, power tussle, and the struggle by each group to get the best out of the relationship at the expense of the other group (Bank, 2007; Lemanski, 2009). This status quo leads to disputes that if not amicably resolved sour the relationship between the two groups, and turn violent, leading to the breach of public peace. While landlords could be forced to repossess their rental properties, tenants could be evicted and left with no home or business to turn to. This situation could create homelessness for many residents, cause the abrupt closure of businesses and loss of jobs and at the same time lead to the loss of income for others.

Although indigenous dispute resolution measures are utilised by landlords and their tenants to resolve their disputes, the absence or not enough justiceability of these measures and the need for the preservation of the landlord-tenant relationship might have prompted parties to take their disputes to the police or law courts with their attendant challenges. It was the need for speedy, fair and early resolution of landlord-tenant disputes in Lagos State that led to the creation of the Citizens Mediation Centre (CMC) in 1999, which among other forms of disputes it was established to resolve, attends to disputes between landlords and tenants, and offers the alternative dispute resolution (ADR) mechanisms of mediation to find solutions to the disputes between Lagos landlords and tenants. The CMC was designed to resolve landlord-tenant disputes in an inexpensive, speedy, impartial and confidential fashion, among other benefits that alternative dispute resolution is known to offer to disputants. This service by the CMC is very important to the continued prosperity, peace and progress of Lagos State and its growing population.

Using a qualitative approach, this study examines the role of the Citizens Mediation Centre in resolving landlord-tenant disputes in Lagos State, Nigeria. The study will rely on the Human Needs Theory to analyse landlord-tenant relations. Findings from the study are expected to promote a better understanding of the CMC's dispute resolution activities in addition to making recommendations on how the centre can improve its landlord-tenant dispute resolution in Lagos State.

II. STUDY OBJECTIVES

The objectives of this study are to:

1. Examine the role of the Citizens Mediation Centre in resolving landlord-tenant disputes in Lagos State.

2. Utilise the Human Needs Theory to analyse landlord-tenant relations in Lagos State.

3. Identify the challenges facing the CMC in the resolution of Landlord-Tenant disputes in Lagos State.

4. Make recommendations on how the CMC can improve its landlord-tenant dispute resolution in the state.

The research design for this study is the qualitative approach which relies on the use of secondary data-gathering methods such as academic journals, periodicals, textbooks, magazines and the internet for the collection of data used in analysis of the variables in the study

III. LITERATURE REVIEW

The authors of this study consider the landlord as an individual or organisation that owns a property (whether for residential or business purposes) and includes anyone deriving title under the original landlord (including its/his/her heirs, successors, agents, managers or employees acting on their behalf) and who transfers this property to another person or organisation who is the tenant for a period under an agreement and is entitled to the rent and profits from the premises during the tenancy and the immediate reversion of the property at the expiration of the tenancy.

On the other hand, the tenant is a person or institution and includes an individual's family, sub-tenants or a lessee of a dwelling or property who receives the landlord's consent to occupy the said property or rental unit for an agreed-upon consideration and period.

Dispute connotes the disagreements or conflict that may happen within or to the landlord-tenant relationship. Landlord-tenant disputes can be caused by social, economic, interpersonal, or personality factors. Mediation is an activity voluntarily entered into by disputants, whereby a professionally trained neutral facilitator (Mediator) using recognised methods systematically encourages communication between the parties, with the aim of enabling them to reach a resolution of their dispute by themselves (Alaska Judicial Council, 1997; Nosyreva, 2003). It is a peaceful dispute resolution tool that is complementary to the existing court system and the practice of arbitration.

IV.   LANDLORD-TENANT DISPUTES

The landlord-tenant relationship in Nigeria has been argued not to be different from the perspectives shared from other parts of the world. According to Wahab and Adetunji (2015) in a very recent work, they aver that while landlord-tenant relationship is founded on an agreement and is usually reasonable, some common problems have been observed. These include incompatibility of goals between the parties, differences in behavioural style, distortions in communication or communication gaps, unmet expectations, needs or interests, unequal power relations and wrong perceptions. Landlord and tenant disputes could arise from personality clashes, incompatible interests, needs and desires, self-esteem problems, hidden expectations and one's party's suspicion arising from a negative experience in the past (Cloke & Goldsmith, 2000). Danielsen (2005) believes that landlord-tenant disputes could arise out of feelings that one party does not recognise, respect, accept, listen to or accommodate the other person's diversities such as culture, language, personal beliefs, values and interests. Stigliz (2011) identifies the issue of power differentials as one challenge that puts landlords and tenants on the war path.

In Nigeria, several studies have also identified the various causes of landlord-tenant disputes. These include inadequate facilities; non-payment of utility bills, security and development levies; maintenance issues; domestic scuffle, and misunderstanding among residents (Awodiran, 2008; Kolugo, 2010). In his study of multi-tenanted buildings in Ajegunle area of Lagos State, Olusola (2009) discovered that conflict between landlords and tenants in that area was caused by lack of maintenance of buildings and facilities by landlords, improper use of housing infrastructure by tenants culminating in blocked drainages, damaged electric poles, broken entrance gate, and unwillingness of tenants to participate in any repairs or maintenance work. Similarly, Kehinde (2010) identified house renovation (16.0%), refusal to pay utility bill (5.3%), intolerance (5.3%), parking space (1.3%), use of generating set (1.3%) as causes of conflict between landlords and tenants in Lagos State.

Consequently, from the studies reviewed, causes of landlord-tenant disputes in Nigeria, with focus on Lagos State, can be categorised into social, economic, interpersonal, or personality factors.

V.   EXISTING INDIGENOUS CHANNELS FOR LANDLORD-TENANT DISPUTE RESOLUTION

In managing landlord-tenant disputes, several indigenous dispute resolution measures have been identified in literature such as tenants' intervention, ejection of conflicting tenants by the landlords or their representatives, intervention by mediators made up of members of the executive committee of landlord associations, community leaders (Baale or Ward Chiefs), opinions leaders, Estate Surveyors/Managers/Agents, elders in the community, and the local government/town planning authority, among others (Kehinde, 2010; Oni, Durodola & Oni, 2014; Shodayo, 2011; Wahab & Odetokun, 2014). Against the background of a housing shortage situation in Lagos State, and the fact that conflict is inevitable in any interpersonal social relationship (George & Amusan, 2013; Onyeonoru, 2015), it becomes imperative for landlords and tenants, in the existing housing stock, to find more amicable ways of managing their disputes so that they do not become violent with recourse to the judicial forum with its attendant disadvantages of lengthy and costly trials, adversarial posturing, lack of privacy and confidentiality, among other drawbacks (Burton, 1997). The establishment of the Citizens Mediation Centre, which among other objectives was to find an amicable dispute resolution process to landlord-tenant disputes in Lagos State, was seen to be timely and aimed at reducing the incidents of landlord-tenant disputes in the state (Citizens Mediation Centre, 2012) and neutralising the drawbacks located within the indigenous dispute resolution mechanisms.

V. THE CITIZENS MEDIATION CENTRE

The Citizens Mediation Centre (CMC) under the Directorate of the Citizens Rights of the Lagos State Government Ministry of Justice was set up in 1999 in response to the pressure and demands for an Alternative Dispute Resolution scheme and also as part of the Lagos State Government policy of providing an enlargement of access to justice and its institutions (Citizens Mediation Centre, 2012). The Centre was carved out of the Directorate for Citizens Rights (DCR), which was established from the complaint centre. CMC is the first agency established by any government in Nigeria to provide comprehensive legal assistance and mediation services for indigent members of the public and residents as an Alternative Dispute resolution body from the court system and arbitration (Citizens Mediation Centre, 2012). These legal services are to be offered free to disputants. The CMC later became a separate entity by the enactment of the Lagos State Citizens Mediation Law No. 6 of 2007 which consolidated and institutionalised the development of the Centre, providing legal framework for its operations (Lagos State Government Ministry of Justice [LSGMJ], 2013).

VI. CMC'S MANDATE/OBJECTIVES

The Lagos State Citizens Mediation Law no. 6 of 2007 empowered the CMC to provide mediation on disputes relating to:

1.   Landlord and Tenant matters

2.   Workmen Compensation Matters

3.   Family Matters (including marital disputes, child custody)

4.   Employer and Employee Disputes

5.   Property Inheritance and Land Matters

6.   Monetary Claims

7.   Juvenile

8.   Estate

9. Property Inheritance
10. Commercial disputes
11. Other Civil-Related Disputes

The state government had considered that the traditional adversarial method was not only incapable of amicably resolving disputes, but arising from the economic, social and political development in the country, there was a considerable rise in the number of cases in the courts, which put tremendous pressure on the court system and made the adjudicatory process a painful one for disputants. Moreover, most people, particularly the indigents found litigation to be cumbersome, technical, time-consuming, and expensive, hence the resort to alternative dispute resolution mechanism (Citizens Mediation Centre, 2012). Therefore, CMC was created with a view to providing a friendly, congenial and business-like atmosphere where disputes are resolved by experienced mediators. Particularly, some disputes are of sensitive and confidential nature and disputants would wish to settle them in private rather than in the glare of public proceedings. In addition, there are claims by parties involving small sums which are hardly worth the expenses of litigation. It is for all these concerns that parties seek alternative methods of dispute resolution which led to the government's establishment, support and promotion of the Citizens' Mediation Centre in the state.

VI. THE HUMAN NEEDS THEORY

This school of thought is led by the following theorists: Abraham Maslow, John Burton, Marshall Rosenberg and Manfred Max-Neef. Their studies within the Human Needs Theory have tried to link the relationship that human needs have with conflict and peace. The Human Needs Theory proposes that all humans have certain basic universal needs and that when these needs are not met or people are deprived of them, they will revolt and may even fight back. Abraham Maslow proposed a hierarchy of needs beginning with the need for food, water, and shelter followed by the need for safety and security, then the need for love or sense of belonging, self-esteem and, finally, personal fulfilment and self-actualisation (Daniels, 2001). Later on in his life, Maslow proposed self-transcendence as a need above self-actualisation in the hierarchy of needs. By doing so, Maslow and the conflict scholar Burton have acknowledged that human needs go beyond the essentials of food, water, and shelter. They include both physical and non-physical elements needed for human growth and development, as well as all those things humans are innately driven to attain. Some of these needs (Burton, 1990) itemised are as follows:

• Safety/Security: This is the need for structure, predictability, stability, and freedom from fear and anxiety.

• Belongingness/Love: This is the need to be accepted by others and to have strong personal ties with one's family, friends, and identity groups.

• Self-esteem: This is the need to be recognised by oneself and others as strong, competent, and capable. It also includes the need to know that one has some effect on her/his environment.

• Personal fulfilment: This is the need to reach one's potential in all areas of life.

• Identity: This is the need that goes beyond a psychological "sense of self." Burton and other human needs theorists define identity as a sense of self in relation to the outside world. Identity becomes a problem when one's identity is not recognised as legitimate, or when it is considered inferior or is threatened by others with different identifications.

• Cultural security: This need is related to identity; it is the need for recognition of one's language, traditions, religion, cultural values, ideas, and concepts.

• Freedom: This is the condition of having no physical, political, or civil restraints; having the capacity to exercise choice in all aspects of one's life.

• Distributive justice: This is the need for the fair allocation of resources among all members of a community.

• Participation: This is the need to be able to actively partake in and influence civil society.

According to human needs theorists, conflict or dispute does not just arise as a result of the lack of needs for subsistence, but unmet human needs in the areas of protection, identity, recognition, respect, participation and understanding can trigger dispute which if not well managed can engender violent conflict. They advise that disputants should give more importance to these latter needs, truly recognising them as human needs essential to the wellbeing of all human beings (Danielsen, 2005). This stance agrees with the views of Max-Neef and Rosneberg who argue that no need is superior to the other, and that human needs are all complementary and essential to human life and peace.

By way of this theory, landlord-tenant relations in Lagos State will do well when the parties recognise the needs of each party and strive to meet them. That means for peace to exist between landlords and their tenants, the parties must recognise, respect, accept, listen to or accommodate the other party's diversities such as culture, language, values, needs and interests.

VII. CHALLENGES OF THE CMC IN THE RESOLUTION OF LANDLORD-TENANT DISPUTES IN LAGOS

There are many challenges facing the operational effectiveness of the Citizens Mediation Centre in the resolution of landlord-tenant disputes in Lagos State. Some of the challenges have been identified below:

First, there is low publicity of the centre and its activities. Many Lagosians do not know much about the existence of the

CMC let alone its services or activities. This is a drawback that has affected the Centre's ability to provide fast, cheap, informal and easy access to justice for landlords and tenants involved in disputes in the state. The rise in the number of cases in the courts, which puts tremendous pressure on the court system and makes the adjudicatory process a painful one for landlords and tenants, is a pointer to the low publicity of the role the Citizens Mediation Centre could have played in reducing courts' dockets in the area of landlord-tenant disputes.

Second, there is also inadequate coverage of the local government areas in the states by the Citizens Mediation Centre. Recently, a report mentioned that the centre has established offices in three additional LGAs in Lagos State, namely, Ojo, Alimosho and Badagry LGAs (CMC, 2016). While this effort is aimed at increasing the Centre's nearness to disputing parties in these new local government areas, until mediation units are established in all 57 local governments and local council development areas of the State, the objective of helping disputants, including landlords and tenants, to find justice in an inexpensive, timely and amicable fashion may not be realised. Daily, reports are revealing the embedded violent disposition within the landlord-tenant relationship in Lagos State

Third, funding is another challenge that makes it difficult for the Citizens Mediation Centre to effectively discharge its responsibilities, among which include resolution of landlord-tenant disputes. Creative funding windows need to be created or explored by the state government to enable the Centre ably discharge its functions. Grants, aids and other form of funding from international organisations such as the UN-HABITAT can be sought and judiciously used to ensure that the resolution of landlord-tenant disputes in the state is realised.

Fourth, the onus is on the CMC to continue to engage with its target audiences and explain the benefits they will get by bringing their disputes to the centre. These benefits include, among others, that mediation will help landlord-tenant disputants to:

i.   by-pass ineffectiveness in some courts processes because it will provide disputants with greater access to justice and even support the causes of the poorest of disputants;

ii.   find greater satisfaction in the resolutions reached;

iii.   reduce the formality of the legal process, thus speeding up the dispute resolution process for them;

iv.   reduce the time spent on the resolution of their disputes;

v.   reduce the cost of resolving their disputes;

vi.   reduce the level of tension and conflict in their communities;

vii.   overcome the barrier of illiteracy by providing neutrals who speak the local languages of the people;

viii.   have a platform for the expression of their emotions, concerns, and needs without negative and stereotypical labels such as victim, trouble maker, racist or harasser;

Lastly, the CMC has not been able to communicate its success stories to prospective users of its services. For instance, a recent report by the Director of the CMC, Mrs. Oluwatoyin Odusanya has it that in 2015, alone, a total of 37,275 complaints were received, while 22,952 were mediated upon, out of which 21,534 matters were resolved and the monetary settlement was to the tune of N812 million (NAN, 2016). She added further that in January and February 2016, alone, 7,511 cases had been received, while 4,088 were handled by the Centre out of which 4,069 were resolved with the value of the settlement being N84 million (NAN, 2016). These success stories need to be communicated to the Lagos rental market made up of landlords and tenants so they can see the feasibility of bringing their disputes to the CMC for quick resolution.

VIII. RECOMMENDATIONS

To make the Citizens Mediation Centre more effective in the resolution of landlord-tenant disputes, the following are important:

i.   There is need to increase the funding and funding channels to the Centre so it can hire more lawyers and legal professionals who will be able to assist the Centre in fulfilling its mandate of giving justice to Lagosians, particularly those in the rural areas or considered to be indigent.

ii.   There is need for greater publicity of the existence of the Centre and its activities so more Lagosians can become aware of what the Centre stands for and what it can accomplish for disputing landlords and tenants.

iii.   With greater funding, the Lagos State Government, must seek ways to increase the coverage of the Centre to have at least a unit in all the 57 Local Government Areas and Local Government Council Areas in the state. This will bring the Centre closer to the people and give them more access to enjoy its services and benefits.

iv.   Lastly, the CMC itself should continue to engage with its target population and to share its success stories in order to encourage more Lagosians, particularly landlords and tenants to come forward with their disputes for a quick and amicable resolution.

IX. CONCLUSION

There will be a reduction in the breach of public Owing to a housing shortage situation in Lagos State, and the inevitability of disputes conflict in the landlord-tenant relationship, finding more amicable ways of managing landlord-tenant disputes so that they do not become violent with recourse to the judicial forum with its attendant disadvantages will help to reduce the violence-prone outcomes that such disputes take if unchecked. It has been established that if not effectively curbed, landlord-tenant disputes could lead to the breach of peace, cause bodily harm to parties through violent self-help measures, result in possible death of one or both parties, bring about limited access to justice, lead to biased dispute resolution process, or protracted legal battles, and result in lack of confidentiality and expensiveness in the dispute resolution process, among other drawbacks.

The establishment of the Citizens Mediation Centre has resulted in the peaceful resolution of several landlord-tenant disputes which could have turned ugly if they had not been handled by the Centre. The intervention of the CMC has helped to reduce courts' dockets somewhat and has the potential to provide more platforms and access to disputing landlords and tenants in the state when the CMC eventually establishes a unit in all the 57 Local Government Areas and Local Government Council Areas of the state. This portends a lot of benefits to the state. One, it will enlarge opportunities in the housing rental market in the state with attendant benefits for all stakeholders, namely, landlords, tenants, and the state. Landlords will make generate more income from their housing investments, pay their taxes and tenement rates and meet their own financial needs, among others. Access to rental housing means more social and economic stability for tenants living and working in the state and fewer violent run-ins with landlords and problems with the law. The state, on its own, will experience more social stability, peaceful co-existence between its landlord and tenant population, a situation requisite for economic progress, and of course, it means more income through tenement rates to the state. Two, violence from landlord-tenant disputes will be drastically peace arising from landlord-tenant fights and a reduction in the bodily harm likely to be inflicted by parties on each other. Lastly, it will lead to greater access to justice for parties with the advantage of reduced costs, confidentiality, speed in the resolution of conflicts, balance of power relations between landlords and tenants and elimination of injurious self-help measures or other indigenous dispute resolution mechanisms which may not offer better solutions to disputants.

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ICT ACCESS, SOCIAL INFRASTRUCTURAL FACILITIES AND THE PERFORMANCE OF INFORMAL MICRO- AND SMALL-BUSINESS ENTERPRISES (MSBEs) NIGERIA

Olurinola, Isaiah Oluranti (PhD)
 Department of Economics,
Covenant University, Ota, Nigeria
Email: olu.ogunrinola@covenantuniversity.edu.ng

Bowale, Ilesanmi Kayode (PhD)
Department of Economics,
Covenant University, Ota, Nigeria

Bolarinwa, Michael Kayode (PhD)
 Nigerian Institute for Economic,
 And Social Research, Ibadan.

Oluwatobi, Stephen
Department of Economics and Development Studies
Covenant University, Ota, Nigeria.

AND

Ogunrinola, Israel Ifeoluwa
Department of Economics and Development Studies,
Covenant University, Ota, NIGERIA.

ABSTRACT

This paper examines the roles that access to ICT and improved social infrastructure play on the performance levels of informal micro and small business enterprises in Nigerian. For formal sector organisations, studies have been conducted to verify this, but not much is known with respect to micro and small informal sector businesses. This study therefore intends to bridge this yawning gap by carrying out an analysis of the impact of the access to telephone (a major component of ICTs that is fast finding common usage among informal sector enterprise-owners) among informal micro and small businesses in Nigeria. The study relies on primary data on the informal sector enterprises collected by the Nigerian Institute for Social and Economic Research (NISER) in 2014. Basic descriptive statistics in addition to the Ordinary Least Squares Regression model is used in the analyses of the data. Policy measures that will enhance further diffusion of ICT infrastructure among micro and small business to enhance their growth and contributions to income and employment generation are recommended at the end of the paper.

Keywords: Social Infrastructural Facilities, ICT, Micro and Small Business Enterprises, Nigeria.

1. INTRODUCTION

It has generally been agreed in the literature that increased access to information and communications technologies (ICT) as well as availability of improved social infrastructure promote economic development in any type of economy (Deen-Swarray, Moyo & Stork, 2013; Proshare, 2014). This situation is assumed to be true for enterprises as well. For instance, the use of ICT infrastructure has the capacity to increase accessibility of enterprises to vital information thereby enhancing the and productivity and profitability of such business enterprises. These have the capacity of enhancing increased investment that creates more and better employment of resources and generate more income. However, major leapfrogging arising from increased access to ICT and improved social amenities has been traced mainly to formal sector businesses while their informal sector counterparts are less researched. Although the studies of Deen-Swarray, et. al are focused on the impact of ICT on informal business activities in selected developing countries, yet, the conclusion of the study appear too general to be applicable to any country in particular. This study is therefore

focused on Nigeria and the focus is on the informal micro and small enterprises.

Undoubtedly, SMEs and informal sector play important roles in poverty alleviation through income creation and employment generation in an economy. Informal sector enterprises, more often than not are always bedeviled with a lot of challenges such as lack of familiarity with new technology, limited access to finance and markets and lack of awareness of skills and understanding of ICT (Mutala et al.2006). In order for the sector to play important role in an economy it must embrace changes in global technological environment and all necessary infrastructure must be put in place (Migiro, 2006). Globally, there is an increase in the applications of information and technology with the use of internet, mobile phones and personal computers. In view of the renewed attention on agricultural developing as an engine of social and economic growth, coupled with the recent emphasis on the role of SMEs in poverty alleviation , income creation and employment generation , most governments, especially in developing countries have put up policies to encourage the adoption of Information and Communication Technology in agribusiness sector. This has spurred the interest of many scholars, practitioners, and policy-makers.

2. LITERATURE REVIEW

A lot of studies have been carried out on the importance of information and communication technology in growth and development of the economy. However, the economic impact of ICT varies across organizations and countries (Scupola, 2006)). The European Commission (2007) highlights that e-adoption, in form of the use of electronic networks, has helped firms to collaborate and innovate. This has impacted overall economic performance (European Commission, 2007). Beckinsale & Ram (2006), Blackburn & Smallbone (2008) in their studies have shown that the use and diffusion of ICT has brought tremendous improvement in value chain and competition levels of businesses. These and other studies emphasized the role of ICT in the development of mobile commerce in agriculture by identifying the important areas of ICT use in agriculture such as input procurement, production, marketing, food traceability, and financial service delivery thereby empowering individuals.

Many studies on e-adoption have not clearly shown how companies could derive full benefits from e-adoption, but the works of Koellinger (2004) and O'Mahony et al. (2005) did demonstrate how e-adoption has brought about innovations and increase in productivity growth in businesses. E-adoption has created platform for access to government services, increased the quality and quantity of training opportunity, a balancing of gender inequalities and reduction of fraudulent electoral practices (The United Nation 2010.).This does not say that e-adoption does not have its demerits. E-adoption can bring about digital and knowledge divide, displacement of workers, increase of surveillance and decline in labour bargaining power. But the advantages outweigh the disadvantages. In his work on ICT access and the extent of its use and development of informal sector in Kenya, Gikenye (2014) opines that there is a need for proper understanding of the content and information needs of SMEs to be able to formulate the appropriate policy for the businesses. He observed that most SMEs have limited themselves to the use of simple technology, such as mobile phone and have not embraced other forms of technologies. This, according to him was due to lack of finance and lack of necessary skills. Ocholla (2006) in his study also found out that mobile phone is commonly used among the SMEs owners due to the fact that mobile technology interfaces easily with informal oral traditional ways of circulating knowledge and information. Majority of SMEs owners in informal economy are ignorant of the law and rights guiding their businesses Orwa (2007).

Deen-Swarray et al. (2013), in their study of nine African countries, using nationally representative data for informal businesses in residential and semi-residential areas, found out the extent to which informal businesses employ ICTs and

challenges they face. The findings also revealed that the lack of use of other kinds of ICTs such as personal computer and internet were attributable to affordability and availability. Kaynak et al.(2005) are of the opinion that government should provide adequate incentives to enable the SMEs acquire ICTs with minimum investment. They emphasized the need to provide enabling environment in which small businesses could thrive. Duncombe et al. (2009), in their study in Botswana discovered that there was a huge presence of informal information system, and advised that attention be focused on formalization of information systems, especially in sub-saharan Africa, to bring about entrepreneurial development.

Most of the previous studies have concentrated on assessing and ascertaining the level of readiness and adoption of ICT in developing and developed world. Many of these studies ignored the factors that could affect the e-readiness of ICT especially on the part of the small and medium scale enterprises (SMEs) agri-business owners in the informal economy. The previous studies failed to pay attention on individual characteristics and traits of the firms and countries. Understanding the characteristics of the SMEs would enable one to understand the appropriate aspects of ICT to deploy and the pragmatic way of using them to bring about the desired results in a business. There is the need for more research work on the extent to which the various forms of ICTs (such as Mass Media-TV and Radio, and Telephone) have assisted SMEs owners in informal sector in exchanging ideas and experiences for improved awareness and feedback mechanism on policy issues and regulations. However, this study will consider the critical issues on the e-readiness assessment of the use of ICT in agriculture and shed light on the underlying factors that could influence e- adoption of ICT in Nigeria**.**

3. METHODOLOGY OF STUDY
3.1 Research Design

The research design for this study was cross-sectional. It made use of a set of secondary data-set collected on a quantitative survey on informal sector enterprises in Nigeria. As reported earlier, our main objective is to investigate the proposed relationship between access to ict facilities in the informal sector enterprises and the performance of those organisations. By focusing on a set of enterprises having similar characteristics, a greater homogeneity of context is achieved, which enhances the quality of policy advocacy for such context. Also, using micro-data rather than aggregate alternatives, permits a greater details to be captured both for descriptive and econometric analyses. According to Alessie et al. (1992), a research approach employing the use of micro-data provides more units of observations and therefore permits the separate identification of the effects of a greater number of determinants. Second, the approach utilizes heterogeneity in the population rather than aggregating across groups, so that empirical results are richer (See also Davidsson, 2004 as quoted in Urban and Kongo, 2015).

The dataset for this study therefore was the nation-wide enterprise-level data on informal sector enterprises collected by the Nigerian Institute of Social and Economic Research (NISER) in collaboration with the National Planning Commission (NPC) Abuja. Funding for the research was provided by the NPC and UNDP, and the research team was made up of high level manpower from NPC, NISER, National Bureau of Statistics (NBS), Central Bank of Nigeria (CBN), SMEDAN and the Nigerian Association of Small Scale Industrialists (NASSI). The first phase of the study took place in six states drawn from each of the six geopolitical zones of Nigeria plus the Federal Capital Territory, Abuja. The survey was conducted in the year 2013.

The instrument for data collection by the NISER/NPC was a structured questionnaire that was used for obtaining the necessary information regarding the operations of informal sector enterprises in the selected states and the FCT. A 2-stage sampling technique was used in the data collection process.

The first stage was the selection of one state from each of the six geopolitical zones in Nigeria while the FCT was purposively chosen. The second stage was the random selection of one urban and one rural local government area from each of the selected states. In each state, four hundred questionnaire were administered to selected informal sector enterprises in the ratio of 70:30 for the urban and rural locations respectively, in each state selected for the exercise. This gives a total of two thousand eight hundred targeted micro-enterprises for the study.

3.2 The Models used in this study

Two basic micro-econometric models are specified and estimated in this study. The first model examined the determinants of ICT usage in the sampled informal sector micro-enterprises while the second examined the effect of ICT usage (proxied by the ownership and use of telephone in business transaction) and access to improved infrastructure (proxied by total index of infrastructural facilities) on the performance of sampled enterprises. Enterprise performance is measured by the contribution of the enterprises to income and employment generation, as well as business profit.

3.2.1 Determinants of ICT usage in the Informal Sector Enterprises

The model explaining the determinant of ICT access by entrepreneurs is dependent on a number of factors represented by a vector of variables X, while the dependent variable Y_i is a binary variable indicating whether the business has access to telephone services or not. All these are captured in a binary response regression model specified as:

$$Y_i = f(X) \dots \dots \dots \dots \dots \dots \dots . (1)$$

Where Y_i is the measure of access to telephone services, captured with a binary variable (0,1). Thus, when a particular business enterprise has access to the use of telephone for business purpose, $Y_i = 1$, while it is scored zero, otherwise. X is a vector of the variables describing the enterprise, owner, geographical location (whether rural or urban, for instance)

and other characteristics that influence the independent variable Y_i. Since the dependent variable is qualitative in nature, the study has adopted the use of logit model. As such, following Gujarati and Porter (2009), the model is specified explicitly as:

$$Y_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \cdots + \alpha_k X_k + \mu_k \dots \dots \dots \dots \dots (2)$$

Where:

Y_i is a binary variable (0,1) as earlier defined; X_k measures the value of attribute for the kth enterprise or individual; α_k is the measure of change in the measure of probability; and μ_j is the independently distributed random term. Equation (2) is the one estimated and interpreted in this study.

3.2.2 Effect of ICT Access and Infrastructural facilities on Enterprise Performance

In the examination of the determinants of performance of enterprises, consideration is given to several explanatory variables, and more importantly ICT access and the extent of infrastructural facilities available to the informal sector enterprises in the study areas in Nigeria.

Following Gomez and Santor (2001), we specify our basic model as:

$$Y = f(H, S, N, X) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .(3)$$

Where:

Y is the vector of enterprise performance variables (gross weekly Profit, Employment level, Total Asset); **H** is the vector of enterprise-related variables; **S** is a vector of the owner-related variables, *X* is the vector or ICT and Infrastructure-related variables while **N** is the vector of other unclassified variables affecting business performance as specified by economic theory. Some elements of the *S* variables are age of the entrepreneurs, and the highest formal educational attainment measured as number of years spent in school. Other S variables include marital status of respondents, religion, Region of origin of enterprise owner (whether North or South of Nigeria). The elements of *S* variables include, type of enterprise - manufacturing, technical services or trade, location of enterprise - rural or urban, age of business enterprise, initial capital of business, present level of capital, relative ease of accessibility to loan and overdrafts, among others. In a stepwise fashion, the *X* variables are added to the *H* and *S* variables to determine the relative effects of each of the *X* variables on business performance. *X* variables used are ICT access and the extent of available infrastructure to the enterprise.

The estimation of the basic model is in stages as follows. At first, the *H* and *S* variables are estimated in the sub-model:

$$Y = \beta_0 + \beta_i^0 S + \beta_i^1 H + \mu \quad \dots\dots\dots\dots\dots\dots\dots$$

(4)

In the next stage, we added the ICT and social infrastructure vectors **X** as well as other related variables (N) as stated in equation (3) above, thereby resulting in equation (5) below:

$$Y = \beta_0 + \beta_i^0 S + \beta_i^1 H + \beta_i^2 X + \beta_i^3 N + \mu \quad \dots\dots\dots\dots\dots$$

(5)

The *apriori* expectation is that the coefficient estimate of the *X* variables be positive and statistically significant in line with our conjecture of the relative importance of the ICT and economic infrastructure on the development of informal sector enterprises in Nigeria.

4. DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Types, Ownership and Size of Informal Sector Enterprises in Nigeria

Informal economic activities are made up of a wide range of micro, small, and medium-scale enterprises which are mainly in the self-employment categories. Although the economic activities of the informal sector are both legal (e.g. tailoring, block-making, food vending, among others) and illegal (commercial sex activities and all other forms of prostitutions, smuggling, Traditional (untrained) birth attendants, magicians and money doublers, among others) in nature but the activities considered in this study are the legal types. They are (i) Manufacturing Enterprises (ii) Technical Services; and (iii) Distributive Trade.

The Manufacturing sub-sector encompasses all economic activities involving textile/weaving; leather product; plastic product; wood product; metal fabrication; rubber and plastic products; food products; grass/reed crafts; stone crafts; mining/quarrying; boat building and net-making; block making; agro-allied processing (Garri, Soya milk, Zobo processing); animal husbandry (poultry, piggery, fish farming, etc); bakery; sachet/table water manufacturing; and drug making. Out of the 2800 enterprises surveyed, 668 representing 24 percent are of the manufacturing type.

The Technical Service Sub-sector includes those business activities such as repairs and maintenance, informal education services, health services, counselling services as well as labour for menial work. Repairs and maintenance services, vehicle repairs and maintenance, tinkering, carpentry and servicing of various household and commercial tools. Informal health services, especially in the rural areas, include traditional birth attendants, herbalists and other traditional medical practitioners. There are also traditional spiritualists who offer counselling services. These services are rendered for fees paid to those who render them. Main activities covered in this sub-sector include automobile repairs (mechanics, rewire,

vulcanizer, panel beater, painter); Bicycles/motorcycle repairs; footwear repairs (cobbler); Hairdressing/barbing; electronics, including radio/TV/computer repairs; carpentry/furniture; boat repairs; plumbing/pipe fittings; bricklaying; blacksmith; welder and frame cutters; potters and related clay and abrasive formers; fashion designing; and transport operators (taxi, buses, motorcycles (*okada*), tricycle (*keke*). The technical services subsector represents 37.7 percent of the total number of sampled enterprises.

The activities of the distributive trade sub-sector are mostly the distribution of goods through wholesale and retail outlets. Items traded include basic food stuff materials; textile; furniture and fittings; coal and charcoal; plastics and rubber products; building materials; fabricated metal products; computer software and hardware; agro-allied, spare parts; electronics/electrical; laundry; cooked food in restaurants (foods and drinks centres); patent medicine; among others. Thirty-eight percent of total number of enterprises sampled belong to the distributive trade subsector.

In terms of ownership structure, most of the enterprises are run as sole trader businesses as 93.3%of them are solely owned by individuals. Those operated as either Partnership or Family businesses are 3.2% and 2.6% respectively while the rest are run as private limited companies. The modal level of initial and current capital is over N50,000. Over 50 percent of the enterprises belong to this category for the initial capital while over 70 percent of the businesses have a current capital level of over N50,000 which is the modal current capital level. Contrary to the conjecture that many informal sector enterprises have short life-span, some of these businesses have run for over 30 years. According to the statistics gathered from the survey exercise, 65 of the enterprises representing 2.4 percent of the total have been in existence for at least 30 years. Nine hundred and fifty seven of them (representing 35.5%) are between 11 and 29 years old, those in the 6-10 years of age are 24 percent while the remaining 38 percent are recently established and are between one and five years of age in existence.

TABLE 1
SELECTED CHARACTERISTICS OF ENTERPRISES AND OWNERS

MAIN CHARACTERISTICS		PERCENT (N=2800)
TYPE OF ENTERPRISE	Manufacturing	23.9
	Technical Service	37.7
	Distributive Trade	38.4
AGE OF ENTERPRISE	1-5 Years	37.9
	6-10 Years	24.2
	11-19 Years	28.0
	20-29 Years	7.5
	30 Years and over	2.4
FORMS OF BUSINESS OWNERSHIP	Sole Trader	93.2
	Partnership	3.2
	Family	2.6
	Private Limited	2.0
BUSINESS LOCATION	Urban	65.1
	Rural	34.9
GENDER OF OWNER/ RESPONDENT	Male	76,6
	Female	23.4
MARITAL STATUS	Single	28.1
	Married	65.9
	Divorced/Widowed	6.0

Source: Computed from Survey Data

Access to ICT facility proxied by the ownership and use of telephone in business dealings was found to be common among sampled businesses (68.7%), while other infrastructural facilities available vary from 23% for access to piped water, to 73.3 percent and 83 percent for access to electricity supply and motorable road-networks respectively. An infrastructural availability index constructed for each of the enterprises showed that 40.3% of all enterprises have access to at least 3 of the four facilities (telephone, water, electricity supply and access roads) captured in the survey. Three hundred and ninety seven enterprises, representing 17.3 percent of the total have access to all the four facilities. Of those enterprises that have all the four facilities , Manufacturing sector represents 26.4 percent while Technical Services and Distributive Trade constitute and 32.2% and 41.4 percent respectively. Some of these characteristics are presented in Table 1, while those that are considered important

as adjudged by economic theory are incorporated in the empirical analysis in the later section of this paper.

4.2 The Log of Odds of an Enterprise Having ICT Access

As reported in Table 1, not all the enterprises have an access to the four listed infrastructural facilities, and more importantly, telephone which is used as proxy for ICT infrastructure. Factors determining access to telephone on one hand and the combination of telephone and electricity on the other hand, in each of the enterprises was examined by the use of binomial logit model which predicts the log of odds ratio of an enterprise with an identified characteristic possessing an ICT infrastructure (in this case, telephone or electricity and telephone) among the sampled enterprises. Two main models were estimated: the first one made use of Access to telephone (using binary variable (0,1): 1, for owning a telephone and zero, otherwise) as the independent variable; while the second model used the interaction of Electricity and Telephone access as the independent variable. The latter independent variable is important due to the fact that the availability of electricity in the enterprise constitute an incentive for owning ICT gadgets which, more often than not rely, on the availability of electricity for operation and/or battery recharge.

In Table 2, the result obtained for both types of regression estimates are shown as Regression 1 and Regression 2 respectively. In regression 1, the coefficient estimates of the explanatory variables affecting the enterprises' access or otherwise to telephone are reported while the ones affecting the access to telephone and electricity are reported in regression 2 of the same table. The model reported in Regression 1 shows that three of the explanatory variables are statistically significant at the levels of confidence indicated. These variables are: Region of operation of the enterprises, current level of capital employed, and the level of education of the owner/manager of the enterprise. The model as a whole explained 21.3 percent (Nagelkerke R-Squared) of the variance in the log of odds of having access to telephone, and

correctly classified 74.8 percent of the cases. The omnibus test of model coefficients reported a Chi-Square statistic of 72.554 (p<0.001) indicating that the model is able to distinguish between respondents who have access to telephones in their enterprises and those that did not at the time of the survey. In columns 4 and 8 of Regressions 1 and 2, the Exp(B) or the odds ratio are reported and each of these represents the predicted change in odds for a unit change in the predictor if such a predictor is a numeric variable, and for a differential change if a categorical variable. The Wald estimates are reported in columns 2 and 6 and the figures show the importance of the corresponding variable in the model.

In regression 1, the independent variable is access to telephone and three of the explanatory variables (Region, Weekly Profit and Education) are both statistically significant and important predictors. In addition to being statistically significant at the indicated levels, they report very high Wald statistic showing the relative importance of each in the model. For instance, Region South has the highest Wald statistic of 46, followed by Region North of 22. Weekly profit has the next high Wald statistic of 7 while the Biztype-Technical Service has 3 with a statistical

TABLE 2
BINARY LOGIT REGRESSION RESULT FOR ACCESS TO ICT INFRASTRUCTURE IN SAMPLED ENTERPRISES

VARIABLES	REGRESSION			
	B-Est. (1)	Wald (2)	Sig. (	Exp
Owners' Education (Years)	.041	2.284	.13	.9
Gender of Owner: Male	.321	.285	1.26	1.
Gender of Owner: Female	Excl			
Enterprise Age	.004	.043	.83	1.
Region: North	1.452*	22.474	.000	4.
Region: South	2.851*	46.362	.000	17
Region: Abuja	Excl.			
BizType: Manufacturing	.077	.038	.84	1.
BizType: Technical Service	.722+	3.612	.05	2.
BizType: Distrib. Trade	Excl.			

Variable	B	Wald	Sig	Exp(B)	B	Wald	Sig	Exp(B)
Sector: Urban	-.205	.626	.429	.815		.752	.386	1.233
Sector: Rural	Excl.				Excl.			
Total Employed	-.042	2.239	.135	.969	-.034	1.714	.190	.967
Capital Employed	.096	.542	.461	1.101	.101	.633	.426	1.106
Weekly Profit (in Naira)	.447*	7.244	.007	1.564	.421*	7.601	.006	1.523
Constant	-2.971	15.266	.000	.051	-3.440	21.819	.000	.032
N	445				444			
Hosmer & Lemeshow	Chi-Square: 13.885 (Sig.=.085)				Chi-Square: 17.790 (Sig.=.023)			
Pseuddo-R²: - Cox & Snell / -Nagelkerke	.151 / .213				.160 / .213			
Omnibus Test of Coeff.: Chi-Square / Sig:	72.554 / .000				77.190 / .000			
Overall Percentage	74.8				66.4			
Dependent Variable:	Have Telephone? Yes=1, 0 Otherwise				Have Telephone and Electricity? Yes=1,			

Note: * = Significant at 1% level or less; ** = Sig. at 5% Level + = Significant at 10% level

Source: Computed by the authors from Survey Data

significance of 10%. The implications of these is that enterprises operating in the Southern part of Nigeria relative to the North and Abuja are 17 times more likely to possess a phone (a proxy for ICT-access) or, in other words, have access to ICT for business transactions while an increase in profit by one unit predicts a 7 times more likelihood of having a telephone in business operation. The educated owners are three times more likely to have a telephone than their uneducated counterpart.

One important infrastructure that is a complementary factor to ICT access is electricity. Though many ICT appliances are equipped with facilities to make then run on batteries even if there is no electricity supply, but these DC voltage batteries need to be recharged from time to time. Thus it is hypothesised that availability of electricity in the business premises is an enhancing factor for ICT adoption in business. Thus an interactive variable of Telephone and Electricity was used as the independent variable in Regression 2 and the results are reported in columns 5 to 8 of Table 3. This interactive dependent variable led to some interesting results: First, the owners' education variable became statistically significant at 1 percent level with odds ratio of 1.092 and a Wald statistic of 10, making it the second most important variable explaining ICT access after the Region variable.

Second, the education variable is not only statistically significant, it became more important than the coefficient estimate of profit variable in Regression 1. Through the Cox & Snell R² increased from 15% in Regression 1 to 16% in Regression 2 while Nagelkerke's R² remain unchanged. All of these show the importance of electricity for businesses to facilitate ICT adoption in micro and small businesses in Nigeria.

4.2 ICT, Social Infrastructure and Informal Business Performance in Nigeria

4.2.1 Descriptive Analysis

The empirical analysis carried out in this section measures the effect of ICT adoption and the availability of reported social infrastructure on the performance of micro and small businesses in Nigeria. The measure of performance adopted for this study is the self-reported weekly earnings by the owners of the businesses in the survey conducted to generate these data. As already reported in Section 1 of this paper, three types of infrastructure in addition to Telephone were reported by the respondents. These are: Electricity, Pipe-borne water, and access roads. A cross-tabulation of each of these facilities with other characteristics of the enterprise and/or owners and mean profit is shown in Table 3. The table shows the distribution of weekly earnings by some selected characteristics. Businesses having ICT access enjoys twice as much profit as those that do not have as weekly profit levels are N44,053 and N20,202 respectively for those who have telephones and those that do not have it. Electricity supply within business premises guarantees above 150 percent level of profit relative to those who do not have such facility.

TABLE 3
DISTRIBUTION OF MEAN PROFIT BY SOME SELECTED VARIABLES

MAIN VARIABLE	DERIVED VARIABLES	MEAN WEEKLY PROFIT	N	STANDARD DEVIATION
Has Telephone?	No	20,202.93	745	43,589.36
	Yes	44,053.	16	337,799

		40	33	.53
	Total	36,581.32	2378	281,179.19
Has Electricity?	No	26,230.84	657	145,637.86
	Yes	40,093.27	1788	312,018.59
	Total	36,368.28	2445	277,335.94
Has Pipe-borne Water?	No	27,665.77	1825	165,117.44
	Yes	67,681.57	537	506,528.31
	Total	36,763.35	2362	282,119.65
Has Access Road	No	23,946.86	393	46,528.21
	Yes	33,933.57	2029	208,003.62
	Total	32,313.10	2422	191,327.79
Infrastructural Density	Infradex=1	19,748.59	335	46,908.44
	Infradex=2	28,796.38	595	153,742.33
	Infradex=3	30,816.09	897	197,403.54
	Infradex=4	58,571.03	374	320,680.13
	Total	33,301.78	2201	200,415.83
Current Age of Business	1-5 years	24,869.62	955	169,097.66
	6-10 years	31,418.75	612	130,445.37
	11-19 years	42,760.29	695	388,064.38
	20-29 years	86,164.36	188	490,340.72
	30	31,491.	59	69,264.

	years and above	86		77
	Total	36,171.42	2509	273,835.25
Current Capital Level	Less than N1,000	4,476.47	17	6,570.29
	Btw N1,000 - N9,000	8,197.04	193	21,403.72
	Btw N10,000 - N49,000	14,219.92	553	87,221.46
	N50,000 & above	40,196.70	1791	216,711.94
	Total	31,834.90	2568	185,970.18

Source: Computed by the authors from Survey Data

Businesses with pipe-borne water enjoy a profit level of almost N70,000 per week relative to those without it and probably have to expend a large sum of money to provide own water supply.

The *infradex* variable was created to measure the density of available infrastructure to each of the sampled enterprises. Those enterprises having access to all the four facilities is ranked as 4 while those having one is ranked 1. The table above shows that earnings of enterprises increase with increasing *infradex*. while an increasing trend with weekly earning and age of business up to 29 years was observed. The same increasing trend was observed with current capital level.

4.2.2 ICT Access and the Performance of Micro and Small Businesses: An Ordinary Least Squares Approach Tables 5A and 5B present the ordinary least square (OLS) result of the regression of log of weekly earnings of enterprises on the

selected explanatory variables. The importance of this exercise is to determine the effects of ICT and other infrastructure on earnings of micro and small enterprises in Nigeria. In achieving this aim, a non-linear form of equation 5 was estimated and this has given rise to regressions 1 through 7 of Tables 5A and 5B. Since the equation is double-logged to achieve linearisation, the coefficient estimates of the numerical variables should be interpreted as elasticities, while the categorical variables should be interpreted as differential intercept relative to the reference category. The regression analysis shows that in addition to labour market and human capital variables, ICT and infrastructural variables are also statistically significant determinants of earnings distribution among the sampled enterprises. In regression 4 for example, Telephone variable is statistically significant at 10 percent level and its addition to the traditional variables (regression 1) led to the statistical significance of the Trade dummy and an increase in its differential coefficient from .091 in regression 1 to .122 in regression 4. Telephone therefore contributes to earnings and improves the contribution of Trading enterprises to weekly earnings. This result appears plausible if it is realised that information from and to customers, raw material and finished goods prices, among others can be easily transmitted and obtained by the use of telephones for communication and information processing in business.

TABLE 4A - Determinants of Weekly Income

Variable Names	REGRESSION 1		REGRESSION 2		REGRESSION 3		REGRESSION 4	
	B-Estimate	t-value	B-Esimate	t-value	B-Estimate	t-value	B-Esimate.	t-value
LC	1.	14	1.	13	1.	13	1.	13
LCapital	.679*	11.34	.692*	4.574	.709*	5.383	.736*	7.734
LEmpt	.154*	14.72	.155*	4.71	.146*	8.11	.158*	9.61
LEduc	.109*	14.76	.094+	8.5	.079	5.055	.099+	8.985
LBisage	.2*	17.9	.189*	3.021	.186*	5.318	.192*	6.899
Mfg	.64*	21.49	.635*	3.540	.589*	4.1	.641*	2.531
Trade	.091	4.920	.0	4.780	.0	4.0	.122+	9.130
Urban	.0210	3.920	.0860	5.8	.090	6.040	.122+0	3.0
NorthSouth	.05-0	6.39-0	.0270	3.85	.350	5.02-0	.0170	6.34-1
	.0190	2.455	.046-0	3.21566	.041-0	4.555	.052-0	4.45103
Male	.357*	4.4630	.0690 .362*0.		.0380 .384*0		.0890 .35*	1.769
ElectricityW		30				0		

Left table (continuation of Panel A):

Water	5.959*	.087	.097	28.937	.414		0.103+		28.116
Telephon	2.10		5.9266*		5.9395*	28.737	5.852*		
Road	20.1990		19850		19280		19390		
L tradex	.1955		.1990		.2150		.1990		
Constant			.19544		.21147		.19443		
N									
R²	1.861		.562		.847		.488		
R²-Adjust									
F									
Prob(F)	.000		.000		.000		.000		

* Significant at 1% level; + Significant at 10% Level

Source: Computed from Survey Data

On its own, the addition of Electricity variable did not improve weekly earnings (Regression 2, Panel A), and this is surprising at it is contrary to the *apriori* expectations. However, when Electricity variable is combined with Telephone variable in an interaction variable Tel/Elec, there is an improvement in the coefficient of determination while the variable itself is statistically significant at 1 percent level. The supply of electricity to any business premise enhances the access of owners to own and use telephone and other ICT devices, thereby improving the level of earnings in the business enterprise. Apart from road infrastructure which is surprisingly not statistically significant in its effects on business weekly earnings, others have contributed to it in a statistically significant sense. To further examine the aggregate effect of infrastructure on

TABLE 4B: Determinants of Weekly Income

Variables	REGRESSION 5		REGRES	
	B-Est.	t-value	B-Est.	t-val
LCapital	1.777*	14.143	1.632*	
L Empt	0.161*	4.249	0.144*	
L Educ	0.101+	1.935	0.096	
L Bisage	0.191*	5.705	0.197*	
Mfg	0.635*	9.338	0.669*	
Trade	0.101	1.594	0.15*	
Urban	0.022	0.394	0.006	
North	0.062	0.774	0.031	
South	-0.044	-0.016	-0.087	
Male	0.346*	5.091	0.333*	
Tel/Elec				
Water				
Telephon				
Road	-0.032	-0.437		
L tradex			0.147*	
Constan	5.887	27.679		5.86
N	1968		1808	
R²	0.202		0.189	
R²-Adj	0.198		0.184	
F	45.143		37.939	
Prob(F)	.000		.000	

* Significant at 1% level; + Significant at 10% Level
Source: Computed from Survey Data

business weekly earning, the natural log of *infradex* was introduced into the equation and this was found to be statistically significant on its effect on weekly business earnings.

5. SUMMARY OF FINDINGS AND CONCLUDING REMARKS

This study examined the effects of ICT and other social infrastructure like Electricity, pipe-borne water and access roads on the performance of micro, small and medium enterprises in the informal sector of Nigeria. Results from the analysis of data reveals evidence of positive effects of ICT and other social infrastructure on self-reported earnings of sampled enterprises. An interesting result from the analysis is the impact of the interactive variable 'Tel/Elect' which is the combination of electricity and telephone variables.

The implications of these findings for study is that the efforts of government towards making ICT and other social infrastructural facilities available for micro and small business is one important way of promoting the profitability and hence sustainability of these enterprises. When such businesses are profitable, stable and growing, they will become sources of income and employment generation to the Nigerian economy at it is in many developed nations.

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Nigerian Socio-Economic Development: The Roles and Challenges of Small and Medium Enterprises Development Agency of Nigeria (S.M.E.D.A.N). A Descriptive Perspective

AbimbolaAbidemiAdegbuyi
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria.

OlatunjiIdowuFadeyi
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria.

Oladele Joseph Kehinde
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria

OmotayoAdeniyiAdegbuyi
Centre for Entrepreneurship Studies,
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria.

Abstract

In recent time, no other sector has been given so much attention in Nigeria's development plans as the small and medium industrial sector. There has been a conscious decision to de-emphasis the capital intensive, large scale industrial projects by the three tiers of government in Nigeria and put more emphasis on small scale enterprises. Small scale enterprises have been observed over the years to have immense potentials for socio-economic development of a nation. The objectives of the paper is to establish the immense potentials of small and medium enterprises (SMEs) in Nigeria, to identify the challenges being faced by SMEs in Nigeria and the roles of Small and medium Enterprises Development Agency of Nigeria (SMEDAN) in addressing these challenges. This reviewed work revealed that SMEDAN is faced with a lot of challenges ranging from inadequate fund, tribalism, nepotism, lack of enlightenment/campaign amongst others. From reviewed of literature, it was found out that SMEDAN has not carried out its roles to a large extent to help alleviate the challenges faced by small and medium enterprises in Nigerians. It is recommended that there should be more awareness about the existence of the agency and it roles, there should be checks and balances to curb corruption etc. These will help the agency to carry out its roles efficiently and effectively so that the small and medium enterprises will have greater impact on the socio-economic development of Nigeria.

Key word: Small and Medium Enterprises, importance, challenges,Small and Medium Enterprises Development Agency.

1.0 Introduction

There are so many write-ups and discussions about SMEs globally. This has also been the subject in many presentations either locally and internationally. Global bodies such as Worlrld Bank, United Nations Industrial Development Organization (UNIDO), International Finance Corporation (IFC), United Kingdom Department for International Development (DFID), European Investment Bank (EIB) etc. extremely interested in making SMEs a sector to be reckon with especially in developing countries by paying so much attention to the sector than before. In Nigeria so much significance has been attached to SMEs than any other in the development plan of the country. [1].Akinlabi [2]states this major shift started from the economic reform programme in Nigeria since 1986, there has been a major change from investing on capital intensive, large scale industrial project to micro and small scale enterprises this because of their enormous capabilities for developing local linkages for speedy, viable socio-economic growth and development. Also governments at various levels in Nigeria (local, state and Federal levels) have come to embrace the Small and Medium Enterprises. Various policies have been formulated at different levels of government in order to support the growth and development SMEs sector. Some governments have assisted by giving soft loans, purchase of equipment, seedlings, giving distributive trades for items produced and or needed by the SMEs, rural urban migration, enrichment of standard of living of the workers of the SMEs owners and their dependents as well as the SME owner. Small scale enterprises are also in a better position to encourage the usage of local raw materials, also facilitate the growth of non-oil exports. With all the benefits of SMEs, they are still faced with a lot of challenges as enumerated. Therefore it has become necessary to look into the affairs of Small Medium Enterprises Development Agency of Nigeria in order to identify how this agency has supported SME growth in Nigeria. The objectives of this paper are to: establish the immense potentials of small and medium enterprises (SMEs) in Nigeria, (ii) identify the challenges being faced by SMEs in Nigeria and the roles of Small and medium Enterprises

advisory services and other incentives which can aid their growth and development.

Non-Governmental Organisations like the Women in Business (WIMBIZ), David Oyedepo Foundation (DOF) in Nigeria through seminars, trainings, campaign and capacity-development activities have continued to solicit for better support structures for operators in the SME sector. All the huge devotion and backing given to SMEs justify the claims that SMEs are a source of employment creation and wealth accumulation. SMIEIS came into existence in 2003 in order to realize the objective of revamping the SMEs as instruments of socio-economic growth and a viable means for the development of domestic technology, rapid industrialization, generation of employment for our teeming youths and the pivot for sustainable economic development in

Nigeria" [3].

Adeyemi and Aremu[5] add that SMEs are also a means of poverty reduction at low cost, a means of developing entrepreneurial competencies with indigenous technology. Other benefits of vibrant SMEs include development of infrastructural facilities brought about by the existence of such SMEs in their locality, the encouragement of economic activities such as suppliers of various items.

Development Agency of Nigeria (SMEDAN) in addressing these challenges and (iii) proffer useful suggestions which policy makers and other stakeholders involved in the formulation and the implementation of SMEs' development policies will find beneficial when implemented. This paper is a reviewed work that employed secondary data for its findings.

2.0 Literature Review

2.1 Definitions of Small and Medium Enterprises

According to the National Council on Industry (2009) cited in Olajide [6], states that SMEs are enterprises with a capital base of N1.5 million, which must not exceed N200 million, that has a

staff strength of not less than 10 and not more than 300. Essein[1] defines SMEs as business venture with an investment of between N100, 000 and N200, 000 that does not include cost of land. Adesuyi[7] defines Small and Medium-Scale business as any business undertaking which hires between five and one hundred workers with an annual inflow and out flow of about four hundred thousand Naira (N400, 000). [5] defined Small and Medium Enterprises (SMEs) as follows:

Small-Scale Industry: A business concern that has a human capital size that range between 11 to 100 workers with a total capital that is not more thanN50 million, as well asworking capital but does not include the cost of land.

Medium Scale Industry: An industry with a work force between 101 to 300 workers that has a total cost of over N50 million but not exceed N200 million, comprising of working capital but apart from cost of land.

2.1. Roles of Small and Medium Enterprises as Pivotal to Nigerian Economic Development

Small and Medium Enterprises are promoters of socio – economic development of a nation. They are sustainable mechanisms for the achievement of national macroeconomic goals in term of reducing unemployment at low investment capacity and enhancement of apprenticeship training.

For example in the Eastern African country of Kenya, Kombo [8] submitted that micro and small scale entrepreneurs who are into agriculture activities and rural businesses owners have been major contributors to the sustainable progress of Kenyan economy. They emphasized that SMEs have contributed immensely to the national aspiration of creating job prospects, impacting knowledge into entrepreneurs, making income for the economy and being a source of livelihoods for the majority of low income citizens in the country. This make up for 13-15% of GDP of Republic of Kenya in 2005. The major significance roles of this sector are also visible in other countries of the world such as China, Taiwan, South Korea, Singapore, and India among others. They contribute massively to the Gross Domestic production (GDP), export income and transfer of technology of these countries. SMEs by and large have been widely recognized as the trigger for progressive economic advancement. Aside from

the fact that they contributes to the growth in per capital income and output, they encourage the expansion of indigenous entrepreneurship, enhance regional economic balance through industrial transfer of knowledge and largely facilitate effective use of resources ([9];[10];[11]). Small and Medium businesses are a mainstay of a nation's socio-economic improvement. In order for a nation to actualize its full capacity in terms of economic and social transformation, it cannot afford to underestimate the significance of its local micro enterprises and their positive impacts in country's economy. These include free flow of trade from one nation to the other and the attraction of foreign investors into a nation. For instance, a research carried out in Nigeria by the Federal Office of Statistics in 2015 indicates that the micro and small enterprises sector provides, on average, 60% of Nigeria's employment generation and 50% of its industrial production. This has made the government to focus their resources on the growth of the sector as they are high contributors to nation's building. The ratio of Nigerian micro and small enterprises impact on the economy is highly recognized similar to other countries of the world.

Adesuyi[7] sums up the importance of the sector as capacity building, unemployment reduction, technology transfer, industrial dispersal, backward and forward integration, use of local raw materials, development of apprenticeship, poverty alleviation, pooling of resources together etc.

2.1.2 Challenges of Small and Medium Enterprises

The SME Sector in Nigeria is confronted with a lot of hindrances, one of such is that they are usually owned and managed by the family, this affects the effective running of the business as there are no skills acquired such as management skills, financial skills etc. and this poses as a very big threat to the sector. Another major challenge is how to raise capital for the business or the expansion, in most cases fund is generated by the owner's meagre savings. The small business owners are yet to take advantage of external means of raising capital such as banks, co-operative societies, finance houses, venture capitalists, business angels, Non-Governmental Organizations, partnership, investors both locally and internationally and this affects the expansion of business. On the other hand, when the

finance or banks house agrees to provide the fund, the conditions to be met are too stringent for the SME owners to meet up with such as high interest rates on the loan, provision of collateral, too many documentations, bureaucracy in getting approval etc., all these are very discouraging. With all these the sector remains inadequately funded, the majority of about 90% of small and medium enterprises are stagnant because of the challenge posed by inadequate finance [12]. Some of the problems associated with inadequate fund include; poor management skills, inability of owners to employ the services of competent and qualified hands, use of obsolete equipment and machines to run the business, inability to keep up with new technology, inability to compete with large firms in the industry.

Gentry [13] states that with the huge supports by government at various levels, small and medium businesses are still battling with harsh conditions. This occurs based on some limiting factors like very expensive available raw materials that have ripple effects on production prices of goods and services, SMEs are also adversely affected by unavailable of infrastructural amenities and the available one are inadequate while some are dilapidated, for example unavailable, inadequate or dilapidated roads network, electricity supply and pipe borne water. They are also affected by inconsistency in government policies and regulatory measures, high and multiple tax rate, illiteracy etc.

Also Baumback[14] identified lack of basic infrastructure, inadequate access to finance, capital shortage, inflation, inadequate information base, poor policy implementation, and low entrepreneurial skills.

2.2 Efforts by Government Towards the Growth of SMEs

In acknowledgement of the huge prospects of SMEs, some of which have been outlined, various special measures and programmes have been carried out by government to boost (SMEs) development and hence make them more vibrant in Nigeria [3]. Some of these measures include; Small Scale Industries Credit Scheme (SSICS), Nigerian Bank for Commerce and Industries (NBCI), Nigerian Industrial Development Bank (NIDB), SME Apex Unit of Central Bank, National Economic Reconstruction Fund (NERFUND), The African Development Bank/ Export Stimulation Loan (ADB/ESL), Nigerian Export Import Bank (NEXIM), National Directorate of Employment (NDE), Industrial Development Co-ordinating Centre (IDDC), Community Banks, People's Bank, Family Economic Advancement Programme (FEAP), State Ministry of Industry SME Schemes, Small and Medium Industries Equity Investment Scheme (SMIEIS), Bank of Industry (BOI). With all these strategies by the Nigerian government to promote the growth of SMEs,Damachi[15] says all these laudable efforts have little impacts in the growth and development of the micro industrial sector because of corruption, fund diversification, political instability, lack of proper implementation, policy inconsistencies, tribalism and nepotism etc.

3.0 Small and Medium Enterprises Development Agency of Nigeria (SMEDAN)

Most of the numerous efforts made by different Government of Nigeria to stimulate the growth and development of the SME sector produced minimal results. This about the need to have an agency that will coordinate the activities of the sector. This was affirmed when the World carried out a study and made a recommendation to facilitate the birth of a coordinating agency. The attempts by the Government to establish an agency failed severally until 2003, when the Small and Medium Scale Industry Development Agency (Establishment) Act enacted by the National Assembly created the Small and Medium Industry Development Agency (SMIDA). The National Assembly passed the SMIDA amendment bill in December, 2004 [8]. The Act changed the name of SMIDA to the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN). The Agency prides itself as a One Stop Shop for SME development. Their services also cover Micro Enterprises of the Agency since they are the basis for the formation of SMEs. The Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) came into being to accelerate the advancement and expansion of the Micro, Small and Medium Enterprises (MSMEs) sector in a skillful and viable manner. The Agency is vested with the responsibility carrying out its activities in ways that will facilitate the achievement of the transformation agenda of government and the development goals of the Ministry of Trade and Investment.

3.1. The Functions of SMEDAN

The tasks of the Agency as articulated in the SMEDAN Act, 2004 are ; originating and stating clearly policies for micro, small, and medium enterprises progress and enlargement; stimulating, Observing and Managing the development of the MSMEs sector; supporting and assisting development curriculums, mechanisms and to increase the speed of development and innovation of MSMEs; to serve as a frontline for the development of local technology, poverty reduction, and job creation and there by aiding enhanced sustainable livelihoods; serving as a middle man between MSMES and internal and external financier; to ensure access to industrial infrastructure, such as layouts incubators and industrial parks; to help MSMEs in promotion their products; to provide expertise advise, for the development of MSMEs; to stimulate the relationship sub-contracting, networking, and crosscutting strategic linkages between MSMEs and other economic sub-sectors; to promote strong and beneficial linkages between MSMEs and research institutes/higher institutions of learning; to provide advisory services to MSMEs; to carry out government directions, aids and amenities for MSMEs enlargement; giving endorsement to government business regulatory outlines for ease of enterprise development.

3.2 SMEDAN's Scorecard/ Achievements

Oboh[12]opines that since the beginning SMEDAN has been able to make some marks in terms of what it has achieved, he also states that with the introduction of SMEDAN the number of registered SMEs according to National Council of Industry (2012) has grown from 3.5 million to 5.5 million spread across the nation. According to him, some of the specific achievements of the Agency include;

3.2.1 Information, Training, Advisory Services and Business Sensitization: The Agency gave various information about how to source raw materials, equipment, general business knowledge, consultative services, means of accessing fund, through their zonal offices and specialists to a total of 100,993 MSMEs in 2014 cutting across the six geo-political zones of Nigeria.

3.2.2 Entrepreneurship Development and Education in Nigeria Educational System: In 2006, the Agency steered the awareness to make entrepreneurship education a priority in the Nigerian educational curriculum, thereby collaborating with the apex bodies of education in Nigeria; National Universities Commission (NUC), National Board for Technical Education (NBTE) and the Federal Ministry of Education to facilitate the endorsement of adding entrepreneurship in the prospectus of Nigerian secondary schools and tertiary institutions. From time to time the Agency pays visits to various Schools both secondary and tertiary institutions to sensitize them on how to run businesses. The goal is to inculcate entrepreneurial skills in the students and direct their focus on setting up their own businesses after school.

3.2.3 Business Development Services (BDS): The Agency collaborates with Prisons Fellowship of Nigeria and the Nigerian Prison Service to teach and train prison inmates on entrepreneurship, the purpose of this is to empower the prisoner to start their own businesses especially after leaving the prison in order for them to be useful to themselves and desist from crimes.

3.2.4 Corpers' Entrepreneurship Development Programme (CEDP): The Agency embarked on the sensitization campaign among youth corps members at different orientation camps spread all over the 6 geo-political zones in the country since 2010. This scheme is proposed to impart the essence of entrepreneurship in the corps members and making them to be full-fledged entrepreneurs by building capacity and empowering them to be employer of labor instead of adding to the teeming population unemployed youths.

3.2.5 Rural Women Enterprise Development Programmes: This programme is designed to enable the rural women bring out her socio-economic abilities, this initiative is done in partnership with the World Bank and different international partners to train rural women groups in twelve (12) model States of Nigeria.

3.2.6 Capacity building Programme:SMEDAN was able to train a sum of 200,480 existing MSMEs and new business owners in 2013 via its different Entrepreneurship Development Programmes (EDPs) which include General EDP, Youth EDP, Corper"s EDP (NYSC/SMEDAN/MDG), Women EDP, and other Enterprise Support Services (Training the Trainers) dispersed at 36 States of the Federation. At the completion of the skill acquisition training, the trainees were grouped into cooperative society so that it will be easier to seek incentives and loans for them from the Bank of Industry (BOI). This was set up to boost industrial development in the country. This will reduce

unemployment, poverty, crime and also improve the standard of living in Nigeria

3.2.7 Barry University, Miami, Florida/Africa-Diaspora Partnership for Empowerment &

Development (ADPED)/SMEDAN Partnership: The United State under its State Department of Young Entrepreneurs Programme in conjuction with Barry University's Andreas School of Business, Africa Diaspora Partnership for Empowerment and Development (ADPED) and SMEDAN ran a Nigeria Youth Entrepreneurship Program with the theme: "Connecting People, Creating understanding". This was aimed at training 20 young existing and potential entrepreneurs between the ages of 22-35 years, which were randomly selected from all over the nation in order to create entrepreneurial skills and business acumen. Also the programme also tried to promote entrepreneurial thinking, job creation, and business planning and management skills for emerging young professionals. The exercise for the 20 young Nigerians was done at the Barry University, Miami, Florida starting from 11th November, 2014 and ended on 8th December, 2014, 15 of the 20 young people trained were successful in the examination that was conducted after the training, and these 15 young individuals have received funding from the National Economic Reconstruction Fund (NERFUND) and have commenced their own various businesses.

3.2.8 SMEDAN/International Organization for Migration (IOM) partnership: Deportees/voluntary returnees from different countries of the world into Nigeria are trained voluntarily in order to empower them to start a source livelihood.

3.2.9 SMEDAN/Global HIV/AIDS Initiative Nigeria (GHAIN) partnership: SMEDAN gives training to those that take care of people living with HIV/AIDS in selected locations in Nigeria such as Abuja. This helps the care giver to acquire the expertise to take care of the special needs of these people   effectively.

3.2.10 SMEDAN/United Nations High Commission for Refugees (UNHCR)/Nigerian Commission for Refugees (NCFR) partnership: The Agency undertakes training in conjuction with the UNHCR & NCFR for refugees at selected refugees campgrounds situated in Lagos and Ijebu-Ode.

3.2.11 SMEDAN/WIDOWS Initiative: The comes to the rescue of widows by training them in poultry keeping, baking, events decoration, bead making, sewing, tie and die, soap making in locations such as Abuja, Abakaliki, Ebonyi. This empowers them to be financial independence and become bread winners in their families after the demise of their husbands

3.2.12 SMEDAN/NDLEA Partnership: The Agency campaigns in collaboration with NDLEA against drug trafficking and also assists in the rehabilitation of drug addicts through the rehabilitation centres in Bauchi, Lagos and Abuja.

4.0 Research Findings: Findings revealed that SMEDAN is confronted with a lot of challenges which include access to finance, human development challenges, leadership challenges, corruption challenges, tribalism/nepotism, infrastructural and institutional challenges, Policy inconsistency, market challenges, inadequate institutional and legal framework, bureaucratic and tedious procedures, insecurity and lack of sustained favorable environment for private sector investment. All these hinder the Agency from achieving its roles of helping SMEs to combat the challenges they are being faced with.

5.0 Conclusion:The huge potentials that lie in small and medium businesses notwithstanding, the growth of the sector in Nigeria is greatly threatened by poor financing, inadequate local raw materials, wrong attitude of entrepreneur, epileptic public power supply and social conflicts. The challenges faced by SMEDAN should be properly looked into and lasting solutions should be proffered in order for the Agency to continue to foster the growth and development of small and medium business which will positively impact on the socio-economy of Nigeria.

 6.0 Way forward: There should be more awareness campaign to bring the agency to the knowledge of the people, this is because so many small business owners are not aware of the existence of SMEDAN. Those who are aware do not know the benefits that can be derived from there.

 Re-professionalize the agency, most of the staff attending to the small business owners are not professionals. Professionals who understand the rudiments of business should be employed to train the small business owners.

Corruption should be tackled in the areas of misappropriation of fund, tribalism and nepotism. Fund meant for the agency should be judiciously used and the

accounts of the agency should be audited from time to time to curb this menace.

A favourable environment should be created where there is no insurgency in order for both national and international investors have the confidence to partner with SMEDAN so that more SMEs will be assisted.

There should be training and re-training of staff to meet up with technological advancement and change due to globalization so that small business owners can compete with their international counter parts.

Corresponding Author:
AbimbolaAbidemiAdegbuyi (abimbolaadegbuyi@yahoo.com) is a Ph.D. Scholar from the Dept. of Business Management, Covenant University, Canaan Land, Nigeria.

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ASSESSMENT OF PUBLIC PRIVATE PARTNERSHIP ON INFRASTRUCTURAL DEVELOPMENT IN NIGERIA: CHALLENGES AND PROSPECTS.

Olatunji Fadeyi
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria

Abimbola Adegbuyi
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria

Ogbonna Ifeanye
Department of Business Management,
Babcock University,
Illisan Remo,
Ogun State, Nigeria

Edwin Agwu
Department of Business Management,
Covenant University,
KM 10 Canaan Land,
Ota, Nigeria

Abstract

The era of government singlehandedly providing infrastructural facilities are long gone. Governments all over the world in this new dispensation cooperate with the private sectors in the provision and management of various infrastructural facilities in their respective countries. Based on archives of relevant literatures reviewed, this study focuses on Public Private Partnership (PPP) with respect to its effect on infrastructural development in Nigeria. It sets out to assess the role of this union of convenience on the growth of various infrastructures in Nigeria, with a view to evaluating in specific terms the challenges of the partnership on infrastructural development in Nigeria and to proffer solutions to them. Finding revealed that Public Private Partnerships in Nigeria are faced with challenges ranging from dearth of financing and when such is in place, it carries high interest rate. Another strong challenge hinges on lack of experience in project financing by bank officials and technical expertise. The findings further revealed lack of sound legal and institutional framework as a backing for Public Private Partnership in Nigeria. Despite these challenges, the study finds that the mutual relationship between the Public and Private sector had contributed immensely to the growth of infrastructures in the country as revealed by this reviewed work. The study recommends the establishment of the required regulatory framework for proper implementation of Public Private Partnership projects. Moreover, Nigerian banks through the CBN should be assisted to cope with the financing skills required for PPP.

Key words: *Public Private Partnership, Infrastructural Development, Nigeria*

1.0. Introduction

Initially, delivery of public services and provision of infrastructure has been the sole responsibility of the government. However with the growing population, coupled with the needs for development in other areas, governments have been found wanting from effectively

providing all the infrastructural needs of the people. Governments all over the world in this new dispensation, now cooperate with the private sectors in the provision and management of infrastructural facilities in their respective countries. This contractual arrangement is refers to as Public Private Partnership (PPP).

PPP is refer to as a generic term used to describe a myriad of structures that facilitate the participation of the private sector in the provision of public infrastructure and services. It involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project. PPP refers to a specific type of arrangement that involves a long-term agreement between a private sector party and a government in which the private sector party designs, builds, finances and operates public infrastructure in exchange for some form of payment.

Looking at the Nigerian situation with huge infrastructural needs and inadequate funding for such needs, PPP can mutually meet the infrastructural needs and similarly generate the needed funds for the provision and management of these infrastructure, thus lessen the financial burden of the government. Unlike privatization exercise, PPP give room for the government to regulate prices, inhibit market abuse and set up the user charges as the case may be. The poor ways various public assets are manage in Nigeria over the years had shown a big mismatch between the potentials of these assets and the current rate of usage and benefit derived from them. PPP assists the government to concentrate more on facilitation and regulation, while the private investors focus on building facilities and delivery of services mostly on cost recovery terms, thus achieving the fundamental goal of value for money and risk sharing in social development by the private partners. Correct implementation and adoption of PP in Nigeria will have a far reaching effect in solving our infrastructural deficiencies and enhance quality in service delivery systems.

1.1 Public-Private-Partnership Terminologies

According to Centre for Sustainability in Mining and Industry [1] and Afolabi [2] cited in Uwem and Abubakar [3], the commonly used PPP terminologies are explained in the summarized Table 1 below

Table 1: Public-Private-Partnership Terminologies

Commonly used terminology	Meaning
BOT - Build-Operate-Transfer	Private investor builds a facility, sells the output to the public, and transfers it at the end of the contract.
BRT - Build-Rent-Transfer	Private investor builds facility, rents it out, and transfer at the end of contract.
BTO - Build-Transfer-Operate	Private vendor builds facility, transfers to government, who either operates directly or contract out. The private vendor either gets full payment at the end of contract or shares in the earnings from operation thereafter.
CONCESSION	Private vendor (concessionaire) may or may not build facility, but is allowed to manage the facility and charge users a fee for use of the facility.
DBB - Design-Bid-Build	Government agency provides design, puts out tenders and winner builds the facility.
DBFO - Design, Build, Finance and Operate,	Government designs the facility, private vendor finances building and operates for cost recovery.
DBMF - Design, Construct, Maintain and Finance	Government designs, private sector constructs and maintains, and government finances.
EPC CONTRACT - Engineering, Procurement and Construction	Contract whereby the contractor proves a complete installation (e.g. a power plant) to specification, at a fixed price and to a fixed schedule.
FRANCHISE	The service provider (franchisee) is allowed to charge a service fee for the use of the infrastructure or service

	which has already been built. The franchisee pays a lump sum to government.	Transfer to	government agency, and transfers at the end of contract.
Lease/Maintain	Private vendor pays rent for facility and utilizes the resources.	ROT-Rehabilitate-Operate-Transfer	Private entity rehabilitate facility, operates to the extent of full cost recovery, and transfers.
Output specification	Government agency specifies "outputs," and private vendor designs, finances and builds the infrastructure.		
RLT - Rehabilitate-Lease-	Private vendor rehabilitates a facility, signs lease agreement on facility with		

Sources: Afolabi [2] and Centre for Sustainability in Mining and Industry [1] cited in Uwem and Abubakar [3].

2.0 Reasons of Public Private Partnership in Nigeria

According to Infrastructure Concession Regulatory Commission [4], the main reasons that prompts governments to involve in PPPs for infrastructural development and service propagation are: (a) for optimal utilization of available resources and efficiency in services. (b) To improve on the standing organizational plans and policies that will pave more ways for transparency and fairness assessment. (c) To attract more skilled force with competitive flair and orientation on efficient performance. (d) To reform sectors through a reallocation of roles, incentives and improve accountability.

Dabak [5] adjudge that government went into Public Private Partnership with the objectives of delivering significantly improved public services, by contributing to the enhancement of quality and quantity of infrastructures in the nation. Also to release the full potential of public sector assets, including state-owned businesses and exploit the better risk management of the private sector and to provide value for the taxpayer and wider benefits for the economy; and to allow stakeholders to receive a fair share of the benefits of the Public Private Partnership.

According to Dominic, Ezeabasili, Okoro, Dim and Chikezie [6], the reasons for PPP in Nigeria include: gross deficiencies and wide funding gaps observed in the Nigeria's infrastructural spheres, high rate of white elephant projects, high level of corruption in project execution and limited public resources to address the nation's growing infrastructure needs.

The initial option adopted by the government for infrastructural need was privatization, which one expect to show some form of competitiveness and a way to generate funds needed for capital expenses including infrastructures. But since the inception of the privatization process in Nigeria in 1999, it had been marred with lots of abnormalities among which are lack of fairness in the process, lack of transparency and was not made a public bidding exercise as it should be in the real context coupled with corruption by the so called privatization officials. All these shows the government's inability to manage, maintain or even control development of infrastructures in the country.

Privatization in itself is not bad as it has successfully been implemented in some part of the globe and reasons for embarking in this procurement option were notable seen, observed economically in terms of value for money and in terms of quality services. Virtually all the Private investors that acquired some of these government assets are leaping profits at an exponential margin from their investments. The fact is that Nigeria has a large market and most of these private investors have just explored the market size advantage and made total reformation in the way these assets were been previously managed. A formidable developmental synergy called PPP which is most needed to improve infrastructural funding gaps and service needs of the Nigerian populace, whereby public agencies can optimize, control and in most cases regulate the private partner's operations. Inherent risks and the associated performance rewards and penalties embedded in PPP spurs the private partners to achieve efficiency at each stage of the project and introduce an efficient means of getting things done. For an optimal utilization of resources and efficient output delivery, private partner are always instigated to provide an ongoing operations and maintenance management, in addition to the well-designed and built projects. In addition, the public sector are enabled under PPP to harness the expertise, innovations and

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operational efficiencies that the private sector can offer to projects and services initially procured and delivered by the public sector.

2.1 Forms, Models and PPP Legislation in Nigeria

According to Essia and Yusuf [7] PPP procurements and contracts in Nigeria are currently governed by:

1. The Infrastructure Concession Regulatory Commission (ICRS) Act of 2005.
2. The public procurement Act 2007
3. Regulations issued by ICRC governing the PPP process.
4. The state laws as described in each state's PPP policies.

According to Uwem and Abubakar [3] a review of the ICRC Act shows that the Act fails to make clear the funding challenges PPP project may face. The Act neither has a dispute resolution mechanism nor explains how the private investors can be protected in the event of disagreement with the government. There are also no mechanisms for receiving and examining unsolicited PPP proposals from prospective private investors for assessment and sponsorship. Most regrettably, the ICRC is not empowered to package its PPP projects; it merely gives approvals and engages in advocacies. Thus, the critical institutional platform for nurturing PPP projects to maturity is lacking in Nigeria, and the entire institutional architecture for capital budget execution is warped.Dominic, Ezeabasili, Okoro, Dim and Chikezie [6] argued that the aims of the government also define the choice of PPP model to be used. The level and nature of risks that is moved from the government to the private investors distinguishes each of these models from the others. The type to be selected is adequately determined upon proper evaluation of the project features and proper scrutiny taken in any of the chosen objective as regards its relevance, purposefulness and specificity. Four different PPP models which can equally be referred as PPP contract type are often in use are as follows: First is the service contract PPPs, second is the management contract PPPs, third is lease contract PPPs and Concessions contract PPPs (e.g. build-operate and transfer, (B0T), design build and operate DBO) . These PPP models are categorized largely under five areas: Asset ownership, operation and maintenance, capital investment, commercial risk, service and revenue generation use.

Idris, Kura and Bashir [8] argue that there are two basic forms of PPP, which are Contractual and Institutional PPP. Institutional PPP have been quite successful in some circumstances, particularly in countries with well-developed institutional and regulatory capacities. Contractual PPP are significantly more common, especially in developing economies.

2.2 Packaging PPP Contract in Nigeria

Under the ICRC Act, any arm of government with the exclusion of the local government can initiate and manage PPPs, but a number of State PPP projects may need the Federal Government backing so as to receive the confidence of major financiers. The Act envisions that PPP projects would be initiated by a government Ministry, Department, and Agency (MDA), who is expected to process the application up to when approval is obtained [9]. According to Uwem and Abubakar [3], the ICRC Act ascertains a number of steps to packaging a PPP contract. Step I is identification and prioritization of a PPP project by an MDA. Step 2, the MDA obtains clarification from the National Planning Commission (NPC) that the project is in line with plan priorities. Step 3, MDA submits spending plan for PPP project to the Ministry of Finance (MoF) and the Debt Management Office (DMO) for appraisal. In Step 4, MoF and DMO review the costs and contingent liabilities of the proposed projects and advice the MDA on possible revisions, where necessary. Step 5, the MDA includes accepted spending plans in the budget as agreed by MOF and DMO. Budget is approved in Step 6 by the Legislature. Step 7, MDA is permitted to move spending between different budget heads. In Step 8, funds are disbursed to the MDA, and Step 9 is preparation/auditing of annual accounts. Step 10 is consolidation of contractual payments under PPP projects into the national account. Acceptability of a PPP proposal by the MoF and DMO is hinged on the credibility of the private partner, bankability of the project, government prioritization, expected cash flows from the project, and availability of third-party

support from development partners, multilateral agencies, and so on [9].

2.3. PPP PRACTICE IN NIGERIA

According to Uwem and Abubakar [3] various concessions have taken place within the past few years in Nigerian. Laudable among these are Lekki Toll road managed by Lekki Concession Company and Domestic terminal at Murtala Muhammed Airport, Lagos by Bi-Courtney Aviation Services (a subsidiary of Bi-Courtney Limited).

2.3.1.Domestic terminal at Murtala Muhammed Airport, Lagos (MMA2)

This was a concession/BOT to build a new domestic terminal and additional facilities at the Murtala Muhammed Airport (MMA2) in Lagos. MMA2 was the first major BOT infrastructure project to be contracted by a Nigerian company. In 2013, Bi-Courtney was awarded the contract with 12years tenor initially later extended to 36 years. The contracting parties were the aviation Minister, Federal Airports Authority of Nigeria (FAAN) and Bi-Courtney. About six banks were involved in this syndicated loan and project financing. The project bump into a number of problems, among which are inability to secure long term financing agreement, and reluctance of FAAN to maintenance the project by enforcing use of MMA2 by airlines as required in the PPP agreement, couple with several claims of breach of contractual rights by both parties. A number of things are worthy of note from the appraisal of MMA2 PPP in Nigeria.

Firstly, lack of transparent and sustainable long term financing for PPPs. Secondly, lack of effective planning and failure to set dead line that would have help Bi-Courtney's in overcoming its shortcomings. Thirdly, weak framework to regularly observe and assesses PPP projects, thus making conformity to standard difficult. Fourthly, lack of provision to accommodate unanticipated variations in the project. Fifthly, the nonexistence of relevant dispute resolution mechanism for PPP projects leading to escalation of controversies easily and the failure of FAAN's to comply with several court orders, and inability of ICRC to shield PPP projects and private investors.

2.3.2 Lekki Toll road concession project, Lagos

The concession of Lekki Toll Road Phase 1 was between the Lagos State Government and Lekki Concession Company Limited for a period of 30years which involved the upgrading and maintenance of about 50km express road leading to Lekki-Epe. The foremost investors in the scheme comprised Macquarie Bank and Old Mutual of South Africa via the African Infrastructure Investment Fund. Funds for the project was from the support of Lagos Government plus a mixture of debt and equity finance.

The project received a loan of 15years from Standard Bank which served as the first ever local debt financing for such a long time. As the first phase of the project was getting to a close, tolls were built by the company to recover its investment, this met with lots of resistance and litigation from other stakeholders leading to termination of the agreement by the Lagos State Government.

Some of the lesson learnt from this project include the importance of stakeholder's consultation as the people living along Lekki-Epe route were the ones that resisted the toll and went to court. Good impact assessment of project done before commencement. There should be better ways of negotiation and management of people's perception during project implementation.

Establishment of project performance standard that is supported by operational penalty regime, monitoring framework and a viable long term financing plan.

2.3.3. On Going PPP in Nigeria

From the official website ICRC [10], there are 48 ongoing PPP projects in Nigeria among which are: National Theatre Master plan Complementary Facilities Rehabilitation, development Of Mechanic Villages in the six geo political zone, National Stadium Lagos facilities renewal and management, PPP High Voltage Transmission For Transmission Company of Nigeria, Greenfield High speed Land Railway Lines across Nigeria among others.

All these projects if properly implemented and the relevant stakeholders played their part well will be for the good of the nation as a whole and help to solve our nation infrastructural challenges. More so, potential investors will be attracted to the country to get involved in this marriage of convenience.

2.4. Potential Benefits of Public-Private Partnership

Dabak [5] posited the following benefits that can be accrued from PPP initiatives:

i. Value for money: Projects are executed at lower cost with the utilization of private investors' expertise and technology in efficient service delivery, thus having superior product or service at reduce cost.

ii. Quicker delivery of project: Since bureaucratic tendencies are reduce if not eliminated, with PPPs projects are completed swiftly and on schedule than those purely funded and executed by the public sector.

iii. Risk transfer: Associated project risks like finance, timeframe, planning permits, community consultations among others are shifted to the party best equipped to deal with it, both in terms of expertise and costs, to the stability and benefit of the project.

iv. Increased investment: With private sector involvement governments are able to execute more projects frequently and on a bigger scale without the need for extra budget or additional funds.

v. Increased budget/financing certainty: The shift of responsibility (and risk) to the private investor for some of the project elements guards governments from unexpected financial liabilities following cost overruns, delays, or operational difficulties that would otherwise impact upon the budget bottom line.

vi. Improved service delivery: Since both the government and the private sector concentrate on their areas of expertise, PPP enhances delivery of improved service, thus government on policy and governance, while the private sector focused on the technical aspects of design, construction, operation, and management.

vii. Political benefit: Positive public perception about the government as PPP aid swift projects delivery without impacting much on government budget yet superior quality infrastructure or services are provided.

viii. Private sector growth and stability: PPPs provide the private sector with access to reduced risk, secure, long-term investment opportunities that are underwritten by government contracts. Such agreements ensure private capital flows, provide investment opportunities, and stimulate local industry and job markets.

ix. Elimination of corruption: With PPP corruption in awarding of contract and project execution is reduce if not totally eliminated. White elephant project become a thing of the past, as projects awarded are carried out and completed on time.

2.5. Challenges of Public-Private Partnership in Nigeria

PPP in Nigeria is face with various challenges ranging from financial limitations, dominance of public companies, corruption, inability of private companies to access local currency and affordable long term loan [5]. Also PPP is face with the problem of definition, as it is not properly defined in the law permitting the used of the finance option. Afolabi [2] posits that the lack of continuity in administrative policies by political office holders over the year has affected PPP negatively. Frequent changes in important office holders and the Chief Executives of Regulatory agencies impact adversely on PPP projects. For instance the MMA II concessionaire over a period of 7 years has had to deal with 6 different Ministers and 5 different Chief Executives of the Federal Airports Authority of Nigeria (FAAN), each with diverse policies and opinions with respect to PPP.

Similarly, the inability of Nigeria banks due to its size to cope with long term loan for PPP project is an issue to contend with and when such loans are available the interest rates on them will be too high to cope with, coupled with lack of expertise of banks official in project financing [11].

Lack of sound legal and institutional frame work backing Public Private Partnership in the country, in a situation where there is problem with the agreement(s) the private investors are left to bear the burden financially and otherwise [11].

Premature termination of concession right by government is another major challenge, a typical example is the termination of the concession right between Lagos State and the Lekki Concession Company (LCC) over the Lekki-Epe express road [12].

3.0 Recommendation

For public sector to be able to realize its objective of infrastructure development and the private sector to make her profit the following recommendation are worthy of note:

The establishment of the necessary regulatory framework for proper implementation of PPP projects, most importantly with respect to dispute resolution during the tenor of the contract.

The possession of political will by the agents and leadership of government to deal with corruption without any fear or respect for the position of the individual or body involved.

Nigeria banks through the CBN should be assisted to cope with PPP financing, as sustainable long term financing mechanism is key to the success of PPP projects.

Proper definition of PPP as a concept should be made as the ICRC Act failed in this regard.

3.1. Conclusion

PPP had benefited many developed nations, as it is still doing till date and holds tremendous benefits for developing nations like Nigeria in the area of infrastructural growth if properly harness. PPP can improve sustainability and growth of infrastructure development through value for-money project assessments and improved delivery performance. However realizing these commendable results call for an institutional architecture, with robust preference for private sector involvement campaign, which handles market development, regulation, dispute resolution among others and implementation of infrastructure projects in a single clear hull.

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*Corresponding Author: Fadeyi Olatunji (fadeyiolatunji@yahoo.com) is a PhD scholar at Covenant University, Ota, Ogun State, Nigeria.

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Trends in performance improvement of bricklayers in the Nigerian construction industry

*[1]FAGBENLE, OLABOSIPO I.

DEPARTMENT OF BUILDING TECHNOLOGY

COVENANT UNIVERSITY

OTA, OGUN STATE, NIGERIA

**Email:
olabosipo.fagbenle@covenantuniversity.edu.ng**

[2]FAGBENLE, AYOOLA O.

DEPARTMENT OF GENERAL STUDIES

OSUN STATE COLLEGE OF TECHNOLOGY

ESA-OKE, OSUN STATE, NIGERIA

Email: olafagbenle@yahoo.com

[3]TUNJI-OLAYENI, PATIENCE F.

DEPARTMENT OF BUILDING TECHNOLOGY

COVENANT UNIVERSITY

OTA, OGUN STATE, NIGERIA

**Email:
pat.tunjiolayeni@covenantuniversity.edu.ng**

[4]JOSHUA, OPEYEMI,

DEPARTMENT OF BUILDING TECHNOLOGY

COVENANT UNIVERSITY

OTA, OGUN STATE, NIGERIA

**Email:
opeyemi.joshua@covenantuniversity.edu.ng**

[5]OJELABI, RAPHEAL A.

DEPARTMENT OF BUILDING TECHNOLOGY

COVENANT UNIVERSITY

OTA, OGUN STATE, NIGERIA

**Email:
rapheal.ojelabi@covenantuniversity.edu.ng**

ABSTRACT

High performance is regarded as a goal that ensures long term survival of firms and block/brick is acclaimed as one of the primary construction materials all over the world. The craftsmen in this trade also play an important role towards achieving this task. Therefore, a survey of 120 construction sites were conducted in the years 2004, 2010 and 2014 to identify the areas with the need for performance improvement of bricklayers in construction industry. With a focus on six

states from the six geo-political zones in Nigeria, the trends in the findings of this survey among 360 bricklayers were observed and interpreted. The result indicated that provision of working tools and equipment, transport to and from sites, reward systems based on ability and productivity, safety plans including provision of protective devices and first aids as well as finish and go (no delay after day's work) were variables that consistently perceived as need for performance improvement over the years. The variables that were identified as requiring more improvement in the recent year (2014) compared with the previous years were employees' training and

development, job security and employee turnover, quality control, incessant rework and estimating errors, material shortage, delay and wastage as well as labour availability. Those that need less improvement compared to the previous years were access to soft loan from establishment and end of the year cocktail party and award nights. It was concluded that priority attentions should be shifted towards the identified variables for an improved construction performance of these craftsmen as a developmental strategy in this sector.

Keywords: Bricklayers; Construction Industry; Nigeria; Performance Improvement; Trends.

INTRODUCTION

Studies on the performance of construction products and operatives are usually of great concern to scholars and policy makers all over the world. this has been confirmed via the works of many researchers such as [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15]. According to Seeley (1996; cited in [2]), the traditional project performance measures of cost, time and quality are frequently used to assess contractors' performance by clients.

Sidwell(1983; cited in [2]) indentified factors influencing project time performance and concluded that client's experience, form of building, labour force, form of building procurement and project organizational structure are elements of a complex casual factor of project time performance.

In a similar development, Sink (1985; cited in [2]) identified seven dimensions of organizational performance: effectiveness; efficiency; quality; productivity; quality of work; innovation and profitability. [16]believed that the performance of a construction management team is influenced by internal and external factors which were synchronized as project, environment and management related. [6]also identified seven areas of performance improvement of construction contractors in the United States as: management; materials; engineering; construction techniques; regulations; labour; and equipment. These were

further broken down into: materials (procurement, delivery, storage, packaging, prefabrication, standardization, product availability and new products); management (office management, estimating, cost control, scheduling, resource allocation, integration of design/estimating/scheduling/control functions, field inspection, safety management and marketing communications); engineering (design standards, design practices, systems engineering, drafting, specifications and value engineering); regulations (local codes); construction techniques (precast elements, pre-assemble modular and foreign developments); labour (turnover, availability, working hours and labour relations, contract agreement, training and quality control); and equipment (replacement analysis, capacity, simplicity, maintainability, utilization and use of robots).

Adeyemi (2000; cited in [4]) observed the presence of a number of demotivators in the Nigerian construction industry, which are clogs to performance improvement. The ones having direct bearing with operatives' improvement are identified as: inappropriate tools and equipment breakdown; material shortage, delay and wastage; incessant rework and estimating errors; absence of training and safety programmes; job insecurity/employee turnover; non involvement of construction crews in production objective; incompetent foremen; and predominance of Maslow's theory X site managers. [17]researched into the management of labour in

Kenyan construction industry and identified some factors suspected to be negatively affecting labour performance in the Kenyan construction industry. [2]also examined how the factors perceived to be negatively affecting labour's performance vary from site to site in Nigerian construction industry. [6]observed the trends in productivity improvement of contractors in the United States' construction industry.

The objective of this study is to determine the potential areas which need performance improvement of bricklayers in the Nigerian Construction Industry.

RESEARCH METHODOLOGY

Primary data were collected through questionnaire survey and direct field observations. The study samples were randomly drawn from 360 bricklayers in one hundred and twenty construction firms within the six geo-political zones in Nigeria (southwest, southeast, southsouth, northwest, northeast, and northcentral). One state each from the six geo-political zones of the country was selected for the site visitation. They are: Lagos (southwest); Anambra (southeast); Delta (south south); Kaduna (northwest); Katsina (northeast); and Niger (northcentral). Thesurveys were conducted in the years 2006, 2010 and 2014 with a primary aim of identifying the areas that need the performance improvement of bricklayers in the construction industry in Nigeria. Forty sites were visited in which one hundred and twenty bricklayers were observed in each of the year.The essence of this was to achieve homogeneity of response and comparative analysis. The illiterate respondent among the bricklayers were however guided by reading out the content of the questionnaire to them and their responses carefully inputted. Research assistants who were postgraduate students in the built environment were employed for this exercise. Two set of questionnaires were distributed: to the bricklayers and to contractors.

In the first instance, general characteristics of construction firms and the respondents were elicited. They include: nature of the firms; annual turnover; geographical spread; number of permanent employees in the firm; number of equipment owned and/or leased; registration with the Federal Registration Board of Nigeria; years of experience of the respondents; years of working experience of respondents with the company; provision of working tools to the employees by the company, etc. Secondly, respondents were asked to identify the most fertile areas requiring performance improvement. These were also stratified into eight categories: management; materials; engineering; construction techniques; regulations conformity; labour related; tools/equipments; and incentives. Each category comprises a set of micro functions as follows: management (estimating, cost control, scheduling, field inspection, safety management and communicating structure); materials (procurement, delivery, shortage, storage, standardization and product availability); engineering (design standards, design practices and specifications); construction techniques (precast elements and new methods); regulations conformity (government regulations, company regulations, health and safety measures); labour related (availability, turnover, contractual agreement, quality control, training and retraining, and rework; tools/equipment (capacity, availability, access, simplicity and maintainability); and incentives (transport to and from sites, reward system based on ability and performance, safety plans, finish and go, provision of recreation and relaxation centers, end-of-the-year cocktail party and award night, overtime payment and employee insurance). These eight macro variables were then named VAR1, VAR2, VAR3,…VAR8 respectively for factor analytical technique [18]. The coefficients were further subjected to matrix correlation/importance statistical analysis to determine the variables that need performance improvement in this regard. The coefficient that is greater or equal to 0.500 indicates a high level of co-variation between variables involved and also indicates a considerable room for performance improvement in a particular variable/function. Also, a coefficient ranging between 0.499 and 0.201 shows a moderate level form for improvement while those between 0.100 and 0.200 indicates a relatively level of correlation/improvement.

DATA ANALYSIS AND DISCUSSION

Table 1 shows the correlation matrix of the linear relationship between the variables and also indicates the importance level attached according to the bricklayers while Table 2 depicts the management's perception of the rating.

Table 1: MATRIX OF CORRELATIONS/IMPROVEMENT POTENTIAL INDICES (BRICKLAYERS' RESPONSE)

Variables	2006 Survey								2010 Survey								2014 Survey							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	1.000								1.000								1.000							
2	.578	1.000							.581	1.000							.583	1.000						
3	.501	.576	1.000						.503	.578	1.000						.507	.523	1.000					
4	.556	.532	.593	1.000					.556	.541	.595	1.000					.561	.552	.597	1.000				
5	.511	.573	.549	.601	1.000				.507	.572	.598	.602	1.000				.521	.584	.599	.605	1.000			
6	.517	.605	.601	.613	.573	1.000			.521	.607	.609	.613	.581	1.000			.551	.709	.611	.621	.592	1.000		
7	.711	.697	.632	.593	.613	.621	1.000		.723	.701	.633	.599	.621	.624	1.000		.727	.712	.644	.605	.631	.627	1.000	
8	.771	.763	.698	.711	.711	.796	.722	1.000	.781	.701	.716	.771	.799	.799	.732	1.000	.788	.712	.719	.799	.799	.806	.763	1.000

Table 2: MATRIX OF CORRELATIONS/IMPROVEMENT POTENTIAL INDICES (MANAGEMENT'S RESPONSE)

Variables	2006 Survey								2010 Survey								2014 Survey							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	1.000								1.000								1.000							
2	.571	1.000							.577	1.000							.578	1.000						
3	.762	.572	1.000						.765	.573	1.000						.768	.573	1.000					
4	.557	.533	.592	1.000					.559	.533	.594	1.000					.561	.534	.593	1.000				
5	.516	.574	.551	.599	1.000				.521	.577	.556	.600	1.000				.532	.579	.559	.612	1.000			
6	.516	.611	.606	.609	.577	1.000			.515	.613	.608	.611	.588	1.000			.551	.625	.621	.615	.601	1.000		
7	.714	.696	.633	.612	.611	.627	1.000		.716	.701	.653	.618	.617	.629	1.000		.717	.705	.655	.618	.619	.634	1.000	
8	.751	.760	.671	.699	.712	.797	.712	1.000	.771	.770	.699	.701	.715	.791	.715	1.000	.781	.780	.701	.707	.714	.801	.726	1.000

The results obtained in Table 1 indicate that all the variables have high degree of positive relationship with one another. This is a confirmation of the validity of interdependence of these variables (functions) in the review. The score of the relationship between labour-related matters and

incentive application had the highest positive association (.796) in the 2006 survey. Similar associations (.700 and .806) were recorded in the years 2010 and 2014 respectively. It is an indication that an improvement in the performance of bricklayers will necessitate an improvement in the application of the various incentive schemes as earlier indicated. Little wonder that the figures kept increasing with increase in the survey years. This also indicates the urge of this variable as a potential area for performance improvement of bricklayers. Also, the relationship between management and provision of tools/equipment showed high positive associations (.711, .723 and .727) respectively in the three surveyed years. This signposts the essentials of sophisticated tools and equipment as abedrock of result-oriented performance. It also situates tools/equipment as potential area for improvement among the bricklayers. This supports the views of [4] and Adeyemi (2000; cited in [4]) that inappropriate tools and equipment are clogs in the wheel of progress of productivity improvement in the construction industry.

The results of 2014 survey in comparison with the year 2010 depicted a slightly high level of association between labour matter and materials (.709) as against a figure of .607 in the previous year. This also puts material availability as a potential area for performance improvement of bricklayers. The lowest figure recorded is the association between management related and engineering (.501). While this is still considered as falling within the range of potential areas for performance improvement, the reason for the low figure might not be unconnected with the technicalities involved in this component when compared with the technical level of the respondents (bricklayers).

Similar trends were observed in the management's response (Table 2) except in the relationship between managerial and engineering which showed relatively higher association figure of .762, .765 and .768 in years 2006, 2010 and 2014 respectively in comparison with the bricklayers' version (.501, .503 and .507) respectively.This is not unconnected with the premium attached to engineering development by the management as a measure for construction sustainability and business growth. Engineering development and sophisticated construction techniques are vital ingredients that must not be downplayed by any construction company that does not want to go into extinction in the construction business.

CONCLUSION

An analysis of the trends in performance improvement of bricklayers in the Nigerian construction industry in the years 2006, 2010 and 2014 has been demonstrated. Itis concluded that a more purposive attention should be geared towards the provision of working tools and equipment, viable transportation system, virile reward scheme and elimination of hidden policies for an appreciable improvement in the performance of bricklayers to be achieved in the construction industry in Nigeria. Of equal importance are also employees' training and development, quality control and elimination/drastic reduction of incessant rework, estimating errors, material shortage, delay and wastage as well as labour availability. It is also suggested that this trend is performed on other craftsmen in the construction industry as well as its application to other nations of the world.

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An identification of clogs impeding craftsmen's productivity in the construction industry in Southwestern Nigeria

[1]AKOMOLAFE, MARIAM A.
DEPARTMENT OF BUILDING TECHNOLOGY,
COVENANT UNIVERSITY, OTA, NIGERIA
Email:akomolafe01@yahoo.com

[*2]FAGBENLE, OLABOSIPO I.
DEPARTMENT OF BUILDING TECHNOLOGY,
COVENANT UNIVERSITY, OTA, NIGERIA
Email:olabosipo.fagbenle@covenantuniversity.edu.ng

[3]AFOLABI, ADEDEJI;
DEPARTMENT OF BUILDING TECHNOLOGY,

COVENANT UNIVERSITY, OTA
OGUN STATE, NIGERIA
Email:
adedeji.afolabi@covenantuniversity.edu.ng

[4]MAKINDE, FELIX A.
DEPARTMENT OF BUILDING TECHNOLOGY,
COVENANT UNIVERSITY, OTA
OGUN STATE, NIGERIA
Email: bismak1955@gmail.com

[5]FAGBENLE, AYOOLA O.
DEPARTMENT OF GENERAL STUDIES,
OSUN STATE COLLEGE OF TECHNOLOGY,
ESA-OKE, NIGERIA
Email: olafagbenle@gmail.com

ABSTRACT

Construction firms in Nigeria are known at making frantic efforts to compete favourably for contracts, make profits and also strive to remain in business. For this to manifest however, productivity among others must be sustained. This paper therefore addresses the clogs that can affect craftsmen's productivity in southwestern Nigeria. With a focus on the two states (Lagos and Oyo) in the study area, one hundred questionnaires each, backed with on-site observation, were administered to the management and craftsmen on construction sites in the three stratifications (large, medium and small firms). Parametric and non-parametric statistical techniques' results indicate that the five most ranked factors affecting craftsmen's productivity are inadequate/lack of tools and equipment, rework, material shortage, inclement weather and fatigue. The paper concluded that all the identified factors must be addressed by the stakeholders in the construction industry in order to improve craftsmen's productivity in Nigeria.

Keywords: Construction Industry; Clogs; Craftsmen; Identification; Productivity; Southwestern Nigeria.

INTRODUCTION

The construction industry is considered to be very essential to the economy of every nation. This importance stems from a wide range of reasons associated with certain peculiar features of the industry such as its products being investment-goods (Kazaz and Ulubeyli, 2004; cited in Fagbenle, et al. 2004). It covers half of the whole field of fixed capital accumulation (Fagbenle 2006), therefore, it constitutes the most single sector of capital

formulation in any national economy (Ayandele, 1996; cited in Fagbenle et al., 2004). Adedeji (2008; cited in Fagbenle, et al., 2011) observed that building industry being a subset of the construction industry is one of the most important sectors of the Nigerian economy. Productivity is considered as one of the most important factors affecting the success and overall performance of every organization, whether large or small, in today's competitive market (Ersoz, 1999; cited in Wilcox, et al., 2000).

Past studies (Kuprenas, 2003; Cheung et al., 2004; Navon, 2005; Ugwa and Haupt, 2007) are however related to calculating the effect of productivity factors. They also looked at the construction industry as a whole, yet the majority of the workers are employed on building sites. Various factors have been identified by different researchers from the time aspect in different construction sites. Lack of materials, incomplete drawings, incompetent supervisors, lack of tools and equipment, absenteeism, poor communication, instruction time, poor site layout, inspection delay and rework were found to be the ten most significant problems affecting construction productivity in Nigeria (Fagbenle, Ogunde and Owolabi, 2011). Corroborating this, Olomolaiye et al. (1987; cited in Fagbenle et al., 2004) asserted that the five most significant factors in Nigeria are lack of materials, rework, inadequate equipment, supervision delays, absenteeism, and interference. Kaming et al. (1997) discovered that lack of materials, rework, worker interference, absenteeism, and lack of equipment were the most significant problems affecting workers in Indonesia. Lack of materials, weather and physical site conditions, lack of proper tools and equipment, design, drawing and change orders, inspection delays, absenteeism, safety, improper plan of work, repeating work, changing crew size and labour turnover were found out to be the most critical factors in Iran (Harris et al., 1996).

Lim and Alum (2005; cited in Iyer and Jha, 2005) found that the major problems with labour productivity in Singapore are recruitment of supervisors, recruitment of workers, high rate of labour turnover, absenteeism at the workplace, communication with foreign workers, and inclement weather. Lema (2004; cited in Navon, 2005), through a survey of contractors in Tanzania revealed that the major factors that influence productivity are leadership, level of skill, wages, level of mechanization, and monetary incentives. Abdulaziz, Jarkas, and Bitar (2012; cited in Fagbenle et al., 2014) carried out a survey in Kuwait and their findings indicated that clarity of technical specifications, extent of variation/change orders during execution and coordination level among various design disciplines were the main factors impeding labour's productivity. In view of this, Maloney (1983; cited in Olomolaiye and Ogunlana, 1989) remarked that craft workers as the major player executing construction processes and activities have a significant influence on construction labour productivity. In the same vein, Dai et al. (2009; cited in Fagbenle et al., 2011) considered craft workers to be in the ideal position to know where and how much of site's productivity is lost or could be gained. Since labour productivity involved the management of labour, project supervisors/engineers often regarded as middle level managers are responsible for the coordination of the instructions from upper level managers for implementation by the craftsmen. These instructions equally affect construction labour productivity. In today's era, one of the biggest concerns for any organization is to improve their productivity, representing the effective and efficient conversion of resources into marketable products and determining business profitability (Wilcox et al., 2000). Consequently, considerable effort has been directed to understand skilled labour productivity concept with different approaches taken by researchers, resulting in a wide variety of productivity definitions (Lema and Samson, 2002; Oglesby et al., 2002; Pilcher, 1997). This research therefore focused attention on the various factors perceived to be impeding skilled labour productivity in building construction projects in Southwest Nigeria.

RESREACH METHODOLOGY

Data were put together through questionnaire survey. Samples were randomly elicited from construction craftsmen and management in the two selected states of southwestern Nigeria (Lagos and Oyo). The decision was based on the volume of construction activities that are taking place in the two states compared to other states in the southwestern Nigeria, except Ogun which is considered too close to Lagos

State. Two sets of questionnaires were prepared onlikert type scale of one to four to sample the opinion of two of the main construction stakeholders (craftsmen and management) inidentifying the clogs perceived to be hindering construction productivity and to also determine the premium placed on them. The craftsmen surveyed were bricklayers and carpenters because a vast majority of the construction materials used on sites are blocks/bricks and timber (wood). Research assistants were employed to distribute questionnaires and assist some of the respondents on site to interpret the questionnaires. The project types considered were building construction while the sites were stratified into three major types (large-sized, medium-sized and small-sized firms). The stratification was based on the geographical spread and annual turnover (Fagbenle et al., 2004).Sample size was calculated from the following formula (Sediary, 1994; cited inFagbenle et al., 2011):

$n = n^1/[1 + (n^1/N)]$
Where,
n = sample size
$n^1 = S^2/V^2$
N = total estimated population
V = standard error of the sampling distribution = 0.5
S = maximum standard deviation in population. Total error =0.1 at a confidence level of 95% and $S^2 = (P)$ x (1-P) = (0.5) x (0.5) = 0.25, where P is the proportion of population elements that belong to a defined class. Therefore, 100 questionnaires were administered on each of the identified target respondents, of which 75 and 72 questionnaires were filled and returned by craftsmen and management respectively. From the 75 questionnaires returned by the construction craftsmen, 20, 25 and 30 questionnaires were respectively from large-sized, medium-sized and small-sized firms. For the management, 21, 23 and 28 questionnaires were from large-sized, medium-sized and small-sized firms respectively. This was to allow for the homogeneity of study and for comparison of findings.

The relative index (RI) attached to each of the identified clogs was calculated using the following formula (Fagbenle, 2000; cited inFagbenle, et al., 2011):

Relative Index = $\dfrac{\text{Point Total}}{\text{4 x Sample Size}}$

Several factors perceived to be impeding craftsmen's productivity have been identified in the literature and out of which sixteen (16) most critical clogs relevant to this study were elicited for the respondents' ranking. They are: materials shortage; incomplete drawings; poor supervision; inadequate tools and equipment; workers' absenteeism; poor communication; instruction time; poor site layout; inspection delay; rework; interference; inclement weather condition; high rate of labour turnover; level of skills of workers; sophistication of mechanization; and monetary incentives. The next section therefore presents the findings of the study.

RESULTS AND DISCUSSIONS

Results in Table 1 showed that craftsmen in the three categorizations of construction firms surveyed were of the strong convergent of opinions that the five most influencing clogs impeding their productivity on sites are: inadequate/lack of tools and equipment (RI = 0.78); rework (RI = 0.74); materials shortage (RI = 0.70); inclement weather (RI = 0.67); fatigue/interference (RI = 0.61). Inadequate/lack of tools and equipment has been identified as the bane of construction productivity on sites. Use of obsolete tools and equipment will no doubt impede the speed of a craftsman regardless of his wealth of experience and complaints will always be the order of the day in this regard. On the other hand, a well-motivated craftsman with state-of-the-art tools and equipment is not unlikely to radiate with confidence in his daily activities which in turn increases his productivity. No wonder that this factor was accorded the highest premium by the craftsmen. This supports the views of Fagbenle et al. (2011) and Olomolaiye et al. (1987) that use of adequate tools and equipment is a great asset for construction productivity. Also, continuous rework of a particular construction activity over a long period of time seems to discourage such craftsmen on sites which in turn impede productivity. Material shortage on it will no doubt leave workers idle on site and productivity for that period of time will be near zero. This is in tandem with Kaming et al. (1997)'s findings on Indonesian construction sites. Also, inclement weather such as high temperature

(extremely hot sun), heavy downpour and harsh weather can go a long way in reducing the performance of an average craftsman on site. The study corroborates the findings of Lim and Alum (2005) that harsh weather remains one of the greatest challenges affecting productivity on construction sites in Singapore. Fatigue and interference were accorded the same weight by the respondent craftsmen. It is obvious that an already worn-out craftsman can hardly perform any magic in terms of productivity on construction sites. Also, issuing out instructions upon counter instructions to the craftsmen by the superior officers on construction sites might be counter-productive and little wonder that this factor was also rated high (fifth) by the respondent craftsmen on sites. Other rankings by the craftsmen indicated the following: poor supervision (RI = 0.56); monetary incentives (RI = 0.56); inspection delay (RI = 0.49); incomplete drawings (RI = 0.47); sophistication of mechanization (RI = 0.46); poor communication/instruction time (RI = 0.44); level of craftsmen's skills (RI = 0.43); workers' absenteeism (RI = 0.41) high rate of labour turnover (RI = 0.37) and poor site layout (RI = 0.31).

Table 1: Relative Index of Clogs Impeding Craftsmen's Productivity on Construction Sites in Southwestern Nigeria (Craftsmen's Responses)

S/N	Factors (Clogs)	Large Firms	Medium Firms	Small Firms	All Firms	Rank
1.	Material Shortage	0.63	0.79	0.67	0.70	3rd
2.	Incomplete Drawings	0.48	0.50	0.44	0.47	10th
3.	Poor Supervision	0.48	0.68	0.53	0.56	7th
4.	Inadequate/Lack of Tools and Equipment	0.75	0.84	0.75	0.78	1st
5.	Workers' Absenteeism	0.31	0.58	0.33	0.41	14th
6.	Poor Communication/Instruction Time	0.39	0.55	0.39	0.44	12th
7.	Fatigue	0.55	0.71	0.58	0.61	5th
8.	Poor Site Layout	0.25	0.39	0.30	0.31	16th
9.	Inspection Delay	0.40	0.61	0.47	0.49	9th
10.	Rework	0.69	0.81	0.72	0.74	2nd
11.	Interference	0.51	0.72	0.59	0.61	5th
12.	Inclement Weather	0.61	0.78	0.63	0.67	4th
13.	High Rate of Labour Turnover	0.26	0.52	0.33	0.37	15th
14.	Level of Craftsmen's Skills	0.50	0.40	0.40	0.43	13th
15.	Sophistication of Mechanization	0.31	0.44	0.62	0.46	11th
16.	Monetary Incentives	0.44	0.64	0.60	0.56	7th

Management's views (Table 2) on the first five clogs impeding construction productivity on sites were a bit similar to the craftsmen's ranking in this regard except Clog Serial Numbers 10 and 1 that were interchanged. For instance, the five most ranked clogs by the management in the three categories of construction firms used for the study were: inadequate/lack of tools and equipment (RI = 0.78); materials shortage (RI = 0.74); rework (RI = 0.72); inclement weather (RI = 0.70); and fatigue (RI = 0.68).

Table 2: Relative Index of Clogs Impeding Craftsmen's Productivity on Construction Sites in Southwestern Nigeria (Management's Responses)

S/N	Factors (Clogs)	Large Firms	Medium Firms	Small Firms	All Firms	Rank

1.	Material Shortage	0.71	0.73	0.77	0.74	2nd
2.	Incomplete Drawings	0.46	0.47	0.47	0.47	15th
3.	Poor Supervision	0.62	0.65	0.65	0.64	7th
4.	Inadequate/Lack of Tools and Equipment	0.73	0.79	0.82	0.78	1st
5.	Workers' Absenteeism	0.49	0.49	0.50	0.49	14th
6.	Poor Communication/Instruction Time	0.55	0.56	0.56	0.56	11th
7.	Fatigue	0.66	0.69	0.70	0.68	5th
8.	Poor Site Layout	0.43	0.45	0.44	0.44	16th
9.	Inspection Delay	0.60	0.63	0.64	0.62	8th
10.	Rework	0.70	0.72	0.75	0.72	3rd
11.	Interference	0.64	0.67	0.68	0.66	6th
12.	Inclement Weather	0.68	0.70	0.73	0.70	4th
13.	High Rate of Labour Turnover	0.58	0.61	0.62	0.60	9th
14.	Level of Craftsmen's Skills	0.50	0.51	0.51	0.51	13th
15.	Sophistication of Mechanization	0.53	0.53	0.54	0.53	12th
16.	Monetary Incentives	0.56	0.58	0.59	0.58	10th

Others, which are almost different in ranking by the craftsmen, include the following: interference (RI = 0.66); poor supervision (RI = 0.64); inspection delay (RI = 0.62); high rate of labour turnover (RI = 0.60); monetary incentives (RI = RI = 0.58); poor communication/instruction time (RI = 0.56); sophistication of mechanization (RI = 0.53); level of craftsmen's skills (RI = 0.51); workers' absenteeism (RI = 0.49); incomplete drawings (RI = 0.47); and poor site layout (RI = 0.44). There was a consensus of opinions among the three site categorizations and the two categories of respondents on the least rank accorded poor site layout. Investigations revealed that this challenge was hardly being encountered on construction sites by them, hence, the lowest premium attached to it.

CONCLUSION

The clogs impeding craftsmen's productivity have been identified and the premiums accorded each of them by the two categories of respondents (craftsmen and management) surveyed have also been highlighted. In an attempt to have an improved productivity from the two types of craftsmen (bricklayers and carpenters) studied, the following are advocated: lack/use of obsolete tools and equipment on construction sites in the three sites categorizations should be discouraged; avoiding persistent rework on construction sites by issuing out right instructions to the operatives (craftsmen) from inception and clients sticking to the original site drawings. Also, a vibrant material supply unit and automation of the material unit will help in reducing the material challenge on sites. Provision of protective devices is sure pathway for reducing the effects of inclement weather on craftsmen in the three categories of construction sites. Craftsmen should also be allowed to make effective use of their 1-hour rest (break) period each day in order to recuperate well and regain lost energy. Moreover, undue interference by superior officers and issuing of persistent instructions upon counter instructions to craftsmen on sites should be discouraged if productivity is to increase.

This paper has restricted its study to clogs impeding productivity of bricklayers and carpenters in southwest Nigeria. It will however be worthwhile for further studies to be conducted on other regions of the country and Africa as a continent for comparison's sake. Also, the application should be tested on other categories of craftsmen in the construction industry for a wider acceptability.

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ASSESSMENT OF THE TRIP PATTERN OF HIGH DENSITY RESIDENTIAL ZONE IN NORTH CENTRAL NIGERIA: GENDER PERSPCTIVE

[1]Busari Ayobami A.
Department of Civil Engineering
Covenant University
Ota, Ogun State, Nigeria
Ayobami.busari@covenantuniversity.edu.ng

[2]Tenebe Imokhai.I., [2]Gideon Adeyemi
Department of Civil Engineering
Covenant University
Ota, Ogun State, Nigeria

[2]Adekalu Kenneth A., [2]Oniemayin Babatunde I.,
[2]Ofuyatan Olatokunbo M., [2]Bamgboye Gideon O.,
[2]Emenike PraiseGod C.
Department of Civil Engineering
Covenant University
Ota, Ogun State, Nigeria

Abstract—**Low income earners constitute a large percentage of the nation's population with a significant percentage of the female gender. This study elucidates the germane factors affecting the modal choice of low income household in Nigeria with special focus on the female gender in Okene, Kogi state. To achieve this, questionnaires were distributed to respondents in the study area using 1 in 15 dwelling units. It was buttressed with the use of focus group discussion method. Information on socio-demographic characteristics, trip pattern, modal split and frequency of trips were analyzed with the aid of statistical tools. The result of the research showed that the trip pattern of the female gender is higher than the male. Conversely, male gender frequency of trip is higher than the female with 59% and 41% respectively. Income was found to be the significant factor affecting the choice of mode among the female gender in the study area. The result of this research will aid government at all levels in providing an effective mass transit scheme to cater for the high density residential dwellers with special focus on the female gender.**

Keywords—Mobility; frequency of trips; High density residential zone; modal split; female gender.

INTRODUCTION

Transportation and mobility is as old as humanity itself. It is one of the basic needs of humanity for survival. Mobility can be defined as the travel behaviour measures majorly categorized as daily or weekly trip which could also be motorized or non-motorized trip that is related to distance (2). There exist a relationship between land uses and travel characteristics.(3)Showed the relationship between trip pattern and work trip of both female and male gender. Women trip pattern is quite different from their male counterpart in most nations. In the developed world, men are considered to have a high trip pattern than female according to (1).

Study by (4) showed the relationship between trip pattern by focusing on shopping trips in urban centre. (5) studied travel mode within university environment which showed that travel modes in the university environment should be made to be more gender friendly especially in the government owned university where the transportation systems were constructed in era where the female gender were grossly underrepresented in the university system.

Also, the size of settlements to a very large extent affects the range of local jobs and services that can be supported and this influences the range of public transport services which can be provided. Densely populated areas are prone to people who tend to travel shorter distances and they spend less time travelling on average (6)(7)(8). Studies by (9)(5) showed the effect of land use and how income and car ownership affects both work trips and non-work trips in Akure. There exist dearth's of literature on mobility using gender approach which becomes necessary in a bid to forecast the trip generation of a city considering female gender as they constitute a large proportion of Nigeria's population. Mobility limitations have so many adverse effects from the health angle. Accordingly, built environment also have an effect on trip pattern according to research by (1)(10). Nigeria as a nation has a high percentage of the poor in which the female gender contributes a very high percentage according to (5). Hence this study will elucidate the trip pattern of female gender in Nigeria with special focus on Okene, Northern Nigeria.

METHODOLOGY

A. Study Area

Okene is the administrative headquarter of Igbira ethnic group located inKogi state, south-central Nigeria. It lies at the intersection of roads from Lokoja, Kabba, Ikare, Ajaokuta,

and Anchi. The town was originally founded on a hill near the present site; it lies in the valley of the Ubo River, which is a minor tributary of the Niger River. The people of Okene are mostly Cotton weavers which are a traditional craft, and the women folks are known for their weaving of imported silk (11). The LGA has an area of 328 km ; the last population census conducted stated that the LGA has 320,260 people (Figure 1).

Figure 1: Map of Kogi State showing Okene

B. Sampling procedure and strategy for data collection

Questionnaires were distributed in the study area for six months. The question entails the socio economic and demographic characteristics of the study area. Information on trip pattern was also studied to show the relationship between frequency of trips, per capita trip etc. of the female gender. One in fifteen dwelling unit was adopted based on the population of the study area. The focus group discussion was done during the women meeting in the area (both business and religious gathering).

C. Data Analysis

This research was analyzed with the aid of SPSS version 16, tables and curve were presented to show the relationship between the studied variables.

RESULTS AND DISCUSSION

- *Focus Group Discussion Result*

Based on the result of the focus group discussion, the high density area is mostly inhabited by the low income earners. This residential zone is the domain of the core inhabitant of Okenne. They are mostly occupied by the Igbira tribe of kogi state. The discussion showed that most of the dwellers are artisans, farmers, traders, house wives and the aged. In a bid to a randomly selectthe sample size, the business or traders group meeting did not captured the educated female so religious group was alsoused. The result of the focus group discussion showed that the women gender are often times low income earners and possess fewer cars than the male counterpart as asserted by (12).

- *Frequency of trips*

The work trip pattern of the male gender showed that it is a little bit higher than the female work trip pattern with 59% and 41% respectively Figure 2. Conversely, female gender accounted for the highest frequency of non-work trip. Correspondingly, the female gender has the highest aggregate frequency of trips. On the overall they embark on more trips. Also majority of the female are low paid (Fig 3).

- *Gender disparity in income and mode of transportation on work trip pattern*

The result of the Levene's Test for Equality of Variances and t-test for Equality of Means however confirms that the observed differences in monthly income, work trip and mode of transportation were not significantly different among the male and female participants. Only income significantly affected the trip pattern of the respondents.

- *Mode of transport on non-work trip pattern*

It was further observed from the Levene's Test for Equality of Variances and t-test for Equality of Means in the independent samples test that there were no significant differences in non-work trip and mode of transportation among the gender components as evidenced from the result in table 1.

The Focus Group Discussion showed that the most significant mode of transportation of the female gender is taxi compared with male gender that mostly adopts the use of motorcycle. Taxi as transportation mode in Okene is readily available but lacks flexibility. As a result a significant number of the female gender either adopt the use of motorcycle or walk. Nevertheless, based on the cost, high percentages of the respondents adopt the use of walk especially for recreational trips. Income was stated as being an important factor in determining the modal choice. This may be due to the fact that the male gender are highly paid than the female and they engage in more lucrative jobs that the female gender. This discussion further showed that majority of the female gender are either house wife (without a job), petty traders who work from home and this significantly affected the work trip pattern.
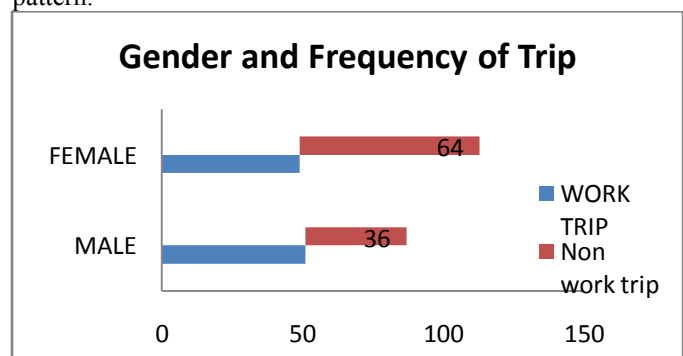
Figure 2: Relationship between gender and frequency of trips
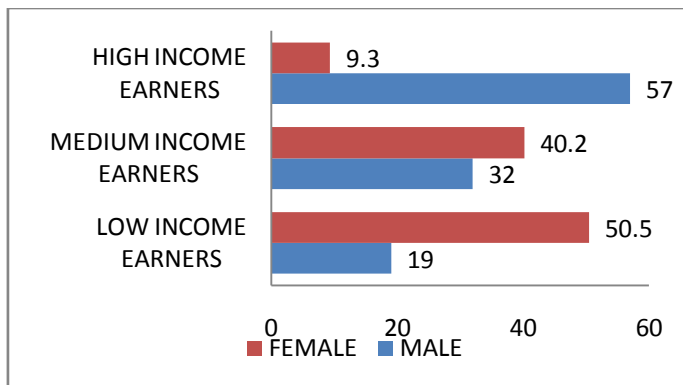
Figure 3: Relationship between income and gender

Table 1: Non Work Trips Levene's Test for Equality of Variances for Non Work Trip and Work Trip.

Non Work Trip		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*
Monthly Income	Equal variances assumed	0.016	0.899	0.01	28	0.992	0.005
	Equal variances not assumed			0.01	26.621	0.992	0.005
Work trip	Equal variances assumed	0.311	0.051	-0.28	28	0.782	-0.036
	Equal variances not assumed			-0.275	24.164	0.786	-0.036
Mode of transportation to the place	Equal variances assumed	0.026	0.872	-0.434	28	0.667	-0.249
	Equal variances not assumed			-0.435	26.077	0.667	-0.249
Non Work Trip		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*
Monthly Income	Equal variances assumed	0.016	0.899	0.01	28	0.992	0.005
	Equal variances not assumed			0.01	26.621	0.992	0.005
Work trip	Equal variances assumed	0.311	0.051	-0.28	28	0.782	-0.036
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Mode of transportation to the place	Equal variances assumed	0.026	0.872	-0.434	28	0.667	-0.249
	Equal variances not assumed			-0.435	26.077	0.667	-0.249

CONCLUSION

The result showed that female have the highest frequency of trips on the aggregate but lower frequency of work tripcompared with the male gender. Income was found to be a significant factor affecting the frequency of trips and modal choice. From the Levene's Test for Equality of Variances and T-test for Equality of Means in the independent samples test showed that there were no significant differences in non-work trip and mode of transportation among the gender components.

RECOMMENDATION

The result of this research showed that income is a significant factor affecting the trip pattern, modal split and frequency of trip of the female gender. Government at all levels should provide a low cost transportation facility to cater for intra city trips of the female gender because they have the highest frequency of trips.

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AUDIT STANDARDS AND PERFORMANCE OF AUDITORS': EVIDENCE FROM NIGERIAN BANKING INDUSTRY

Eluyela Damilola Felix and Ilogho Simon Osiregbemhe
Department of Accounting School of Business, College of Development Studies
Covenant University, Ota Ogun State, Nigeria
trendy_felix@yahoo.com
silogho@gmail.com

Abstract

The study address the issue of auditors' performance and audit standards in Nigerian Banking Sector and the understanding of issues surrounding the way and manner that Nigerian auditors' carry out their work. As a result of issuing qualified audit report in the Nigeria financial institutions, billions of naira has been lost by many bank owners and customers due to the negligence of the auditors'. Therefore, the aim of this study is to assess the influence that audit standards has on performance of auditors' in the Nigerian banking sector. The study uses both primary data in form of questionnaires and secondary source of data, previous articles and journals where reviewed on audit standards and auditors performance. The findings used pearson correlation to show the relationship between audit standard and auditors' performance. The study brought to the limelight the positive relationship that exists between audit standards in general and auditors performance in the Nigerian banking industry. Also, there are so many critics to the International Auditing Standards. The study therefore recommends more clarifications and interpretations to this standards to help improve the performance of auditors.

Keywords—Audit Standards, Audit Quality, Audit report and Auditors' performance.

1.0   Introduction

The auditing profession is guided in standards. Whether issued by the international or local bodies, the outcome of the standards is to have an impact on the activities and behaviour of auditors, (Robert, 2013:4). We generally presume that all of these standards improve the quality of financial reporting. While many will take this perspective as an article of faith, it is still worthwhile to ask: Do auditing standards matter? The purpose of this paper is to provide some insights into that question based on an interpretation of existing theoretical and empirical research in auditing standards.

The International standards on Auditing (ISA's) have been developed to complement practices of auditing among various countries and these standards are to be used when there are no standards developed locally. On July 2006, Nigeria Standards on Auditing (NSA) issued 9 standards. However, it's compulsory for all business establishment listed on the stock exchange market, like NSE (Nigeria stock exchange) to comply with these standards.

However, the compliance with the general audit standards (International Standards on Auditing and Nigeria Standards on Audit standards) have been violated by many professional Auditors in Nigeria, as seen in (Akhalumeh & Ohiokha, 2013). Based on this background, this paper address the issue of auditors' performance and audit standards in Nigerian Banking Sector and the understanding of issues surrounding the way and manner that Nigerian auditors' carry out their work. To this end, this paper intend to discuss the following research questions: What role does audit standard plays in performance of audit work? Therefore, the structure of the paper is as follows. In the second section of the paper we develop the literature review of previous studies. The third part describes the empirical data collection method used for the analysis. The fourth part presents the empirical results and analysis. Finally we present a discussion, our conclusions and suggestions for future research.

2.0   Literature Review

The banking sector has witnessed a lot of crisis for some years now and a lot of attention has been directed to the auditors and accountants role in these industry. Accountability and Transparency is one of the code of ethics of Accounting and Audit profession which all Accountants and auditors must strictly adhere to. This may help in detecting financial irregularities on many company and thereby revealing any case of fraud in the company. Nevertheless, many scholars have opined that professional accountants have engaged their skills and experience to cover and encourage illegal practices as seen in the literature, (Sikka, 2008a). Take for instance, The Accounts falsification of Afribank Plc was said to have been to the negligence of Akintola Williams and Deloitte (AWD), also the overstatement of Cadbury Nigeria Plc profit was

deliberately done by them. (Bakre, 2007) as cited by (Musa, Success, Iyaji, 2014) said that between the year 1990- 1994, the Nigerian economy has lost more than N6 billion ($42.9 million) to fraud and this has been within the banking sector alone.

Every standards issued are means to an end itself. They can also be used as tools of instructions that helps in the overall achievement of the organisation goals and objectives. Igbinosun (2011) defined Auditing standards as a number of rules accepted by the profession as guidelines to measure transactions, event and circumstances which affect financial results and financial information supplied to beneficiary parties". Every audit standards should be applicable and appropriate to the objectives of the audit. To this end, every standards must satisfy 4 criteria, these are: acceptability, consistency, suitability and relevance. Between 1980 to 1991, the Auditing Practices Committee (APC) was the standard setting body issuing various auditing standards. Later APC was succeeded by Auditing Practices Board (APB) and they issue the Statement of Auditing Standards.

Standards on Auditing always guide in setting the minimum standard for technical proficiency level. Regardless of the types, Objectives (whether it's for profit or not for profit) and size of the organisation, all audit standards are applicable to the independent auditor based on the audit of the financial statement of the company. At the end of the audit engagement, the auditor will be expected to present a report to the users and shareholders of the company in form of the audit report. In this audit report, the suitor must inform the users that the audit has been carried out in accordance with specified auditing standards. This standards help to provide guidance on the required minimum level of care expected from the auditor in the audit engagement, (Gill & Cosserat, 2000).

Schulte (2007) also states that when the conduct of an auditor is in question in legal proceeding, it is not the province of the auditing profession itself to determine what is the legal duty of auditors or to determine what reasonable skill and care is required to be exercised in particular case, although what others do or not what is usually done is relevant to the question of whether there had been a breach of duty. The court may decide that the standards are deficient. To meet changing business conditions and expectations, auditors should review and update their practices and procedures." The greater harmonization and rise in comparability of financial statements can be increase by IAS.

2.1 Agency Theory

Agency theory suggests that the firm can be viewed as a nexus of contracts (loosely defined) between resource holders (Nwanji, 2007). An agency relationship occurs wherever one or more persons, called principals, hire one or more other persons called agents, to carry out some specific service and then delegate decision- making process to agents. This theory

is interested in Agency Conflict (conflict of interest) that exist between the principal and the agent, and also corporate governance and business ethics. From the Ethicists point of view, "it is pointed out that the classical version of agency theory assumes that agents (that is, managers) should always act in principals (owners') interests. However, if taken either the principals interest are always morally acceptable ones or manages should act unethically in order to fulfill their "contract" in the agency relationship. Poor Understanding of agency theory and its application has led to the bad practice of corporate governance in the recent failure of banks. This led to the aim of this study.

3.0 Methodology

This study make use of Pearson Correlation coefficient to test the relationship between audit standards and performance of auditors. This has been successfully used in prior studies (Bakre, 2007; Igbinosun, 2011; Musa, Success and Iyaji, 2014). To aid this work, the geographical coverage includes Western part of Nigeria, specifically Lagos state, because most bank headquarters are situated in the state. The population for this study consists of all the twenty-one banks in Nigeria that are involve in the preparation and presentation of financial statements. For the purpose of validity and reliability, ten banks was selected for sample size. The sample size were selected using convenience sampling based on costs and proximity of the researcher. This banks are selected based on their stability, profitability, and spread of network, customer base and deposit. Eighty questionnaire were distributed to the stakeholder of the banks and sixty were returned back. The stakeholders are bank customers and bank staffs.

4.0 Findings

The Pearson correlation was used for to test the relationship between Audit Standards and audit report. This was validated by (Bakre, 2007; Igbinosun, 2011; Musa, Success and Iyaji, 2014). The study shows there is a strong positive correlation between the two variables. The study findings is in agreement with Ohiokha & Akhalumeh (2013), they said that there is a positive correlation between auditing standards and performance of auditors. They carry out their study on the manufacturing sector that are listed on the stock exchange.

The results in the table below shows a descriptive analyses of the data used for this study. The International Auditing Standards (ISA) has been proven to be quality, as noted by (Bakre, 2007; Igbinosun, 2011; Musa, Success and Iyaji, 2014). From the results of the study, it shows that there is a positive correlation of 0.90. The results also show that auditors comply with the all relevant standards. This is in relation with the Agency theory used in this research work.

5.0 Conclusions and Recommendations
The study evaluate the relationship between audit standards

and performance of auditors in Nigeria banking sector. General observation has been directed towards the basic role of audit which has move from the pretentious condition that all the company funds are duly accounted for, and also audit work provides assurance services to the management of an organisation whose investors may be interested in. So, there is a need for standards setters to improve and work on this standards.

The policy implication for this study show that there are so many critics to the International Auditing Standards issued by International Audit and Assurance Standard Board (IAASB). The study therefore recommends more clarifications and interpretations to this standards to help improve the performance of auditors.

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APPENDIX

Correlations

		STD.QUA	COMPL.Q	I.A	ADHERENCE	KNOW.BASE	APP.RENUM	APPRO.MEA.RISK
STD.QUA	Pearson Correlation	1	-.165	.168	-.183	.413**	.666**	.117
	Sig. (2-tailed)		.207	.199	.162	.001	.000	.375
	N	60	60	60	60	60	60	60
COMPL.Q	Pearson Correlation	-.165	1	.069	.314*	.101	-.171	-.394**
	Sig. (2-tailed)	.207		.598	.015	.441	.191	.002
	N	60	60	60	60	60	60	60
I.A	Pearson Correlation	.168	.069	1	.045	-.192	.209	-.127
	Sig. (2-tailed)	.199	.598		.730	.141	.109	.333
	N	60	60	60	60	60	60	60
ADHERENCE	Pearson Correlation	-.183	.314*	.045	1	.203	-.230	.006
	Sig. (2-tailed)	.162	.015	.730		.120	.078	.963
	N	60	60	60	60	60	60	60
KNOW.BASE	Pearson Correlation	.413**	.101	-.192	.203	1	-.039	.090
	Sig. (2-tailed)	.001	.441	.141	.120		.767	.494
	N	60	60	60	60	61	60	60
APP.RENUM	Pearson Correlation	.666**	-.171	.209	-.230	-.039	1	.020
	Sig. (2-tailed)	.000	.191	.109	.078	.767		.879
	N	60	60	60	60	60	60	60
APPRO.MEA.RISK	Pearson Correlation	.117	-.394**	-.127	.006	.090	.020	1
	Sig. (2-tailed)	.375	.002	.333	.963	.494	.879	
	N	60	60	60	60	60	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 1

Where:
Std.Qua= Standard Quality
Compl.Q= Compliance Quality
I.A= Internal Audit
Adherence= Adherence to rules
Know.Base= Knowledge base
App.Renum= Appointment and Remuneration
Appro.Mea.Risk= Appropriate Measure Risk

Development Of A Predictive Model For Productivity In A Beverage Company In Oyo State

Onawumi, A. S.
Mechanical Engineering Department,
Covenant University, Ota. Nigeria.
ayodele.onawumi@covenantuniversity.edu.ng
Ajayi, O. O.
Mechanical Engineering Department,
Covenant University
Ota. Nigeria.
oluseyi.ajayi@covenantuniversity.edu.ng
Adelodun O.A.
Mechanical Engineering Department
Ladoke Akintola University of Technology
Ogbomoso, Nigeria
oluwaaseunimisi@gmail.com

Abstract— **Productivity is a key measurable performance index which finds it application in all sectors of human endeavor. Production system is not an exception as significant flow of resources takes place throughout the life of its output. However, it is quite tasking for many organization to come up with a reliable evaluation matrix as efforts are made to improve upon the traditional method of estimation. In this study a computer assisted measure was deployed in the development of appropriate predictive model for determining the productivity of a Beverage Company considering the economically dependent variables of costs of safety and labour. Computer code was developed into productivity calculator for labour productivity and profit determination using MATLAB programming platform. The model was subsequently trained and validated to a significant level of p = 0.5 using relevant records gathered from the company. The predictive calculator has the capacity to assist decision makers in the planning and controlling scarce resources - in the beverage companies and related production firms- which characterizes the current economic situation in Nigeria.**

Keywords— Productivity, Safety. Predictive model, Computer program, Resource management

I. INTRODUCTION

Nigeria is a country believed to be fast growing in industrialization which is a good development as it creates job opportunities. However, productivity of workers is a subject of concern since there are no complete automated systems. Productivity is the effective and efficient utilization of available resources in generating desired output (Spring, 2011). A scenario is that of cement industries in Nigeria where the exhaust end do spread into the atmosphere, a toxic dust which is poisonous to humans. This toxic waste could have been precipitated and serve as a byproduct reusable within cement production process (Key, 2013). The lack of quantitative means of evaluating and monitoring labour productivity has led to a fall in profit gained in manufacturing companies. The statistics of World Health Organisation states that 160 million has work-related illnesses and 268 million involved in non fatal workplace accidents (ILO, 2005). This will adversely affect the final output of employees. Thus, a need to look into developing user-friendly software which can serve as managers' tool for predicting at a glance, what labour productivity will look like from system safety dimension as determinants..

II. LITERATURE REVIEW

The general belief by firms that investing in safety is a cost has negatively affected the productivity and competitive power of affected industry because high accident rate do deteriorate human capital (Fernadiz-Muniz, Montes-Peon and Vazquez-Ordas, 2009). In other words, there is a feedback on the financial productivity. The food and drink processing industries are in many ways the manufacturing sector which is most fundamentally linked to human existence (Tumoda, 1993). Repeated needs to stand for long hours in a refrigerated room add to the risk of strains in elbow and wrist. Respiratory disorders, frostbite and rheumatic disorders are what workers can also suffer from. Workers in high temperature environments are exposed to the risk of burns. All of these have consequential effect on productivity of workers.

Productivity measurement is a pre requisite for improving productivity as it helps to know a progressing organization in their maximal utilization of available resources (Spring, 2011). Productivity measurement has been a challenging concern for theorist, experts in productivity and industries for over ninety four years now. Thus, the phenomenon has gone through different iterations resulting in various models (Jeremy, 2011).

Table 1: Productivity Indicators

Indicator	Formula	What it measures
Labour Productivity	$\dfrac{ValueAdded}{Numberofemployees}$	Efficiency and effectiveness of employees in the generation of value added
Sales per employee	$\dfrac{Sales}{Numberofemployees}$	Efficiency and effectiveness of marketing strategy
Value -added – to- Sales ratio	$\dfrac{ValueAdded}{Sales}$	Proportion of sales created in organization over and above purchased material and services
Profit-to-Value Added Ratio	$\dfrac{Operting\ \Pr ofit}{ValueAdded}$	Operating profit allocated to the providers of capital as a proportion of value added
Labour Cost Competitiveness	$\dfrac{ValueAdded}{LabourCost}$	Efficiency and effectiveness of the organization in term of its labour cost
Labour Cost per employee	$\dfrac{LabourCosts}{Numberofemployee}$	Average renumeration per employee
Capital Productivity	$\dfrac{ValueAdded}{FixedAssets}$	Efficiency and effectiveness of fixed assets in the generation of value added

Source: Spring 2011

According to Rifat (1996), Neural Network possessed variety of tools for optimization, predicting, approximation pattern and modeling. It is however advisable to combine the use of both model fitting and statistics for complex real world applications. Factor model was used for predicting daily productivity as:

$$PDP = \alpha + \beta_1 - \beta_2 + \beta_3 + \omega + \theta + \lambda_1 C + \lambda_2 C^2 + \lambda_3 C^3$$

where PDP is Predicted Daily Productivity; α is constant term representing standard conditions; β_1 is work type coefficient; β_2 is physical element coefficient; β_3 is design detail coefficient; ω is construction method coefficient; θ is weather zone coefficient; C is crew size; $\lambda_1, \lambda_2, \lambda_3$ are corresponding coefficients for crew size term.

Davis (1994) developed a productivity forecast model for packaging operation of a pharmaceutical firm making use of factors involved in computing productivity index. This author opined that all labour elements having evident impact on productivity should undergo systematic analysis. This model enables supervisors to guess and test productivity consequences when direct and indirect labours are differently combined.

III. RESEARCH METHOD AND MATERIALS

A beverage production company was used for the study being a common example of small enterprises available. This was a good representation of the manufacturing industry since it is a general belief that small enterprises don't take system safety serious. Also, such a company becomes necessary to study as the country encourages sustainability of small scale businesses.

The primary source of data for this study was from first-hand information gathered from companies' records. These records allowed monitoring changes in the behavioural pattern of the subject matter to be predicted or studied over time since the records gave history of the subjects investigated as well as internal and external factors affecting the trend. Hence, data concerning costs of input and costs of output were collected and analyzed to get the Value Added per employee in calculation of Labour Productivity.

i. Computer program development

The implementation was done with Matlab R2013, the syntaxes are however compatible with earlier version of Matlab. Matlab's NN (NN means Neural Network) tool is a powerful AI toolbox designed in Matlab. NN Toolbox for applications such as data fitting, pattern recognition, clustering, time-series prediction, and dynamic system modeling and control. Computer codes were written for the model to be developed. Twelve model equations were generated from this. The model equations were synchronised to develop predictive models for predicting profit and labour productivity from records of Safety training expenses, Medical expenses, Number of employees and Direct labour cost for the past six consecutive years (2009-2014).

ii. Computer program validation

The validation of neural network predictions come from supplying the network with the same problem with which it was trained and checking its deviation from the actual value. This was done using the data collected for the years 2009 - 2014 serving as historical data as presented in Table 2. The figures 1a and 1b shows the validation plots.

Table 2: Data collected between the years 2009 to 2014

Year	Safety Training (#)	Medical Expenses (#)	DirectLabour Cost (#)	Number of employees
2009	100001000	3005110	2100050	155
2010	102020603	4570052	2303180	164
2011	124502400	1421170	3005507	155
2012	153021107	412819.25	4264535	155
2013	183420324	410349.32	2300507	150
2014	170751611	357270.55	3600100	150

It can observed from figure 1a that there was a huge mean square error (MSE).This was suspected to be as a result of falsified data given as historical record or due to lack of proper record keeping process. However, this does not affect the accuracy and authenticity of the model developed.
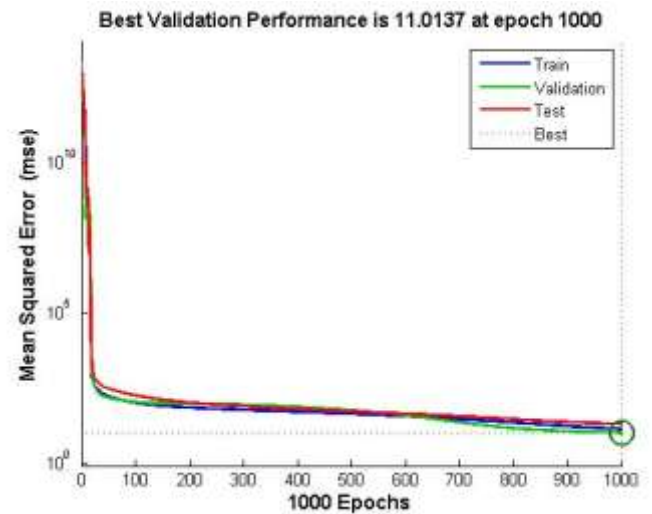
Figure 1a   Plot of best validation performance

IV. RESULTS AND DISCUSSIONS

The Predictive model

The developed program is user- friendly and interactive. It accepts system input parameters from the users through input tabs and dialog boxes on the interface, perform necessary action and produces output. The Table 3 shows the variations between the original values collected and predicted values used in validating the model for reliability. The accurate prediction of this software was evident in the highest percentage error which was 0.09 when original data was compared with predicted value for six years. From the computer predictive software, when other variables are kept constant, medical expenses is inversely proportional to productivity and profit. This means, reduction in medical expenses leads to a rise in both dependent variables. However, the reduction in medical expenses must be a sizeable one else, labour productivity reduces while profit rises.
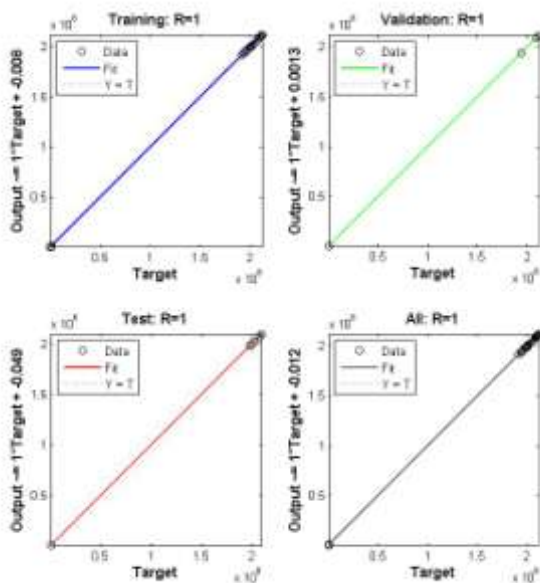
Figure 1b   Plots of training, test and validation

Table 3: Deviations of predicted values from original values

Year	Original Productivity	Labour Prod. Predicted	Percentage Error	Original Profit	Predicted Profit	Percentage Error
2009	4005	4000.72981	0.09	23808	23799.25	0.036
2010	4100	4097.394258	0.06	25253	25252.242	0.003
2011	7641	7637.868879	0.04	72805	72820.107	0.0002
2012	10205	10204.63485	0.003	75600	75600.114	0.00015
2013	7206	7202.28759	0.051	504300	504302.27	0.00045
2014	7005	7008.23646	0.04	212735899	212735523	0.000003

Some of the model equations developed by different relationship of variables

Various model equations resulted from relating the available variables. These are given in equations 1 to 12.

Equation of Labour Productivity against Direct Labour Cost and Safety Training

$$f(labourprod) = 520.2 - 9.462\,Sin\,(0.9881\pi xy) + 0.3225\,e^{(-0.3841y^2)} \qquad 1$$

where x and y are direct labour cost and safety training expenses respectively

Coefficients (with 95% confidence bounds)

Equation of Profit against Direct Labour Cost and Safety Training

$$f(profit) = 12.76 - 4.812\,Sin\,(0.9942\pi xy) + 0.3743\,e^{(-0.1073y^2)} \qquad 2$$

where x and y are direct labour cost and safety training expenses respectively

Coefficients (with 95% confidence bounds)

Equation of Labour Productivity against Direct Labour Cost and Medical Expenses

$$f(labourprod) = 598.1 - 66.49\,Sin\,(0.006052\pi xy) + 0.3655\,e^{(-0.7991y^2)} \qquad 3$$

where x and y are direct labour cost and medical expenses respectively

Coefficients (with 95% confidence bounds)

Equation of Profit against Direct Labour Cost and Medical Expenses

$$f(profit) = 12.6 - 3.256\,Sin\,(0.07443\pi xy) + 0.8209\,e^{(-0.5866y^2)} \qquad 4$$

where x and y are direct labour cost and medical expenses respectively

Coefficients (with 95% confidence bounds)

Equation of Labour Productivity against Direct Labour Cost and Number of Employees

$$f(labourprod) = 483.5 - 21.22\,Sin\,(0.6063\pi xy) + 0.4572\,e^{(-0.6432y^2)} \qquad 5$$

where x and y are direct labour cost and number of employees respectively

Coefficients (with 95% confidence bounds)

Equation of Profit against Direct Labour Cost and Number of Employees

$$f(profit) = 0.09446 + 0.3578\,Sin\,(0.5356\pi xy) + 0.6418\,e^{(-0.0774y^2)} \qquad 6$$

where x and y are direct labour cost and number of employees respectively

Coefficients (with 95% confidence bounds)

Equation of Labour Productivity against Safety Training and Medical Expenses

$$f(labourprod) = 551.9 + 18.31\,Sin\,(0.1328\pi xy) + 0.1524\,e^{(-0.849y^2)} \qquad 7$$

where x and y are safety training and medical expenses respectively

Coefficients (with 95% confidence bounds)

Equation of Profit against Safety Training and Medical Expenses

$$f(profit) = 14.09 + 1.417\,Sin\,(0.5754\pi xy) + 0.01496\,e^{(-0.6189y^2)} \qquad 8$$

where x and y are safety training and medical expenses respectively

Coefficients (with 95% confidence bounds)

V. CONCLUSION

A predictor has been modeled which can predict profit and labour productivity of Beverage Production Industries when medical expenses, expenses on safety training and direct labour cost are taken as known independent variables. Such a managers' tool as this can be useful to small scale enterprises and in turn boost economy of the country as higher productivity means higher revenue for the government.

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Policy Reversals and Economic Development: A View from the Financial Sector

Kehinde Adekunle Adetiloye
Department of Banking and Finance
Covenant University, Ota.
kehinde.adetiloye@coveantunversity.edu.ng

Joseph NiyanTaiwo
Department of Banking and Finance
Covenant University, Ota.
joseph.taiwo@covenantuniversity.edu.ng

Abstract

Developing countries have a variety of market instruments that monetary authorities target to influence the direction of growth of the economy. This paper studies the reversals and manipulations of the market variables of interest rate and exchange rate in the desired direction in which the country should advance. The study employs Granger VAR to estimate the data sourced from WDI and Central Bank of Nigeria. The endpoints targets of Credit to the Private Sector (CPS), Capital Formation and Gross Domestic Product were adopted for the study. The results show that interest rate is more significant in both differenced and non-differenced results. The impact of exchange rate is more evident in capital formation than in the others. Though all the endpoints show a high-level of significance at the overall level, interest rate is more highly significant than exchange rate, and RGDP is the most important for the entire variables as an endpoint. The paper recommends the active management of interest rate first to encourage investment rather than the current practice and for a reduction in the rate. Since the current management of the exchange rate is not sustainable, literature supports the management of the variables within control of the monetary authority while the external variable should be less actively managed.

Keywords: Policy reversal; interest Rate; Exchange Rate; Capital formation; Credit to the private sector; Gross domestic Product

JEL: G1, E5

INTRODUCTION

Financial market main instruments of prices are interest and exchange rates which enable the prices of credits and currency to be set respectively. These are within the ambit of the monetary authorities to manipulate and influence for the betterment and good direction of the macro economy. Depending on the objectives to be achieved either in the short, medium or long term the monetary authorities deploy these instruments to good advantage and the betterment of the economy. The Monetary Policy Committee (MPC) sets the bench mark interest rate in Nigeria as well as influences the price of foreign currency by the sale of the foreign currency.

With the recent change in the monetary policy rate of the Central Bank of Nigeria, policy analysts were aghast at to what direction the CBN was leading the country economically. At a recent monetary policy Committee meeting of the Central Bank of Nigeria, the announcement of an increase in the rate of interest to be 12.00 was made to theperplexed public who believed the interest rates in economy was one of the highest in any financial market. The country has had double digit interest rate deferential for so long. The MPR, being a fulcrum rate around which all other rates gravitate, the central bank just increased the rates up to 12% and that without explanation to the public as it does not owe them one in particular. Lending rates have hovered between 18% (prime lending rate) and 36% in some cases for commercial banks, while the deposit rates remain abysmally low at between 1.5% and 3%. Time deposits commanded between 5% and 8% for very large sums for fairly long period. With the reduction in the MPR some five months before, the public expected the rates to come down, but the lending rates had remained high while the deposit rates had crashed. A one sided effect was thus noticed in the market. Perhaps one of the unexplained reasons is the need to reduce liquidity filtering into the foreign exchange market which is seen to be pulling down the value of the Naira. Thus from the point of lending rate loans had remained constrained while net savings were of short duration within the banks. Thus credit to the economic sectors that require fairly long term lending was also constrained.

This situation is compounded with the export sector's unimpressive performance where the main export of the country dwindled leading to the short supply of main counterpart currency for exchange for imports and for making payments. The situation had driven the price of the dollar through the roof such that in less than one year the Naira lost 28.4 % of its value at the official market and more than 67.5% premium exist between the official and parallel market rates of the currency. Against the backdrop of the scenario is the adroit stand of the government not to devalue the currency and allow

the price affect to hold. Within all these information is the fact that more than $20 billion is held in currency domiciliary accounts with the banks in the country. Simple macroeconomics of exchange rate commends the currency to market depreciation and an official devaluation from the standpoint of the monetary authority. This was not allowed and the high differential continued with the CBN now selling the foreign currency to banks on a selective basis with emphasis on need, having banned a total number of 49 items from its platform. This means that the end-users of foreign currency at this level must seek to purchase at the unpredictable parallel market. Arguments as to what the matter that was amiss was with particular reference to the export performance and other fundamentals. There was thus argument if the monetary–fiscal mix of the country's economy was sound as outlined in Flood and Garber (1984). While the market eagerly awaits devaluation, the CBN has continued to hold on. All this coming from a political terrain that was new. Much with the government posture, it has become difficult for the Central Bank to play the market normally and adjust to the environment.

The main objective of this paper is to study the sudden reversals of the market rates policy of the government to a more rigidly managed regime. The paper intends to study the management of the market rates: the interest and the exchange rates under a managed and fairly fixed structure to uncover which is more important. The paper is structured as follows: Following after this introduction is the literature review on exchange and interest rates reversals in a new governmental structure on both concepts and the Nigerian experience. Next is the methodology and empirical analysis which is followed by the discussions on results and expectations. The fifth section recommends on extant issues and concludes the paper.

LITERATURE REVIEW

Policy changes have been recurring events in most economies around the world and have been the way to shift from one method of public management to the other and a way to move the market in a desired direction by the government. Thus the world has witnessed changes form one form of market to the other: from classical regulation to deregulation and in some countries guided deregulation, socialism to market determined prices, Keynesian to monetarism, public enterprises to privatisations, pure expansionist economies to cutbacks in expenditure and from progressive tax income structures to flatter taxes [1]. With the political environment, policy changes come from the gaps observed in the economy. At the political front, Cuikerman and Tomassi (1998) [2] define policy reversal as a situation in which the unlikely party implements certain unusual policies. Using a Downsian political signalling model, Moen and Riis (2010) [3] show that policy reversal can exist to set an equilibrium phenomenon and voters are likely accept to such reversals as a warranted reaction rather than political extremism.

Policy somersaults or reversals are the sudden change of direction or a complete somersault of a stated direction for which business and other organisations have relied to subsist, by the government or a major regulator in the economy. Policies are in themselves the plan of action to direct sectors of the economy in a manner in which the direction of development is stated. Policy reversals have been undertaken in the matured financial markets that have taken economists and the analysts by surprise and sometimes to the astonishment of the market. Policy reversals, or somersaults or as economically referred to as 'shifts in preferences' in a democracy may imply three things. According to Dur and Swank (1997) [4], voters' preferences may induce a change, which may raise costs or lower benefits upon intervention, and may mean that insufficient information was the basis of the earlier decision. For instance, if an untested policy was hijacked by a few people who are profiting at the expense of the majority, then a reversal in the interest of the people is imminent. Sudden policy changes in democracy can and should occur. Dur and Swank (1997)[4] offer explanations for policy reversals and conclude that most voters and government are by majority rule and who have incomplete information about the aggregate consequences of bundles of public projects (choices) though not all parts of policies are welcome by the voters. A model presented by the study reveals that the winners and losers of policy actions are progressive in the support or withdrawal of support for policies. Winners among uncertain supporters are thus more enthusiastic and vice versa. Thus uncertain voters among the people may initially oppose a project though they may end up winners eventually.

Policy reversals can be deliberately undertaken to smoothen the effects of a policy that where stabilisation policies cannot be optimal with the differences observable in pollution and product economies [5]. Saxonhouse and Stern (2005) [6] introduce the many effects of policy reversals on the Japanese economy where economic fortune of the country has since gone down since 1989 such that the real capital growth rate has gone down from about 4% to 1.05% affecting the economy from the foreign and external trade to central banking as well as financial intermediation within the country. All caused by various policies' somersaults from the fiscal to the monetary authorities.

Coming from the above argument, countries may face serious economic instability when the political environments change, though it is still in practise of democracy. The changes that happen in the political arena may have substantial changes on the economic direction such that the system is affected to seriously impact on the total output of goods and services and even productivity in the system. With the Nigerian type of economy (rent seeking, trading in primary commodities, etc.) plans to shift focus from raw material production to manufactured goods have not been fulfilled and the continuance on the afore-mentioned type of economic management has been more pronounced than any form of change. Barro (1996, 1999) [7,8] reports the early experiences

that a transiting economy may face found variously that the impact of political freedom may produce uncertain outcomes. The increase in political freedom with accompanying choices of available investment may result in limitation on governmental power. In military regimes where questions are hardly allowed and freedom of speech curtailed the experience of business environment may depend so much on the level executive thinking and intelligence.

Gurgul and Lach (2013) [9] extensively study the post-communist European countries and reports that political instability (implying a change in governmental arrangement) hampered the rate of economic growth with major changes hindering economic prosperity and growth of the countries studied, implying that changes in the political sphere is accepted but expected to changes to the expectations of the people on the economy with time. Aisen and Veiga (2013) [10] show empirically by adopting the total factor productivity (TFP) that politically instability is particularly harmful for growth by discouraging human and capital accumulation, but with the highly unstable and fragmented countries need to address the root causes of their problems before growth can expected.

Policy changes are exemplified in the case of South Africa when the apartheid policy changed as from 1994. Faulkner and Loewald (2008) [11] examined various sectors of the South African economy and conclude the role of institutions was important in the growth while greater knowledge, higher level of competition and flows of information were major channels. Literature on policy instability and with government changes are not within reach but the Nigeria situation would provide some insights.

Within the Nigerian environment, evidence from [12] studying the period between 1983 and 1999, indicates that the economic projects that were instituted by the military did not bring salutary developments to the economic sphere of the country. The paper discusses extensively on the programmes rather than projects undertaken. Determinants of success of military governments in Nigeria were adduced to the role of the traditional rulers and to the social institutions that promote the direction of the minds of the people. George, Shadare and Oluyemi (2012) [13] give the military some credits with the identification of the ills of the society at take-over of government but did not address those problems sufficiently. Literature has been less charitable to and has not given much credit to the military in governments in Nigeria. The environment should witness spontaneous growth at the available political freedom and choice that come with democratic government, but Igwe (2010) [14] and Ademu [16] believe that not much has been witnessed in terms of developments in the country, though these studies do not completely agree.

Apart from lags in policy formulation which hamper development and growth, policy implementation has been cited as one of the major changes governance faces in Nigeria.

Ozumba (2014) observes the widening gap between intentions and results of government of polices. A number of the problems were identified and brings out lack of continuity and inability to own projects of early administration. The paper recommends good leadership and governance and elimination of corruption as major issues to be addressed before policies can yield expected results in Nigeria.

Policy reversals are precipitated rather by actions in the economy within which such policy is formulated. The most common reversal not often within control is the capital flows. With regard to the reversal of flows of capital into the economy Bello (2014) [17] confirms the fear that sudden reversals of capital can have negative effect on the Gross Domestic Product, though FDI is seen to more reliable than portfolio flows, which tends to be more fluid. Amos, Ajike and Akinlabi (2014) [18] indicate in their study that policy reversals bring inconsistency to government and makes planning difficult with result of the study using the manufacturing sector as case study. The study finds exchange rate and interest rate most culpable for the dismal performance of the manufacturing sector which has affected the economic growth. The inconsistency in policies makes the business environment more unpredictable and thus long-term planning becomes difficult which comes with enormous costs for the market to transfer to the weak party to bear. Rodrik (1991) [19]had earlier concluded that this is a major challenge for most developing economies as a result of the unstable political environment [20]. Conway (1988) [20] focuses more on private investment in developing countries with key price in the economy such as interest rate to measure the level impact of instability on manufacturing. The study found out that interest was highly significant and import prices insignificant. The other significant variable was export prices and that the most affected sub-sector is the manufacturing.

Developing countries attempt to grow through the passage of financial market liberalisation by the lifting of every form of repression that may be stifling the market thus allowing easy flow of credit form the surplus sectors to the deficit sectors (these include flows from abroad).

Figure 1 **Three Final Development Outcomes (Year on Year per cent change)**
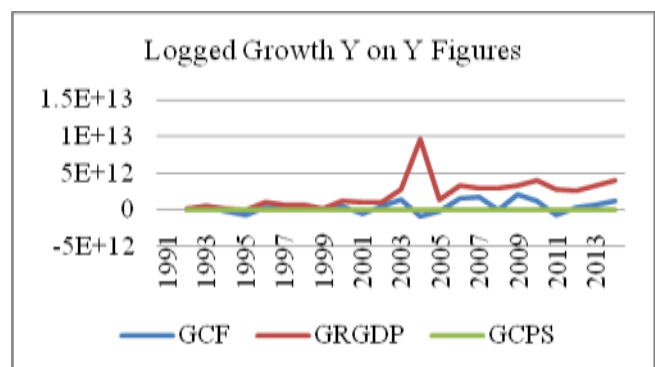
Source: **Data from the World Development Indicators**

Aggregation into the national economy passes through soft targets like the credit to the private sector into the Gross domestic product and into third targets such as capital formation which tends to the accumulation of capital stock for the economy.

METHODOLOGY AND EMPIRICAL ANALYSIS

The paper adopts two key market variables heavily influenced by the monetary authorities: the key interest rates and the foreign exchange rate. The two being prices influence the market transactions for the three different economic units: the government, firm and the household units. The variables adopted for the study also include the primary developmental variables: capital formation (CF), Real Gross domestic product (RGDP) and credit to the private sector (CPS). The market variables adopted are the variants of the (a) interest rates: the interest rate premium is adopted for the analysis and is defined as: *LR – GTR* where L is lending and GT represents Government treasury rates (b) PPPER as purchasing power parity exchange rate between the domestic and counterpart currencies for consumption goods. The complete available years of the data is truncated to 24 years from 1991 to 2014. Data have been varied over the years and this has affected the length of the series of some of the data especially the RGDP and the CF. comparable data for exchange rate differences that can be accounted for Official and Market exchange rate is taken care of by the Purchasing power parity factor. The data is sourced mainly from the World Development Indicators (WDI) and complemented with the Statistical Bulletin of the Central Bank of Nigeria (CBN).

A technique of analysis that best explain the scenarios is Vector auto regression (VAR) estimation processes which help to understand the interrelationships that exist between variables and the shocks introduced into such relationships. This is complemented with Granger causality process which brings further understanding to how each of the variables affects the others

The above is modelled as follows: a VAR process is

$$Yt = \alpha + \sum_{k-1}^{k} A_k \, Y_{t-k} + \sum_{1-0}^{L} B_1 \, X_{t-1} + e_t \qquad (1)$$

Where Yt endogenous variables

- Y_t : a (nx1) endogenous variables (*Intrp, ppper*).
- X_t : a (nx1) exogenous variable : *capform, CPS, RGDP*.
- e_t : a (nx1) residual term.
- A_k : the matrix that measures how endogenous and exogenous variables returns react to their lags.

- B_1: the matrix that measure how *Intrp, ppper* react to the exogenous variable.

A *VaR(p)* model with p variables is written as follows

$$y_t = A_1 \, y_{t-1} + A_2 \, y_2 + \dots + A_p \, y_{t-p} + Bx_t + \varepsilon_t \qquad (2)$$

RESULTS, OUTPUTS AND DISCUSSIONS

The data shows a descriptive of 23 usable observations across which are somehow sufficient for the analysis. Data with large figures are abbreviated and describes as seen below. The standard deviations of that the RGDP and CAPFORM have the highest variability while the INTRP has the lowest followed by the PPPER. Market variables have the maximum for INTRP at 14.5% and the minimum at 2.47%. Minimum over the period for PPPER is 4.57 while the maximum is 99.40. The table is as below.

Table 1 **Descriptive of the Variables**

	INTRP	CPS	CAPFM	PPER	RGDP
Mean	7.116	4297.205	4.6E+12	45.22	3.66E+13
Med	6.315	1096.536	2.94E+12	40.098	2.83E+13
Max	14.576	17128.98	1.06E+13	99.399	6.80E+13
Min	2.473	58.12295	1.97E+12	4.5780	1.96E+13
S. D.	2.820	5671.825	2.88E+12	27.940	1.66E+13
Skew	1.191	1.161985	0.841599	0.4209	0.529228
Kurt	4.477	2.853485	2.089596	2.121	1.783336
J-B	7.535	5.196370	3.509411	1.418	2.492241
Prob.	0.023	0.074408	0.172958	0.491	0.287619
Sum	163.6	98835.71	1.07E+14	1040	8.41E+14
SS.D	174.96	7.08E+08	1.83E+26	1717	6.06E+27
Obs	23	23	23	23	23

Source: Data from the World Development Indicators and the Central Bank

The initial VAR table with two lags (as the criterion chosen) indicates very few significant points for each of the endpoints of market intervention rates. The result shows that the RGDP show a more compact F stat and more significant interaction with the other variables than PPPER with a robust F stat and only one significant variable CAPFORM which is just beyond 0.10. The market INTRP indicates more significant interaction with other variables than PPPER. For instance most the significance level is between 0.05 level and 0.01, especially with CPS and RGDP in both lags.

A Granger-VAR output indicates more with explicit outputs that indicates the direction of the results. The INTPR show a highest granger causality with RGDP and CPS being the next both beyond 0.01 levels and finally with PPPER at beyond 0.01 level but insignificant with CAPFORM. The overall output indicates that the causality with the three variables of interest is beyond 0.01 levels. The PPPER shows an output that indicates that it is lees significant in the adopted endpoint variables, total causality being beyond 0.10 at 0.0607. It shows a strong impact and causality on CAPFOM only at

0.0413 which is beyond 0.05 level and insignificant with the rest of the variables: CPS, INTRP or GDP. All the endpoint variables show some attachment to other market variables. For instance CAPFORM granger causes INTRP at 0.10 and CPS at 0.05 levels but insignificant with PPPER and RGDP. CPS shows that it is significant with RGDP only beyond 0.10 levels. RGDP is however significant with the market variables: with INTRP at 0.04 and PPPER at 0.004. The strength of this causality is understandable and quite clear as the flows of causality indicates where direction is. It is also significant with the other endpoints variables especially with CAPFORM beyond 0.01 (0.004) and CPS beyond 0.05 (at 0.0423). Overall significant of the RGDP show it is beyond 0.01 levels. This is also the overall result for the other variables. Other results are as shown in Tables 2 (a – c). It is generally observed the raw data obtained higher level of significant results than the differenced data, though the results do not indicate any significant differences that can bring about a dissimilar outcome.

Table 2 (a) Dependent variable: CPS

Exclud	Chi-sq	Df	Prob	Exclude	Chi-sq	Prob.
D(INT	2.440	2	0.29	INTRP	0.942	0.62
D(RGDP)	3.558	2	0.1688	CAPFORM	4.507776	0.10
D(CAPF)	4.041	2	0.13	PPPER	0.613	0.73
D(PPP	0.291	2	0.86	RGDP	5.569	0.06
All	14.42	8	0.07	All	30.40	0.00

Table 2 (b) Dependent variable: CAPF)

Exclud	Chi-sq	Df	Prob.	Exclu	Chi-sq	Prob.
D(INT	10.473	2	0.005	INTR	5.303	0.070
D(CPS	17.448	2	0.000	CPS	8.441	0.014
D(PPP	7.355	2	0.025	PPPE	1.947	0.377
D(RG	2.857	2	0.239	RGD	2.953	0.228
All	28.160	8	0.000	All	40.503	0.00

Table 2 (c) Dependent Variable RGDP

Exclude	Chi-sq	Df	Prob	Exclude	Chi-sq	Prob.
D(INT)	3.33	2	0.18	INTRP	6.327	0.04
D(CPS)	2.07	2	0.35	CPS	7.140	0.02
D(CAPF)	7.82	2	0.02	CAPF	12.517	0.00
D(PPP	3.52	2	0.17	PPPE	13.142	0.001
All	9.49	8	0.30	All	21.066	0.007

Source: Data from WDI and Output from the System

The discussion on the result centres on the level of significance and direction. While the market variables are used to influence the direction of credit or attention to the other sectors and the endpoints are what the outcomes are, then the result show a fair impact of the manipulation of interest or exchange rates to impact or influence development of the country. For instance from all indication of these result, the interest rate is more important for management of the economy than the exchange rate. The significant level of the

INTRP is evident on two of the three endpoints: RGDP and CPS, while RGDP causality is on both the market variables as well as the other endpoints, the CPS shows strong causality with only RGDP. PPPER is significant only with CAPFORM and none other. The implication of this is that exchange CAPFORM is linked with the CPS. The complete results are shown as Table 1.

RECOMMENDATIONS AND CONCLUSIONS

The interest rate is the economy affects more business units than the exchange rate which affect the firms importing intermediate inputs. In fact a significant level of importation for consumption which is drawdown on the nation's foreign exchange reserve. The management of the interest rate now is being used to influence the exchange rate as a result of the perceived liquidity in the banking system. The constrain of credit to reduce the demand for foreign exchange may not be best option as causality to exchange rate from interest is not highly significant and no causality exist from credit to exchange rate. Interest rate should rather be used under the present dispensation to attract more investible projects that can add tot eh output and in the process the capital formation in the economy.

Another basic recommendation concerns the premium on interest rate which is the basic price used in this study. The interest rate in the economy is one of the highest in any formal banking system in a developing country. The high rate encourages rent-seeking behaviour from the banks and discourages lending to the productive sectors of the economy. Since the banks can still report profit without much of intermediation to private sector, then a proactive management of interest rate for the purpose of directing credit to the needed sectors of the economy is important.

The exchange rate as presently management is less than optimal as it is not sustainable. The authorities must find a way to reduce currency substitution in the economy which seems to be a reason why the demand is high for foreign exchange. Literature has proved time again that the impossible trinity needs to be controlled from home first before the external relations would find itself in a desirable manner. In this wise it best to manage the interest rate more proactively and manages the exchange rate on a passive basis.

From the foregoing it is quite clear that electoral promises not based on full information might turn out to be disastrous for politicians coming freshly into government. The scenarios in Nigeria follows the Dur and Swank (1997) analyses of sudden policy reversal and somersaults that countries like Nigeria has experienced of recent. The essence of political change is to bring the citizens into a new elixir of life that was not possibly obtainable in the previous administration, which perceivably can be corrected with the new administration that made electoral promises based on incomplete information. Sudden policies reversals of this type might not be easily forgiven by the citizenry.

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Gender Parity of Science Students in Covenant University

Justina A. Achuka, Mojisola R. Usikalu,Marvel L. Akinyemi, Olusola T. Kayode, and Temitope J. Abodunrin.
Department of Physics
Covenant University Ota,
Ogun State, Nigeria
Justina.achuka@covenantuniversity.edu.ng

Oluwafunmilayo O. Ometan
Department of Physics
Lagos State University Ojo
Lagos State, Nigeria

Abstract—**Science is the key to technological and economic development of a society. Over time, science field has been a male dominated branch of study. Advancing women equality in this field of study will influence the world's economy positively. Assessment of gender parity index in tertiary institutions is a tool that will enable the recruitment of female students into the sciences. Ten (10) years of undergraduate and five (5) years of postgraduate students data of Covenant University were used for this study. It was observed that more female opted for biological sciences. The total number of female science students was found to range from 5.0-14.8 %, 6.5-36.7 % and 9.1-50.0 % for first, second and doctorate degree respectively. The result showed 90 % disparity in favour of males for science undergraduate students, 40 % disparity for masters and 90 % for doctorates' students. Strategies to win more female into the sciences should be encouraged.**

Keywords—Science; development; gender parity

I. Introduction

Sciences played a substantial role from the creation of the earth till the development we see in our world today. Scientific inventions and innovations are the manifestations of latent potentials and not gender abilities. World over, increasing women participation in all human endeavours has been encouraged, having realized the contribution of women to economic growth. When girls do better in society, everyone benefit [1]. Literature revealed that where about 57% of the nation's college population are women, less than one-third major in science, technology, engineering or mathematics (STEM) [2]. The study noted that women have the ability but lack the interest. Contrarily, survey by [3] showed that out of girls that are in sciences, most of them are attracted to the life sciences.

According to [4], 85 percent of the measured growth in U.S. per capita income is due to scientific revelation and technological innovation. Inability to reach full mathematical potential jeopardizes future economy [4]. Community initiatives that will birth the best of Sciences should be encouraged. Recognizing and utilizing women potentials has yielded positive result in Saudi Arabia. In 2011, just 1 % of researchers are women but within two years the number has increased to 19 % [5]. She suggested that highlighting women success stories will encourage more female to pursue careers in the sciences. The study by [6] noted that honouring scientist achievements and inclusion of qualified women as speakers at conferences will increase women's overall participation in scientific discourse.

A survey by [7] on female student in U.S College showed that discouragement from school authorities through lack of diversity in teaching approach is responsible for low female graduate in STEM fields. The study by [8] revealed that weaker and unequal positions of women in scientific communities are the worst obstacles discouraging younger women from the sciences. Researcher [9] reported a decline in the number of women earning a bachelor's degree in Physics. She stated that the scarcity of early guidance and mentorship are the major factors. Another Researcher reported that good role models and ignoring stereotypes are powerful driving force in pursuing career in Physics [10]. Research by Organization for Economic Cooperation and Development (OECD) found that girls do worse than boys in mathematics due to lack of self-confidence on the part of the girls [11]. Mathematics anxiety resulting in poor performance by girls has been reported by [12]. Literature revealed that Mathematics phobia is transferrable [13].

Rather than living with the notion that sciences is male dominated field of career, it is time for all and sundry to put up adequate strategies to tap the science abilities in women in order to further advance its usefulness. Mathematics is the engine for a vibrant economy [4]. Harnessing women creativity is a boost to our economy. Therefore, the study was embarked upon to determine the gender parity index of science students at Covenant University in order to develop strategies to win more girls in the sciences.

II. METHODOLOGY

The data used in this study was obtained with approval from the Center for System and Information System of the

University. The records of students who enrolled for undergraduate, masters and doctorate programmes were collected. Ten (10) years calendar session for undergraduate, five (5) years each for masters and doctorate programmes were used. The selection of the sessions for each level of education was based on the researcher's discretion, bearing in mind the full accreditation of such programmes.

The choice of using five (5) core science Departments in the College of Science and Technology was based on the objective of the study. Descriptive method such as mean, ratio and percentages was used to analyze the results. These are presented in tables and figures. The gender parity index (GPI) was calculated using (1).

$$GPI = \frac{No\ of\ female\ enroln}{No\ of\ male\ enroln} \qquad (1)$$

Where GPI = 1 means equal parity; GPI < 1 means disparity in favour of male; and GPI > 1 means disparity in favour of female.

III. RESULTS AND DISCUSSIONS

The result presented in Table 1 showed that more female enrolled for Biological Science programme with 74.2 % for the number of years studied. This can be corroborated with the fact that females in the sciences are attracted to the life sciences courses [3].

The percentage enrollment for Chemistry, Computer Sciences, Mathematics and Physics are 48.3 %, 34.3 %, 35.8% and 20.2 % respectively. These values showed that Mathematics related courses frighten the females. This confirms the study by [12] that girls have higher mathematics anxiety than boys.

According to [2] very few women choose further learning in mathematically based fields. The myth that careers in those field are meant for the male gender is also a factor. More so, Physics is known to be tough and require more hard work, this might be responsible for having the least value.

Figure 1a showed that for ten (10) years running, 90 % of the session had fewer females enrolled for sciences than their male counterpart. Lack of interest on the part of females and inabilities to pay the price to make a career in these fields are major challenge. Study has shown that girls are more interested in careers where they can play the role of helpers and make the world a better place [3]. Furthermore, Figure 1b depict that males pursue higher education than females.

The result presented in Table 2, showed that more female enrolled for Biological Sciences and Chemistry courses at Master's level. The Doctorate programme has Biological Sciences, Chemistry and Computer Sciences having more female enrollment during the study period. The burden of family finance has forced some women to pursue higher degree in order to meet the need of their home. While these categories of women do that, they still opted for the less Mathematics oriented courses in the sciences. This is evident in the gender gap of students who enrolled for Physics and Mathematics programme at the Master's and Doctorate level.

Table 1: Undergraduate students at Covenant University

Degree in view	Session	Course of Study										Total of Science student		Grand total of all students	
		Biological Sciences		Chemistry		Computer Sciences		Mathematics		Physics					
		F	M	F	M	F	M	F	M	F	M	F	M	F	M
UNDERGRADUATES	2005/2006	26	6	10	10	45	53	9	7	1	7	99	83	752	833
	2006/2007	29	7	7	10	37	62	4	9	2	9	79	97	775	784
	2007/2008	43	19	20	14	35	61	6	17	2	20	106	131	855	912
	2008/2009	50	16	19	23	30	70	13	16	11	49	123	174	831	1038
	2009/2010	49	16	17	25	32	85	6	16	10	57	114	199	919	1136
	2010/2011	28	8	14	14	19	45	3	11	15	52	79	130	622	784
	2011/2012	29	9	13	10	34	81	1	7	11	30	88	137	779	1046
	2012/2013	29	10	10	9	21	49	4	1	10	35	74	104	761	964
	2013/2014	18	5	11	8	28	67	3	5	10	37	70	122	729	927
	2014/2015	21	16	9	16	27	17	4	6	14	43	75	158	863	1008
Total	10 Sessions	322	112	130	139	308	590	53	95	86	339	907	1335	7886	9432
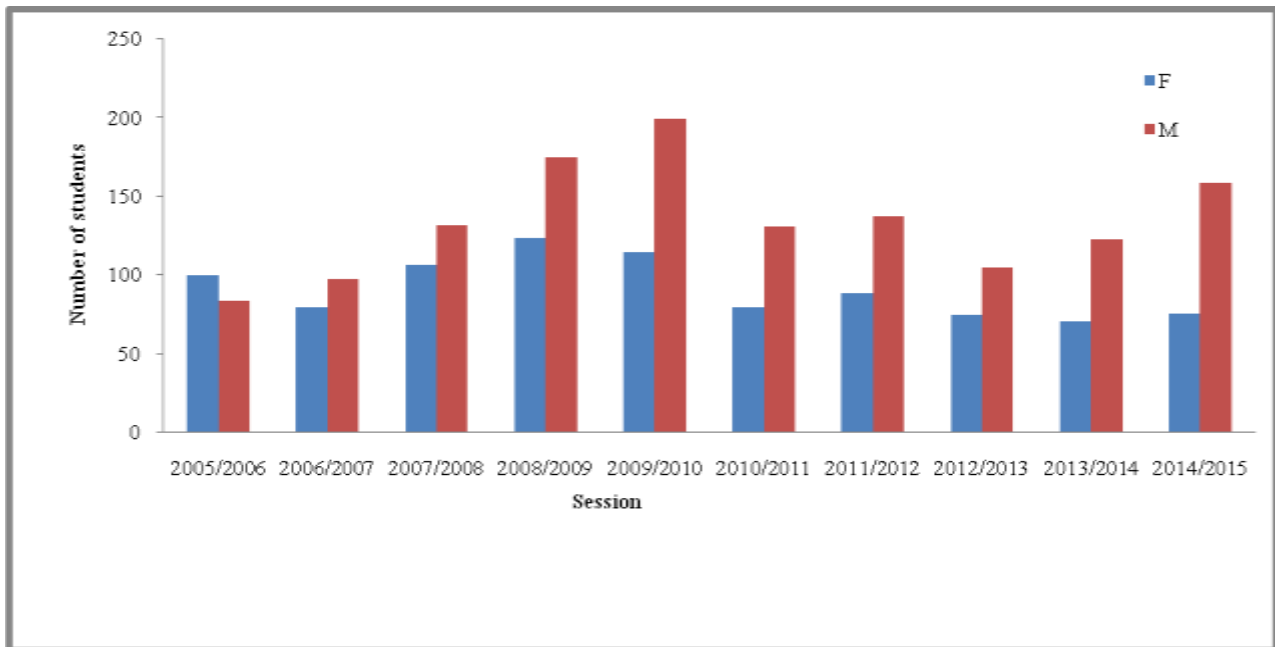
Figure 1a: Total number of undergraduate science students per session
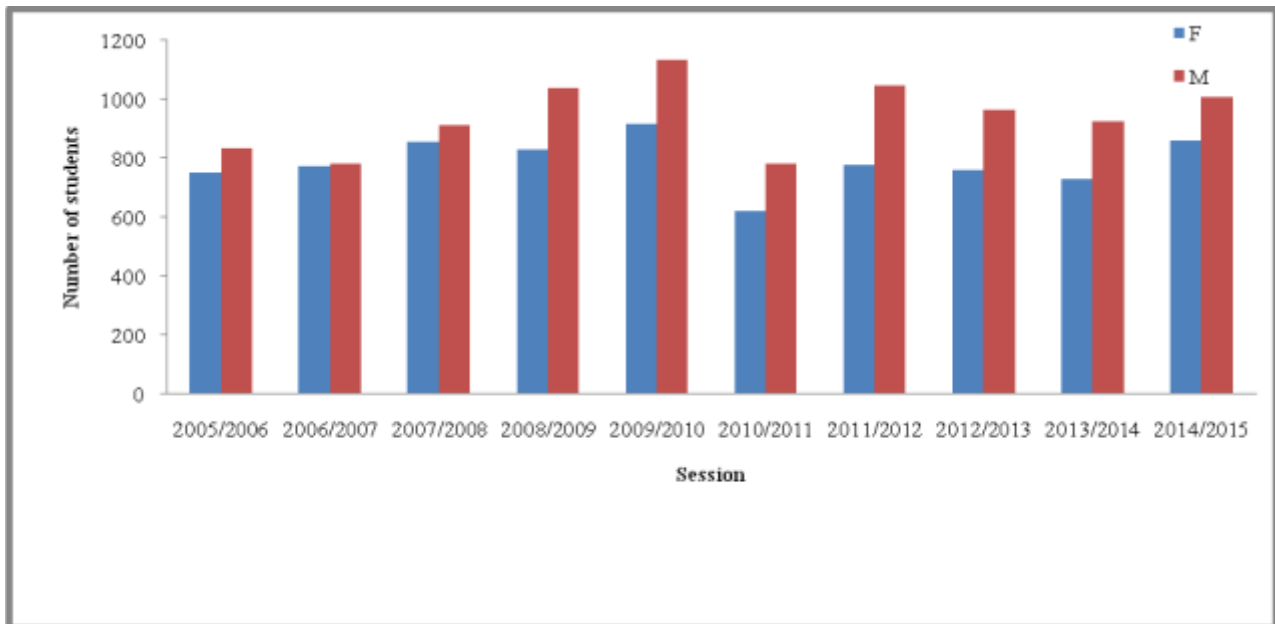
Figure 1b: Grand total of all undergraduate students per session

The result presented in Table 2, showed that more female enrolled for Biological Sciences and Chemistry courses at Master's level. The Doctorate programme has Biological Sciences, Chemistry and Computer Sciences having more female enrollment during the study period. The burden of family finance has forced some women to pursue higher degree in order to meet the need of their home. While these categories of women do that, they still opted for the less Mathematics oriented courses in the sciences. This is evident in the gender gap of students who enrolled for Physics and Mathematics programme at the Master's and Doctorate level.

Table 2: Postgraduate students at Covenant University

Degree in view	Session	Course of Study											Total of Science student		Grand total of all students	
		Biological Sciences		Chemistry		Computer Sciences		Mathematics		Physics						
		F	M	F	M	F	M	F	M	F	M			F	M	F	M
MASTERS	2010/2011	2	1	1	2	3	3	0	1	0	2	6	9	52	58
	2011/2012	11	1	1	1	3	4	0	0	0	2	15	8	63	62
	2012/2013	2	0	0	0	0	3	0	0	0	1	2	4	31	50
	2013/2014	9	6	4	2	3	6	0	0	2	1	18	15	49	58
	2014/2015	6	3	3	3	3	4	1	1	0	2	13	13	101	109
Total	**5 Sessions**	**30**	**11**	**9**	**8**	**12**	**20**	**1**	**2**	**2**	**8**	**54**	**49**	**296**	**337**
DOCTORATES	2010/2011	0	1	2	0	1	0	0	0	0	0	3	1	6	11
	2011/2012	0	0	0	0	1	0	0	0	0	3	1	3	11	22
	2012/2013	2	0	2	0	0	0	0	1	0	2	4	3	17	20
	2013/2014	6	2	1	1	2	1	0	5	2	4	11	13	29	47
	2014/2015	4	3	2	2	1	3	1	8	0	0	8	16	29	75
Total	**5 Sessions**	**12**	**6**	**7**	**3**	**5**	**4**	**1**	**14**	**2**	**9**	**27**	**36**	**92**	**175**

(a)

http://cu-icadi.covenantuniversity.edu.ng
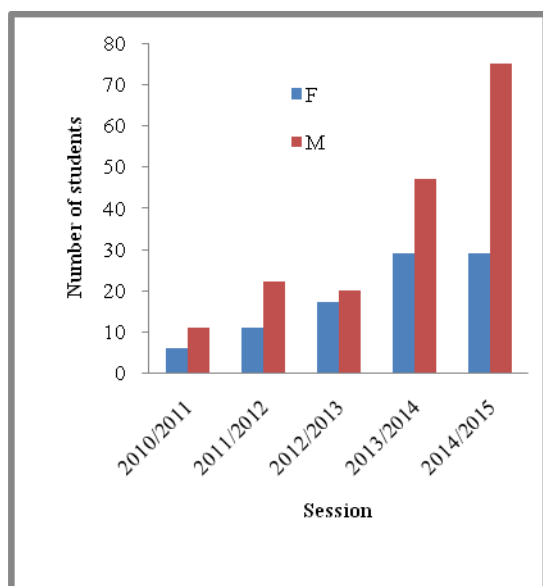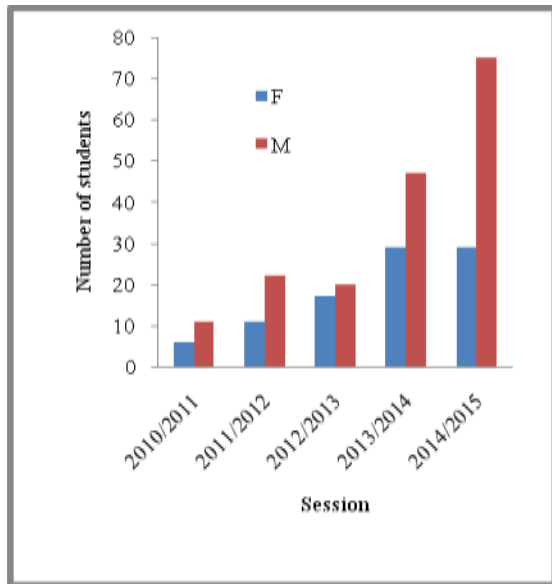
(b)
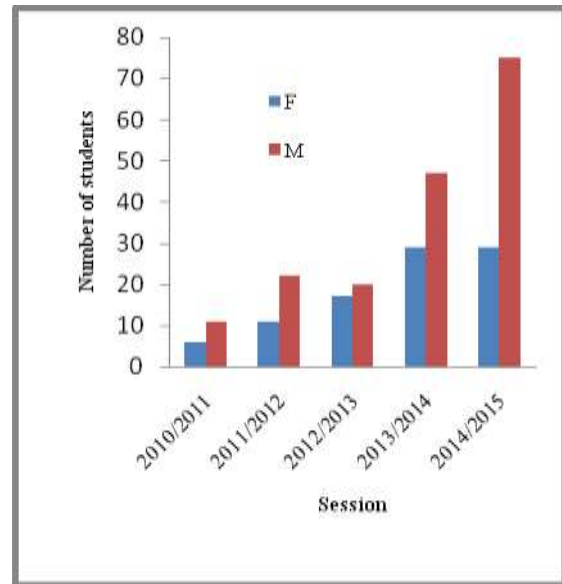
(d)

(c) Total number of doctorate's science students per session (d) Grand total of all doctorates' students per session
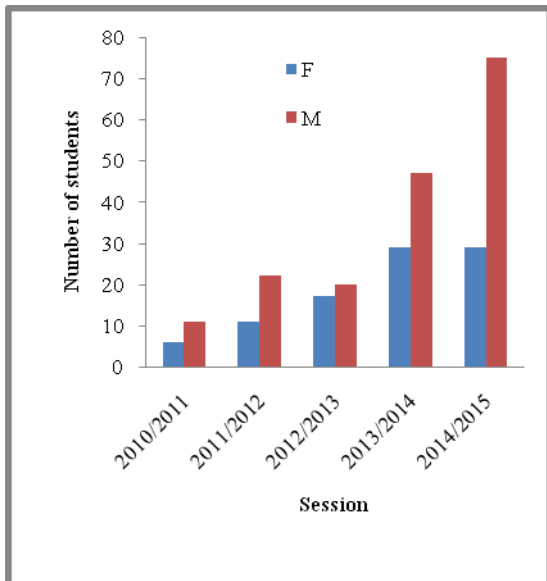
(c)

Figure 2: (a) Total number of master's science students per session
(b) Grand total of all master's students per session

Table 3: Gender Parity Index of undergraduate students at Covenant University

Degree in view	Session	Total of Science student		Gender Parity Index (science)	Grand total of all students		Gender Parity Index (all students)	Female science students in the University	Female students in the University
		F	M	GPI	F	M	GPI	(%)	(%)
	2005/2006	99	83	1.2	752	833	0.9	13.2	47.4
	2006/2007	79	97	0.8	775	784	1	10.2	49.7
	2007/2008	106	131	0.8	855	912	0.9	12.4	48.4
	2008/2009	123	174	0.7	831	1038	0.8	14.8	44.5
	2009/2010	114	199	0.6	919	1136	0.8	12.4	44.7
	2010/2011	79	130	0.6	622	784	0.8	12.7	44.2
	2011/2012	88	137	0.6	779	1046	0.7	11.3	42.7
	2012/2013	74	104	0.7	761	964	0.8	9.7	44.1
	2013/2014	70	122	0.6	729	927	0.8	9.6	44.0
	2014/2015	75	158	0.5	863	1008	0.9	8.7	46.1
Mean	**10 Sessions**	**91**	**134**	**0.7**	**789**	**943**	**0.8**	**11.5**	**45.6**

The result of figures 2 (a-b) and 3 (a-b) depict that both at Master's and Doctorate level, the number of males enrollment for the science courses considered superseded that of females. The same was also observed for all the students. Parental factor might be a major contributor on this regards.

Most parents believe that their male children will preserve the name of the family. As such they prefer to spend more money on the education of the male children than the females.

Table 4: Gender Parity Index of postgraduate students at Covenant University

Degree in view	Session	Total of Science student		Gender Parity Index (science)	Grand total of all students		Gender Parity Index (all students)	Female science students in the University	Female students in the University
		F	M	GPI	F	M	GPI	(%)	(%)
MASTERS	2010/2011	6	9	0.7	52	58	0.9	11.5	47.3
	2011/2012	15	8	1.9	63	62	1.0	23.8	50.4
	2012/2013	2	4	0.5	31	50	0.6	6.5	38.3
	2013/2014	18	15	1.2	49	58	0.8	36.7	45.8
	2014/2015	13	13	1.0	101	109	0.9	12.9	48.1
Mean	**5 Sessions**	**11**	**10**	**1.1**	**59**	**67**	**0.8**	**18.3**	**46.0**
DOCTORATES	2010/2011	3	1	3.0	6	11	0.5	50.0	35.3
	2011/2012	1	3	0.3	11	22	0.5	9.1	33.3
	2012/2013	4	3	1.3	17	20	0.9	23.5	45.9
	2013/2014	11	13	0.8	29	47	0.6	37.9	38.2
	2014/2015	8	16	0.5	29	75	0.4	27.6	27.9
Mean	**5 Sessions**	**5**	**7**	**1.2**	**18**	**35**	**0.6**	**29.6**	**36.1**

The gender parity index for the three levels of education is presented in Tables 3 and 4. Gender parity index for undergraduate was low for all the sessions considered but for one session (2005/2006). The mean being 0.7, this indicates disparity in favour of males. There was also a disparity for all students in favor of male. The mean disparity is 0.8 in favour of males. However, at the masters and doctorates cadre, the baton changed. The mean disparity was 1.1 and 1.2 in favour of females for masters and doctorate programmes respectively. Contrarily, the mean disparity for all students was 0.8 and 0.6 in favour of males for masters and doctorates programmes respectively.

According to [14], recording parity in gender parity index does not necessarily mean that the educational situation for a gender group has improved but rather, the participation or opportunities for the other gender group might have declined.Using percentage scale, female science students are 11.5%, 18.3 % and 29.6 % for undergraduates, masters and doctorates programmes respectively. This further confirms the low number of female science students at Covenant University. Fear of the future, loss of interest, lack of strong will power, parental consent, gender discrimination among others are some of the contributing factors to the low turnout of females in the sciences at Covenant University.

IV. CONCLUSION

This study revealed that the numbers of female science students are very low compared to their male counterpart at the three levels of education at Covenant University. Biological Sciences Department recorded higher numbers of female than males in the three levels of education. Chemistry Department enrolled more females than males at masters and doctorates level. The Department of Computer Science could only boast of more females at the doctorates level. Department of Mathematics and Physics had very low number of females in the three levels of education for the study.

Proffering solution to the factors barring women from pursuing careers in the sciences will encourage and motivate young girls to ply this route. Imbibing the culture of possibility mentality and inculcating same in our young girls at the elementary and secondary school level within. Transferring the same culture through community impact initiatives to this cadre of schools in the neighbourhood will serve as a winning strategy.

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Monitoring The Aerosols Loading Over Bamako: Likely Threats To Environmental And Food Security

Emetere M.E., Akinyemi M.L., Sanni S.E. and Akinwumi S.A.
Department of Physics
Covenant University,
Ota, Nigeria
moses.emetere@covenantuniversity.edu.ng

Abstract— **Environmental security is totally relegated in countries of West Africa. The monitoring of the aerosols loading over Bamako was the aim of this study. The outcome of our finding has salient links to food security, aviation and communication industry, thermal comfort and climate system of Bamako and Mali. Bamako is located on longitude 12.65 ºN and latitude 8 ºW. Fifteen years data was obtained from the multi-angled spectro-reflectometry (MISR). The aerosol loading was monitored using analytical and statistical techniques. The outcome is expected to enrich policy making in the nation of Mali.**

Keywords— Environmental security, aerosols, Bamako, MISR

I. INTRODUCTION

Aerosols are mixtures of tiny particles and liquids which may be homogenous or heterogeneous by nature [1]. The homogenous nature of aerosols allows for its absorption into the clouds [2] to form the direct radiative effect (DRE) of aerosol above clouds. Aerosols concentration in the lower atmosphere has been on the steady increase owing to industrial activities and burning of biomass [3]. Recent research has shown that there is poor ventilation over West Africa [4]. It is theoretically expected that the self-cleansing mechanism over the atmosphere of Bamako may be over burdened. An over-burdened atmosphere may initiate other processes. The increase in the aforementioned parameter was due to aerosols dispersion rate. Also, an overburden atmosphere may lead to poor visibility and the regular initiation of radar distress signaling. This aspect is of great importance to the aviation industry. [5] revealed that Bamako is mostly cloudy with a visibility of 12 km. Another effect of a burdened atmosphere is the alteration of communication signals [1]. Hence, the continued environmental security of Bamako is of great importance. Also, the importance of aerosols on climate change in Bamako is very important because it could threaten the food security of the nation. Therefore in this paper, the aerosol loading was monitored using analytical and statistical techniques. The outcome is expected to enrich policy making in the nation of Mali.

II. VALIDATION OF DATA SOURCE

Bamako is the capital and largest city of Mali, with a population of 1.8 million (2009 census, provisional) and it is located on longitude 12.65 ºN and latitude 8 ºW in the Sahelian geographic region, south of the Sahara (see Figure 1), therefore, we expect a high impact of the north east winds alongside Sahara dust. Furthermore, it is also under the influence of local steppe climate. Its metropolitan area is about 499 km^2. Bamako has an average temperature and precipitation of 27.4 °C and 662 mm respectively. The distance of Bamako to the Sahara is about 742 km. In the past, no ground observation of aerosols was available; hence, the satellite observation was adopted. Satellite observation was obtained from the Multi-angle Imaging Spectro-Radiometer (MISR) for a period of fourteen years. The MISR operates at various directions i.e. at nine different angles (70.5º, 60º, 45.6º, 26.1º, 0º, 26.1º, 45.6º, 60º, 20.5º) and gathers data in four different spectral bands (blue, green, red, and near-infrared) of the solar spectrum. The blue, green, red and infrared bands stretch through wavelengths of 443nm, 555nm, 670nm and 865nm respectively. MISR acquires images at two different levels of spatial resolution i.e. via local and global mode. It gathers data from the local mode at 275 meter pixel size and at 1.1Km from the global mode. Typically, the blue band is to analyze coastal and aerosol studies. The green band analyzes Bathymetric mapping and helps in the estimation peak vegetation. The red band analyses the variable vegetation slopes while the infrared band analyses the biomass content and shorelines.

Fig. 1.   Map of Bamako and the Sahara influence.

III. METHODOLOGY

In statistics, coefficient of variation is referred to as relative standard deviation and expressed in percentage. Coefficient of variation is not used to determine few meteorological parameters because of the inconsistency of its interval scale. For example, coefficient of variation is appropriate for the Kelvin scale but inappropriate for the Celsius scale because its

data is characterized by interval scale i.e. the ability to possess positive and negative value. Therefore, we adopted the coefficient of variation because the scale used has a characteristic interval scale and appropriate for comparison between data sets of widely different yearly or monthly means. Coefficient of variation can be represented mathematically as

$$CV = \sigma/\mu \qquad (1)$$

In equation 3, σ is the standard deviation and μ is the monthly mean.

The raw MISR dataset was processed using Spread Sheet Application (Excel). The monthly mean was calculated for each year. We tested the accuracy of the data by applying the aerosol dispersion model that was propounded by [6]. An extension of the dispersion model used is given as

$$\psi(\lambda) = a_1^2 \cos\left(\frac{n_1 \pi r(\lambda)}{2} x + \alpha\right) \cos\left(\frac{n_1 \pi r(\lambda)}{2} y + \alpha\right) + a_2^2 \cos\left(\frac{n_2 \pi r(\lambda)}{2} x + \beta\right) \cos\left(\frac{n_2 \pi r(\lambda)}{2} y + \beta\right) \qquad (2)$$

Here, α and β are the phase differences, k is the diffusivity, τ is the AOD, ψ is the concentration of contaminant, λ is the wavelength, 'a' and 'n' are atmospheric and tuning constants respectively. This technique had been severally adopted for environmental modelling to determine coefficient or constants from a set of available data [7]. The Matlab curve fitting tool resolves numerically the constants highlighted in Equation (2) and gives the statistical analysis of the MISR dataset.

The percentage retention can be determined from the coefficient of variance for each year. This was done by considering the previous and current years which are denoted as G_P and G_r respectively. Hence, we propounded the aerosols retention between two years as:

$$A = \left|\frac{G_P - G_r}{G_P}\right|^2 \times 100\% \qquad (3)$$

The aerosols retention can be calculated using values in tables 1-2 to obtain the corresponding values in tables 3-4. Any apt statistical tool could be used to obtain the atmospheric aerosols retention. In this paper, Matlab and the Excel packages were used to obtain the results shown in the following section.

IV. RESULTS AND DISCUSSION

The AOD pattern of Bamako shows a gamma distribution with the maximum in April (Figure 2). The aerosol content in Bamako gradually reduced from April to December. Since, Bamako is located on the same tropical savanna climate, it is expected that the influence of north-east dust may be high. Out of fourteen years data, three years 2004, 2010 and 2012 had

their maximum in March. The AOD pattern over Bamako agreed with the proposed model (Figures 3 and 4). Majority of the satellite observation in October and November did not correspond with the model. This may be as a result of excess influx of the north east dust into the environment. Hence, the aerosol retention which is expected to be high in March and April could rise above 30% as predicted by [8]. The inability of the self-cleansing mechanism over Bamako to reduce its aerosols retention and loading could lead to a maximum AOD in June as shown in Figure 2.
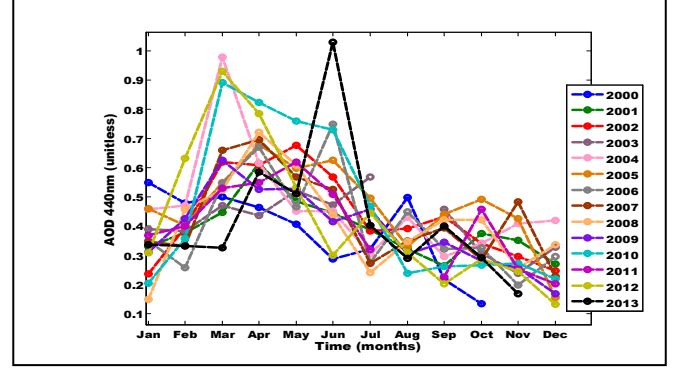
Fig. 2.   AOD pattern for Bamako 2000 - 2013
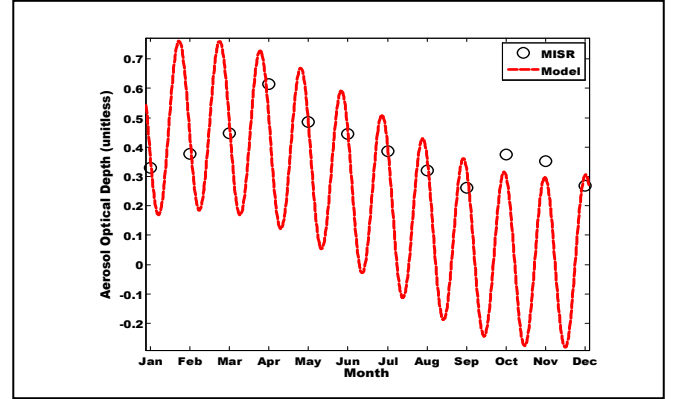
Fig. 3.   AOD for new model and MISR for the year 2001.
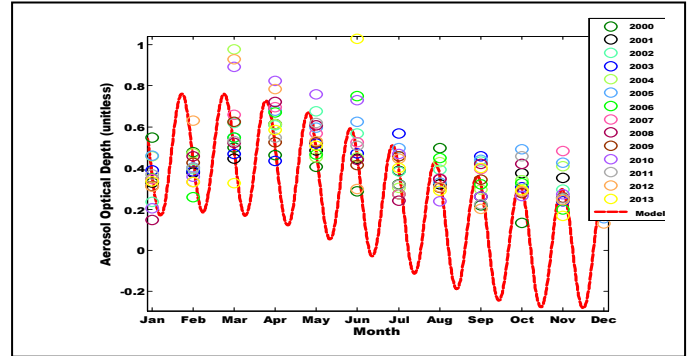
Fig. 4.   AOD for new model and MISR for the year 2000-2013.

From figures 2 to 4, the atmospheric constants, phase differences and tuning constants were obtained using the Matlab curve fit tool and equation (2) and the values are as shown in Table 1 below:

Table 1: Atmospheric constants over Bamako

Location	a_1	a_2	n_1	n_2	α	β
Bamako	0.7616	0.6676	-0.04547	0.8321	$\dfrac{\pi}{3}$	$\dfrac{\pi}{3}$

Based on variability in aerosols yearly dispersion, we statistically examined the AOD distribution over Bamako as shown in tables 2 & 3.

The highest AOD mean within the 95% confidence interval, 99% confidence interval, variance, standard deviation and coefficient of variation was obtained in 2010. The highest skew and kurtosis can be found in 2004. The highest Kolmogorov-Smirnov stat can be found in 2004. These results show that the lower atmosphere of Bamako may not be dynamic as cities in the northern Mali [8]. Hence we examined the atmospheric aerosol retention shown in Tables 4 & 5.

Table 2: Statistical AOD analysis 2000-2006

Statistical Tool	2000	2001	2002	2003	2004	2005	2006
Mean	0.39	0.39	0.43	0.41	0.47	0.47	0.41
95% confidence interval	0.1	0.06	0.1	0.07	0.12	0.09	0.11
99% confidence interval	0.14	0.09	0.14	0.09	0.16	0.13	0.15
Variance	0.02	0.01	0.02	0.01	0.03	0.02	0.03
Standard deviation	0.14	0.1	0.15	0.1	0.18	0.14	0.17
Coefficient of variation	0.36	0.25	0.35	0.23	0.39	0.3	0.42
Skew	-0.7	0.97	0.36	-0.3	2.25	-0.8	0.91
Kurtosis	-0.75	1.31	-1.2	-0.4	6.1	1.24	-0.1
Kolmogorov-Smirnov stat	0.22	0.18	0.18	0.13	0.33	0.15	0.22

Table 3: Statistical AOD analysis 2007-2013

Statistical Tool	2007	2008	2009	2010	2011	2012	2013
Mean	0.43	0.41	0.39	0.46	0.4	0.42	0.42
95% confidence interval	0.1	0.102	0.08	0.17	0.1	0.16	0.15
99% confidence interval	0.14	0.144	0.12	0.24	0.14	0.22	0.22
Variance	0.02	0.026	0.02	0.07	0.02	0.06	0.05
Standard deviation	0.16	0.16	0.13	0.27	0.14	0.25	0.23
Coefficient of variation	0.36	0.391	0.34	0.58	0.35	0.58	0.54
Skew	0.55	0.333	0.21	0.68	-0.05	0.98	2.04
Kurtosis	-1	0.075	-0.6	-1.5	-1.35	0.04	5.04
Kolmogorov-Smirnov stat	0.2	0.132	0.13	0.26	0.14	0.27	0.27

The undulating nature of all the statistical values is an evidence of the influence of climatic change on the yearly aerosols loading [9]. However, the negative Skew values as shown in 2000, 2003, 2005 and 2011 are subject to investigation. [10] gave the significance of negative Skew. It was explained that it reflects synergism of the events. Therefore, there is a positive synergy in the AOD data set in 2000, 2003, 2005 and 2011. This means that the aerosol retention in other years were very conspicuous on an annual basis. Also, a negative kurtosis exists in 2000, 2002, 2003, 2006, 2007, 2009, 2010 and 2011. This means that the probability of the AOD data (in the aforementioned years) to conform to model is low. This assumption can be seen in the non-conformity of October and November readings of these years to the proposed dispersion model (Figure 2).

The statistical results shown above necessitate the use of equation (3) to examine the aerosols retention in the atmosphere of Bamako (Table 4 & 5). The aerosols retention can be used to monitor the performance of the atmospheric self-cleansing mechanism. The most significant highest values of aerosols retention can be found in descending order in 2011 (42.03%), 2003 (23.52%), 2001 (17.41%), 2010 (16.78%), 2004 (15.61%) and 2012 (15.47%). It can be shown the possibility of aerosols retention build-up for the space of 3 years, that is, 2001-2003.

Table 4: Atmospheric aerosols retention over Bamako 2001-2006

	2001	2002	2003	2004	2005	2006
Aerosol deposition	17.41	7.4	23.52	15.61	8.96	8.43

Table 5: Atmospheric aerosols retention over Bamako 2007-2013

	2007	2008	2009	2010	2011	2012	2013
Aerosol deposition	2.6	0.53	1.99	16.78	42.03	15.47	0.54

V. CONCLUSION

Aerosols have the capacity to influence climatic conditions as shown in the statistical analysis. In this paper, a good statistical analysis and prediction of annual aerosol retention in Bamako state has been presented as a necessary step towards knowing the aerosol concentration, deposition or degree of aerosols loading for 14 consecutive years. The optical state values over Bamako (Table 1) showed the reality of both environmental and food security in the nearest future if the excess aerosol loading is not checked or controlled. This is because the optical state over an area affects photosynthesis, agricultural production and the energy balance of the atmosphere. From the studies/statistical analyses, the skew and Kurtosis are reliable tools for predicting the aerosol loading and concentration in Bamako although, they do not reveal the actual loading potential (aerosol loading rate) of the aerosols in the area. The most significant highest values of aerosols retention can be found in descending order in 2011 (42.03%), 2003 (23.52%), 2001 (17.41%), 2010 (16.78%), 2004 (15.61%) and 2012 (15.47%).

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Restructuring the Electrical Power Sector for Sustainable Development

AbelEhimenAiroboman, MNSE
Department of Electrical and Information Engineering
Covenant University, Ota, Ogun state, Nigeria
Email: abel.airoboman@covenantuniversity.edu.ng

Peter AigboviosaAmaize
Department of Electrical and Information Engineering
Covenant University, Ota, Ogun state, Nigeria
Email: peter.amaize@covenantuniversity.edu.ng

Augustus EhiremenIbhaze, MNSE
Department of Electrical and Electronics Engineering
Bells University of Technology, Ota, Ogun state, Nigeria
Email: solumideajose@gmail.com

Ignatius KemaOkakwu
Department of Electrical and Electronics
EngineeringUniversity of Benin, Benin City, Nigeria
Email: igokakwu@yahoo.com

Abstract - **The globalization of the market place, industrialization and national wealth of any sovereign state can be attributed to seamless and efficient power supply. Using Nigeria as a case study in Africa, with a seemingly large population and a potentially large market, with an undeniably decayed electrical power infrastructure, this paper, therefore, identifies a fundamental factor underlying the challenged electrical power sector using spreadsheet analysis. The findings emphasize good governance and techno-political innovations as the proper remediation in revamping the infrastructure which will engender uninterruptible power supply for sustainable development**

Key word: Power sector, Globalization, Industrialization, Governance, Sustainable development.

I.   INTRODUCTION

Engineering experts are liable by virtue of enacted code of conduct, good governance, and expertise to place the well-being of the public first in the cause of carrying out their engineering duties. Engineering failure usually lead to loss of huge resources and attract national and media interest. Failure of complex engineering systems is often described as a national disaster which can be prevented hence appointing competent individuals with the appropriate expertise to man the Engineering sectors.

Engineers in Nigeria have almost kept mute about the planned action driving some of the most relevant ideas aimed at maintaining a sustainable environment due to the political crack-down over the years. Instead, to their recognition, policy makers and administrators have been at the forefrontin identifying solutions to be employed in mitigating difficulties encountered in engineering practice even when Science Technology Innovation (STI) is the midway to curbing such problems. The effect of this is poor management of infrastructure as presently been observed in the electric power sector. Good governance requires that government should support engineering professionals in all areas in running the

electrical market with emphasis not on politics and quota system but on theexpertise that is embedded in professionals. A complete depoliticizes and de-quotalise electricity market system to harness best result possible [7]. The Nigerian engineers are among the best in the world, but due to politics of appointing a political figure as the head of the parastatal, they generally lose interest in the system [2]. If a good number of engineers were to be among the lawmakers in Nigeria today, then STI would have been maximized greatly thereby leading to a corresponding improvement in the well-being of the masses[4]. As a matter of fact, power unavailability has become a veritable avenue to gaining more votes during elections. This is just because if a politician can easily tackle the issue of unavailability of electricity supply, then, such is considered a national hero [1].

Some persons may argue that the permanent secretary in a technical ministry is one who must be technically sound hence, the minister he/she is reporting to   need not to be technically sound but should be one who is vast in policy making and administration. If a policymaker by the virtue of the former is not technically grounded with the activitiesof the ministry then in an actual sense how will he/she know how public policy and technology in the sector interact? The resultant effect of this according to [3] is that their decisions are taken based on the second-hand input which may not necessarily be in the public's interest and practices. The swift containment of ebola spread in the country in 2014 with the minister for Health being a trained medical expert [5] is a clear indication of having trained practitioners lead core professional commissions, parastatals, agencies and ministries in the country. A fundamental driver arising from the de-democratization of the country via unrequired military evasion of governance in Nigeria has created a succession of ministerial appointment based on trust, sector's, past administrative merits and the financial base of the sector rather than competence.

This has plunged many professional ministries with the power sector inclusive into a state of dilemma.

According to the Nigerian Society of Engineer Memorandum and article of Association Article 80(j) *"It shall be considered unprofessional and inconsistency with honorable and dignified and contrary to the public interest for any member to undertake work he is not competent to perform by virtue of his training and experience"*[8].Although most of the policy makers who at one time or the other have served as ministers of power are non-members of the society but the fact remains that they might have taken up responsibilities in areas they are not competent on by virtue of their training and this may not also be interest of the welfare of the public.

Table 1: Generation Capacity of Electricity in Nigeria [7].

Year	Total Generation Capacity (GWH)	Average Generation Capacity (MW)	Per Capital Consumption (kW)
1999	16,089	1837	0.151
2000	14,727	1681	0.134
2001	15,463	1765	0.138
2002	21,54	2459	0.178
2003	20,183	2304	0.172
2004	24,275	2771	0.201
2005	23,539	2687	0.187
2006	23,110	2368	0.178
2007	22,978	2623	0.177
2008	21,110	2638	0.178
2009	18,817	2148	0.139
2010	24,872	2839	0.179
2011	23,652	2700	0.167
2012 (Oct.)	-	4100	-

Table 2: Minister for Health from 1999-2015

Year	Portfolio	Discipline
1999-2001	Minister for Health	Medicine & Surgery
2001-2003	Minister for Health	Parasitology
2003-2007	Minister for Health	Economics
2007-2008	Minister for Health	Medicine & Surgery
2008-2010	Minister for Health	Medicine & Surgery
2011-2015	Minister for Health	Medicine & Surgery
2015-date	Minister for Health	Medicine & Surgery

Table 3: Minister of Justice from 1999-2015

Year	Portfolio	Discipline
1999-2000	Minister of Justice	Law
2000-2002	Minister of Justice	Law
2002-2003	Minister of Justice	Law
2003-2005	Minister of Justice	Law
2005-2007	Minister of Justice	Law
2007-2010	Minister of Justice	Law
2010	Minister of Justice	Law
2010-2015	Minister of Justice	Law
2015-date	Minister of Justice	Law

Table 4: Minister of Power from 1999-2015

Year	Portfolio	Discipline
1999-2000	Minister of Power	Law
2000-2003	Minister of Power	Geology
2003-2007	Minister of Power	Law
2007-2008	Minister of State for Power	French
2008-2010	Minister of Power	Ph.d Energy Economics
2010-2011	Minister of Power	Zoology
2011-2012	Minister of Power	Ph.d (Industrial Engineering)
2012-2015	Minister of Power	Ph.d Materials Engineering)
2015-date	Minister of Power	Law

Table 5: Amount released to the sector 1999-2015 [6]

Year	Amount Appropriated(₦)	Amount Released(₦)
1999	11,206,000,000	6,698,000,000
2000	59,064,000,000	497,850,000.00
2001	103,397,000,000	70,927,000,000
2002	54,647,000,000	41,196,000,000
2003	55,583,000,000	5,207,000,000
2004	54,647,000,000	54,647,000,000
2005	90,283,000,000	71,889,000,000
2006	74,308,000,000	74,300,000,000
2007	100,000,000,000	99,800,000,000
2008	156,000,000,000	112,000,000,000
2009	89,500,000,000	87,000,000,000
2010	172,000,000,000	70,000,000,000
2011	125,000,000,000	61,000,000,000
2012	1,979,000,000	55,300,000,000
2013	146,000,000,000	49,000,000,000
2014	69,800,000,000	48,000,000,000
2015	5,240,000,000	-
Total	1,368,654,000,000	907,461,850,000

II. METHODOLOGY

The data collated was analyzed sequentially using simple percentages and the result interpreted graphically with the aid of spreadsheet.

$$(1)$$

$a = Total\ number\ of\ years\ covered$

$b_i = 0 \le i \le 3$

When i = 0 → Electrical Engineers
When i = 1 → Non-Engineers
When i = 2 → Engineers in Related Field
When i = 3 → Non-Engineers but possess degree relevant in the power sector.
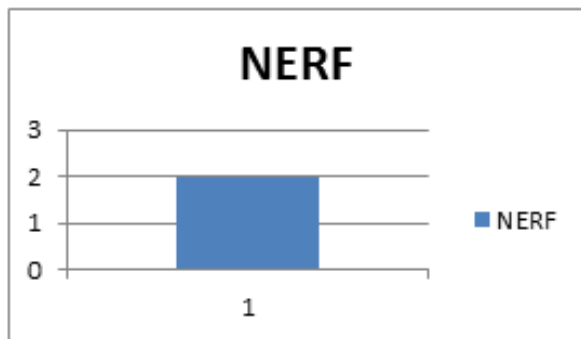
Fig. 1: Graph of NERF Vs No of Years
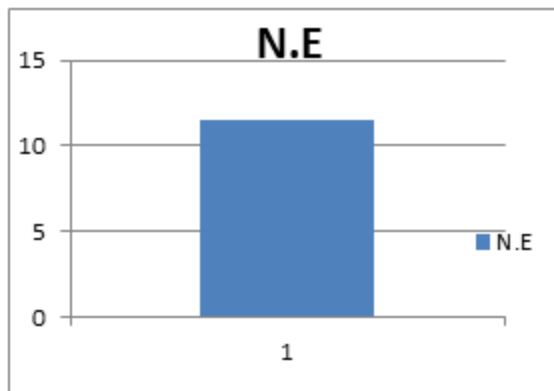
Fig. 2: NE Vs No of Years
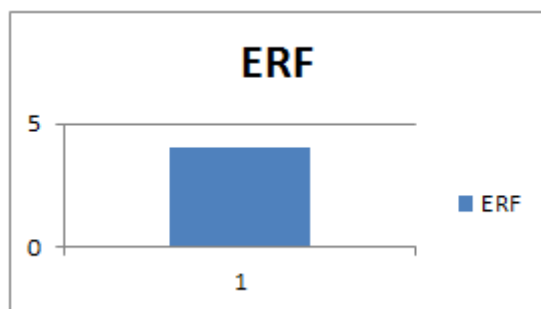
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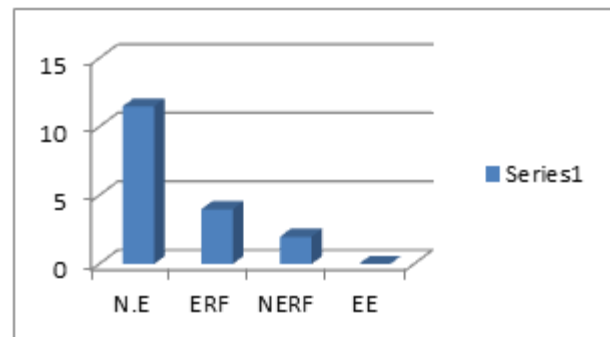
Fig 4: NE, ERF, NERF, EE Vs No of Years

Fig 5: Discipline of Ministers of Justice Vs No of Years
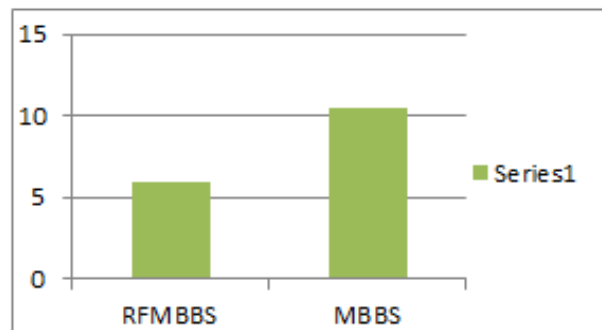
Fig 6: Discipline of Ministers of Health Vs No of Years
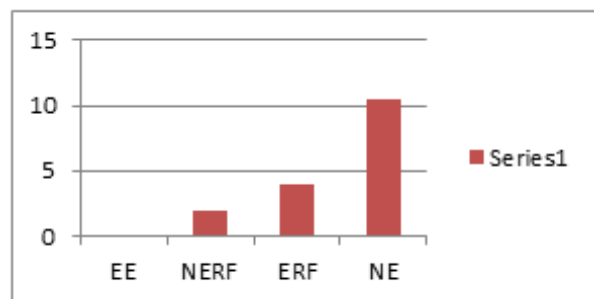
Fig 7: Discipline of Ministers of Power Vs No of Years
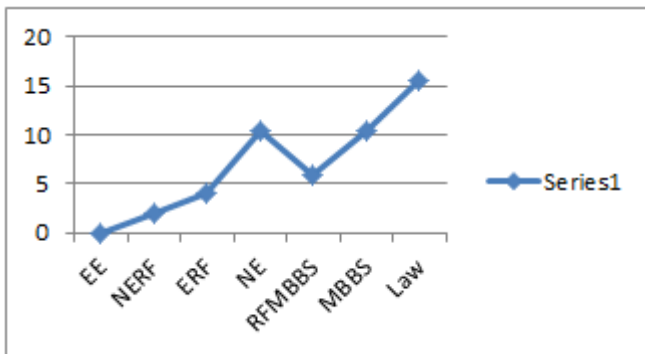
Fig 8: Discipline of Ministers in Professional Ministry Vs No of Years

Table 6 Legend definition

EE	Electrical Engineers
ERF	Engineers in related field
MBBS	Medicine and Surgery
NE	Non-Engineers
NERF	NonEngineers but in related field
RFMBBS	Related Field in Medicine and Surgery

III. DISCUSSION OF RESULTS

From table 1 it is apparent that since the advent of the fourth republic in Nigeria, the average generation capacity is still within 4000MW, Table 5 has also shown the amount that has been appropriated and released to the sector during this period, comparing the generation capacity with the funds appropriated to the sector, it is apparent that funds have been either misappropriated or mismanaged which can be attributed to poor governance. Fig 1-4 has shown that for the past 16 years majority of the ministers of power appointed are non-engineers and these non-engineers have been in charge of the ministry at a percentage of 63.6%, while engineers who possess degree in field related to the power sector have been in charge of the sector at a percentage of 24.2%, non-engineers but who by virtue of a higher qualification possess a degree relevant to the power sector have been in charge for a record of 12.2% while an electrical engineer is yet to be appointed as minister of power.

IV. CONCLUSION

If electrical energy is truly the mainstay of any economy and if appointing non-engineers to head the ministry has done more harm than good, then it is of utmost importance that qualified and registered electrical engineers be appointed to man the power sector henceforth. An electrical engineer has never been favored either by politics, performance or professional competence to be appointed either as the minister of justice or minister for health. Then such favoritism should not be granted to non-engineers for the purpose of manning the sector irrespective of personal interest. The result based on existing records has shown mismanagement at all arms of the sector viz-a-viz poor generation, poor technical know-how, lack of sustainable policy, poor maintenance and maintenance strategy, the poor welfare of staff to mention but few. If the

present generation capacity (4000MW) is divided by the total population in Nigeria (160million) then, a citizen of the country may only get 25W supply power daily which cannot power a regular 60W incandescent bulb it, therefore, implies that the ministers that have been saddled with the affairs to run the sector have from inception have succeeded in providing electric power which cannot power a 60W electric bulb, an indication that they do not know how policy and technology interact.

V. RECOMMENDATIONS

1. The modalities for selection of professionals to head the power ministry should be in consonance with what is obtainable in other professional bodies like the Health and Justice ministries such as
   - Qualified and competent electrical engineers
   - Engineers who possess qualifications related and relevant to the power sector or
   - Engineers who by virtue of a doctorate degree have made themselves an authority in the field should henceforth be appointed ministers of power.

2. Sound management decision based on technical competence is also required when appointing ministers of power
3. Restructuring the power sector with emphasis not only on the technicality of the sector but in the welfare of the staff is required.
4. The power sector in Nigeria is still in its developmental stage with respect to its generation capacity hence, the appropriate authority should incorporate more qualified engineers into the system in order to attain sustainable development.
5. The Federal government should henceforth desist from appointing lawyers, geologist and others who are not grounded in an engineering discipline as ministers of power.
6. Henceforth, public policy should be enacted by electrical engineers such that more professional voices are heard when making key professional decisions.

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A MODEL FOR THE MITIGATION OF ENERGY SCARCITY FOR A SUSTAINABLE MARKET IN AFRICA

[1]AMAIZE Aigboviosa Peter
Department of Electrical and Information Engineering,
Covenant University, Ota, Nigeria.
Peter.amaize@covenantuniversity.edu.ng

[2]AIROBOMAN Abel Ehimen
Department of Electrical and Information Engineering,
Covenant University, Ota, Nigeria.
Abel.airoboman@covenantuniversity.edu.ng

[3]ADOGHE Anthony
Department of Electrical and Information Engineering,
Covenant University, Ota, Nigeria.
anthony.adoghe@covenantuniversity.edu.ng

[4]SANNI Timilehin Fiyinfoluwa
Department of Electrical and Information Engineering,
Covenant University, Ota, Nigeria.
Timilehin.sanni@covenantuniversity.edu.ng

Abstract—A sustainable environment is one with advancement in science and technology, but an ingredient that can foster this drive is the availability of power supply within all sector of the economy. The scarcity of electrical power in Africa particularly in the Sub-Sahara region has been a major setback towards attaining a sustainable technology infrastructure, as a result of this most business that requires electrical power for their daily operation are forced to run their generators during working hours thereby placing the electric power supply authority on standby. The result of this anomaly is an increase in price of goods and services hence, Potential investors who cannot meet up with the huge amount required in running generators tends to look out for where the electrical power is cheap, readily available and not scarce to cite their industries. In this paper, a model has been proposed for the improvement of energy scarcity in Nigeria. The merits of the model if implemented will bring back investors to the country, reduce energy poverty and improve on the reliability of the power system network. The model is also seen as one that will ease the trace of failure within a decentralized power network.

Keywords: Electric Power, Nigeria, Scarcity, Sustainable.

I. INTRODUCTION:

Availability of constant and less expensive electrical energy is crucial for the development of industries, people empowerment and development of the nation. Nigeria is a country that is blessed with abundance of energy in theory with the available energy sources in the country; it is quite painful that we have not been able to convert these various energy sources into energy surplus as a result of poor policy by the institution put in place to take charge of the power sector. Hence, Nigeria is still faced with the nightmare of "darkness" caused by irregular supply of electrical energy that is vital for socio-economic development. According to [2], the generation of electrical energy in Nigeria has reduced drastically as a result of rise in diesel and petrol prices and this has affected the growth of the country's

productive and commercial activities in the past decades. In an effort for the Federal Government to curtain these challenges, has emphasized the noutlined in the National Electric Power Policy (2002) and enshrined in the Electric Power Sector Reform (ESPR) Act of 2005. According to [12], the irregular power supply and other infrastructure, has affected the growth of industries and individual development and this has led to a perpetuating electric power scarcity. This paper therefore identifies electrical energy poverty as one of the drivers of a reform process.

Despite the enormous finances government has committed to this sector and with continuous assuring customers of better services through the rebranding policy targeted at the concerns, values, image and feelings of both the employees and customers of the sector, consumers are still not satisfied with the quality of service rendered by the sector.

Recent energy sector reforms in Nigeria as observed by [1] are simply following international trends. Private sector is gradually taking the lead in energy supply systems as a result of government dominance. This paradigm shift is caused by constraints such as fiscal pressures, environmental factor, efficiency and the need to attract private sector investment. Power sector reforms in Nigeria started temporarily with the adoption of Structural Adjustment Programme (SAP) in 1986. However, it was not until the enactment of the Electric Power Sector Reform Act in 2005 that significant momentum was achieved in the electricity sub sector. The ongoing reforms in the nation's power sector which started in 2005 thus constitute a U-turn or policy reversal for the sector. Gross inefficiency in the sector, the heavy dependence on government treasury, rapid technological development and trends in the management of electricity sectors of other countries were the major motivating factors for the reforms. The reasons for power sector reform are clearly understood. Honestly, the reason for power reform is the irregular supply of electricity in

Nigeria which has led to high revenue losses. As a matter of fact, the reasons include but not limited to: First, power sector reforms is expected to lead to reduction in costs, including short term power and operation costs through efficiency gains, arising from economies of scale as larger-scale plants are enabled by larger markets [3]. This will lead to improved supply conditions, including better reliability and security of supply due to access to imports during emergency situations [3].

Only 40 percent of Nigeria population have access to electricity. This further tells us the level of energy poverty in Nigeria. Also considering the per capita energy consumption of Nigeria, we have 100kWh connected to the grid as stated by [10] which is far less as compared to South Africa, Brazil and China with per capital consumption of 4500kWh, 1934kWh, 1398kWh respectively [10].

II. THE PROPOSED MODEL

The proposed model for the mitigation of energy scarcity in Sub-Sahara Africa country like Nigeria is as shown in figure 1.1 below.
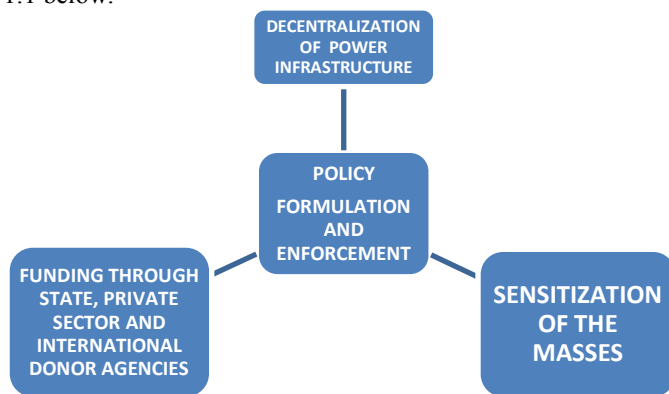
FIG. 1.1 PROPOSED MODEL

III. POLICIES FORMULATION AND ENFORCEMENT

As can be seen from the model, policy formulation and enforcement is at the heart of solving the issue at hand, meaning that if we get this first stage right then every other stage in the model will not be much of a problem and hence the following points have been suggested:

- According to [11], renewable energy technologies should be made national priority on national development policy agenda that is exactly what Kenya did. But in Nigeria such policy does not exist. All we do to lay emphasis on restructuring the old order under the defunct NEPA under the new GENCOS, DISCOS and the regulatory frameworks provided by the NERC. Importance of renewable energy and decentralized energy options have not been properly harnessed and used in Nigeria electricity situation unlike in Kenya. The advantages of the adoption of these technologies in Nigeria include:
  1. Reduction of emissions that can lead to global warming

  2. Ensure price stability since the cost of renewable energy is dependent on the invested amount and not on the increase or decrease of inflated cost of natural resource.
  3. This would therefore give room to job creation and for other economic benefits
  4. Improvement of public health and quality of environment will eventually be noticeable due to availability of power supply.
- Policy to make electricity and modern cooking fuel should be available to all especially to the rural dwellers.
- Registered and qualified engineers whose area of competence are related to the power sector should be involved in policy making
- Policies on the implementation of modern maintenance technique as well as regular training of personnel should be incorporated in the sector.
- The imposition of appropriate penalties such as life imprisonment as stipulated by decree 22 of 1985 as amended on any person or group of persons caught vandalising the electric utility equipment(s) of any level.
- Policy aimed at addressing issues on energy theft should also be enforced
- Policy aimed at enabling the government to focus on the power sector rather than been distracted by other security issues should be incorporated.

V. DECENTRALIZATION OF POWER INFRASTRUCTURE

The decentralization of energy centres on over hauling method to sustainable energy policy for a nation like Nigeria. This involves decentralization of the governance structure, infrastructure, means of production be multiplied, provision of cheap options and devolution of governance, control and management duties. Adoption of decentralization with respect to the infrastructure will help in restructuring the energy and natural resources sectors of Nigeria. Although the sector is now privatized but the nature of service rendered as of the time of writing this paper is nothing to write home about hence, a total decentralization of the powersector infrastructure will therefore implies the:

- Building of generating stations in each of the distribution zones to supply the power need of these zones
- The generated power should be evacuated directly for consumption using embedded generation scheme such that the excess power is eventually sent to grid
- This will eventually make the tracing of faults easier and the resultant effect will be losses minimization as a result of reduction of the distance between the generating stations and the load centres, thereby increasing the system stability.
- Government should give all the six generating stations , the transmission company and the eleven distribution

stations all the support needed especially in the areas of governance

IV. FINANCING THROUGH STATE

To solve the problem of energy scarcity with respect to the fact that about 60 percent of the masses in Nigeria are not presently having access to modern energy, it is necessary for the state governments to make institutional, regulatory, legal framework and finance available. The private sector should also be involved in the financing. The importance of using modern and cleaner energy publicity can be done by international donor agencies, as well as paying part of the investment on production and distribution of electricity.

According to [4] to reduce power scarcity, a two sided method is vital. The first one is that the developing countries should be rendered assistance to increase their capacity to embark on the use of other fuel sources such as LPG and Oil products. Secondly they should be assisted in building new power generating stations, transmission lines and distribution lines to make electrical energy surplus, efficient and increase stability margin of the power system.

Some other measures to be taken to reduce power scarcity include:

- Investors should be encouraged by making loans with no or little interest rates and with long time of repayment periods available.
- In cases where this may not be feasible due to financial challenges by the state then the state should seek support from international agencies in the area of international trade of energy products.

VI. SENSITIZATION OF THE MASSES

The population in Nigeria keeps increasing without a corresponding increase in the amount of power generated. It is in this wise that adequate sensitization of masses is required in the following areas:

- On the need to save energy by embracing energy saving household equipment
- On the need to save energy by disconnecting/switching off all electrical appliances when not in use
- On the need to secure the power utility equipment by guarding it against vandals
- On the need to avoid back-feeding and all forms of energy theft
- If affordable, should incorporate solar panels (or any other form of renewables) when building a new house.
- In cases where this may not be feasible due to financial challenges by the state then the state should seek support from international agencies in the area of international trade of energy products.

VII. CONCLUSION

Energy scarcity in Nigeria will be a thing of the past if the things addressed in the model are strictly adhered to. The paper concludes by suggesting the need for mainstreaming decentralized electricity governance model into the existing framework of energy regulation in Nigeria given the peculiar nature of the country and the use of energy efficient appliances. This is because the decentralization of energy model advocates the decentralization of governance structure to involve the local communities, means of energy production be multiplied, provision of cheap energy options as well as devolution of governance, control and management duties in the other tiers of government to maximize the benefit of the reformed electricity sector in Nigeria.

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Reduction of Traffic Congestion and Carbon Emissions Through Park and Ride Transportation System

Rikhotso, J. T., Ndambuki, J. M.,Kupolati, W.K., Adeboje, A.O. and Kambole, C.
Department of Civil Engineering, Faculty of Engineering and the Built Environment
Tshwane University of Technology (TUT)
Pretoria, South Africa.
Corresponding Author: AdebojeAO@tut.ac.za

Abstract—Traffic congestion results in low vehicular speed, longer trip time, queuing, and blockage of movement coupled with increased demand of space beyond the road capacity. The transportation sector causes 13% of the emissions of greenhouse gas (GHG). It is a sector which is still developing. The fumes from cars contributes majorly to GHG emission. This work investigated park and ride facility as an optimal means of ameliorating congestion and hectic traffic situation within the City of Tshwane's Central Business District (CBD) with a view to lowering greenhouse gases and their impacts on the climate. Traffic counts were conducted on heavily congested routes leading to the CBD and structured questionnaires were administered within the CBD. Carbon Dioxide (CO_2) emitted by traffic within the City of Tshwane Metropolitan Municipality (CTMM) was estimated and the amount of CO_2 to be reduced by using park and ride facilities was determined. Traffic volumes on the selected routes indicated a heavy reliance of over 70% on passenger cars as a mode of entry and exit to the CBD of the city. The survey conducted also showed that about 89% of the people interviewed may be delayed by traffic jams when they are going to work. Fifty-four percent of the respondents indicated intention to use park and ride facilities provided it would guarantee safety, security and reliability. The study also revealed that the use of park and ride transportation system may reduce 96.2% carbon emission by cars traveling along the A Re Yeng Bus Rapid Transit (BRT) line in the city. Park and ride may be further researched for the feeder systems of the A Re Yeng BRT and within townships in the city of Tshwane Metropolitan Municipality.

Keywords—climate; greenhouse gases; passenger cars; traffic count; vehicular speed

I. INTRODUCTION

Traffic congestion occurs on the road or highway due to increase in the number of vehicles moving on the road.Low speed, incessant queuing of vehicles and increased arrival time to reach the destination characterizes traffic congestion.

High energy is used up when there is traffic congestion, this leads to emission of high quantities of carbon monoxide (CO) as a result of combustion within the automobile engines.When carbon monoxide burns in the presence of oxygen (O_2), the product is Carbon dioxide (CO_2) [1]. Traffic congestion and variations in vehicle speeds impact greatly on the emission ofCO_2 [2].South Africa is one of the first twenty countries with the highest emission of greenhouse gases in the world [3]. The transport sector emits greenhouse gases heavily due to the combustion of diesel and petrol fuels used by automobiles [4].

The effects of traffic congestion and the resulting emitted CO_2 on climate change can be minimized through the implementation of park and ride transportation system, which is a modest transportation solution [5]. Park and ride conveniently affords facilities for parking cars at locations outside the city centre. The car parks are connected to public transportation systems within the CBD [6]. Intermodal scheme is another name for the park and ride scheme [5]. Park and ride facilities are usually designed to ameliorate congestion in areas with high concentration of traffic. It serves cities, towns and designated areas by providing parking facilities for locations of interests like stadia, amusement parks and airports. Public transit improvements, highoccupancyvehicles (HOV) and ride sharing are supported by Park and ride scheme [7]. Park and ride facilities improve cycling and enhance reduction of trip time [7]. Park and ride reduces congestion of vehicles on the carriageways; parking demand within the CBD; trip duration and expenses of vehicles and emission of greenhouse gases, energy combustion and the impacts of noise on the environment [7].

The Population, location, land use and work force of an area determines how successful the park and ride facilities would serve [8].

According to [9], 35, 35 and 30% of the entire transport are for mobility, private and public facilities respectively. Though private transportation is the most convenient means of transportation and has continued to increase, it had led to increase in traffic congestion and accidents especially during peak periods. Increase in the number of private vehicle is not a sustainable solution to transportation problem in Tshwane.

Tshwane [10] has been working tremendously to improve its transportation system and integrate all modes of private and public; motorized and non-motorized transportation systems to afford commuters ease of accessibility, safety, economy and gain in time.

The main objective of this research is to reduce traffic congestion and its attendant greenhouse effects in the environment of Tshwane and making it a healthy environment through the development of park and ride facility.

II. STUDY AREA AND METHODS

Tshwane region in the province of Gauteng in the Republic of South Africa was used as the case study for this research. Tshwane is the largest metropolitan municipality and the capital city of the South Africa.

Secondary data for the study area were collected fromgovernmentdepartments while questionnaires were distributed to people within the region of Tshwane.Data collected and used for this research work include:

i. Orthor-photos generated from GIS: The geographic information system, known as GISgenerated dataofroadsandstormwater which was obtained from the Infrastructuretechnologyinformationmanagementdivision of theCTMM.TheMrSIDviewerprogram was used to view the orthor-photos. A map showing City of Tshwane Metropolitan Municipality is presented in Figure 1.
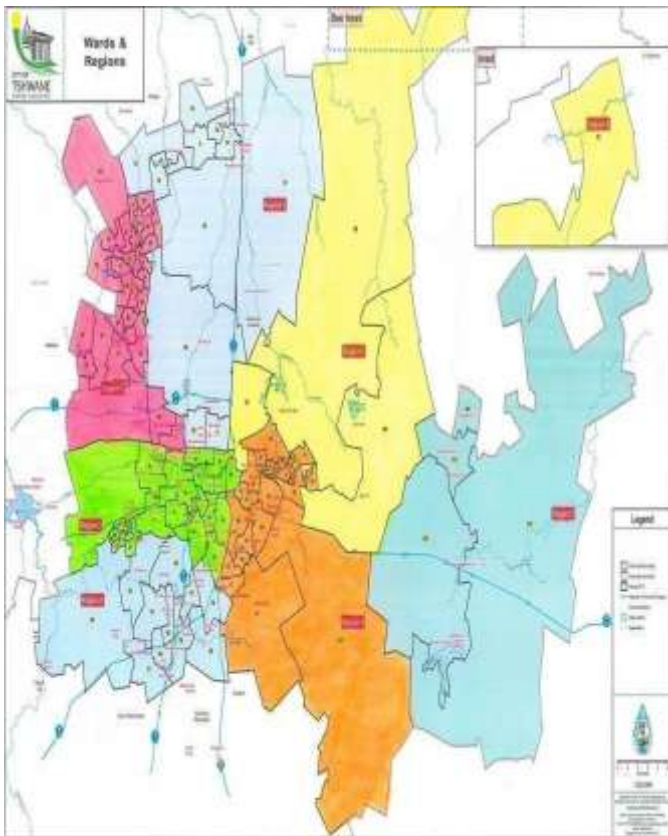
Figure 1: A map showing City of Tshwane Metropolitan Municipality

iiTrafficvolumedata: A 12 hour (06:00to18:00) Manual traffic count was done at the four major intersections leading

to the region of Tshwane's CBD in line with [11]. The count was conducted between Monday,March 5,2012andFriday,March 9,2012. The traffic count method used for enumerating automobiles was the classifiedcount. It was conductedonNelson Mandela, Struben, Pretorious and PaulKrugerStreets.Observations were made on the turning of the vehicles at intersections on DFMalan and StrubenStreets;Boom and PaulKrugerstreets;Hamiltonand Pretoriusstreets;andWillow and NelsonMandelastreets.

iiiFeedbackdatafromquestionnaires: A5 paper - Structured Questionnaires containing 11 questions was distributed to 318 respondents within the Tshwane region of South AfricafromMonday to Friday.

The answers to the questions asked were provided in the multiple choice format out of which respondents indicated their choice against each question.

iv. Data for Volumes of Fuel sold and consumed: The information on air pollution as obtained from the records of the volume of fuel sold were given by the energy department of the CTMM and calculated as follows:

$$MtCO_{2e} = \sum(f_p * EF_p) + (f_d * E[1]$$

where:

    = *petrol volume*

     = *factor for petrol emission*

    = *diesel volume*

     = *factor for diesel emission*

       = *Equivalenceof Carbon di Oxide in Mega Tonnes*

The total quantity of carbon di oxide resulting from combustion of a litre of diesel or a litre of petroldepends on the equivalent chemical constituents in the fuel. An assumption was made that a litre of petroleum product emits 2.36 and 2.60 kg of $CO_{2e}$of petrol and diesel respectively. Hence, the values wereused as emission factor for petrol and diesel respectively [12]. Therefore, the emission factors of diesel and petrol are 2.60 and 2.36kg respectively from $CO_{2e}$and was used for the determination of carbon emitted from diesel and petrol. The contents of methane (CH_4) and nitrous oxide (N_2O)were not used for the determination of the emitted carbon though they are part of the gases that emits the green house effects.

III. DISCUSSION OF RESULTS

A. Transportation Layout Plan and Park and Ride Facilities

The Are Yeng BRT lines shown in figure 2 was used as the transportation layout plan. It meets the accessibility requirements to areas of priority and dedicated lanes with

high service level for transit expected of the park and ride [8].

Parameters used for the identification of land used for park and ride facilities were virgin pieces of land adjacent to the proposed or existing A Re Yeng BRT route; vacant land along the main streets in Tshwane; expropriation or rezoning for land acquisition and ownership; and impacts of the public transportation system on traffic patterns.

Available lots of land for park and ride schemes facilities arepresented in table I and figure 2.The proximity and adequacy of the identified available spaces for the implementation of the park and ride scheme in Tshwane is presented in table II.

TABLE I. AVAILABLE SPACE FOR PARK AND RIDE FACILITY

Space	Area located	Proprietor	Accession	Along BRT lane	Impacts Traffic
Vlakfontein 329JR	Mamelodi	CTMM	Assigned	*	*
Ombre 636JR	Paul Kruger Str.	CTMM	Assigned	*	*
Klipkruisfontein	Soshanguve	CTMM	Assigned	*	*
Ext 507, Erf 394	Wonderpark	Private	Seizure	*	*
Wonderboom	Annlin	Private	Seizure	*	*

Figure 2: LocalityplanindicatingtheidentifiedIntersections(Source:MapStudio,2012)

TABLE II. DIFFERENT LOCATIONS FROM CBD

Area	Distance from designated area to CBD
Area 1	17 km
Area 2	3 km
Area 3	26 km
Area 4	16 km
Area 5	7.5 km

B. Carbon Emission Estimation

Research [13], has shown that for private vehicle car, the fuel consumption is 14.71 litres per 100km in congested traffic and8.241 litres per 100km in unrestricted traffic.

Volvo bus [14] indicated a fuel consumption of 26 litres per 100km for the average speed of 60km/h on their buses. The assumption that for a private car or vehicle, 8.241 litres of fuel is consumed in 100km distance for unrestricted flow of traffic and 14.71 litres of fuel is consumed in 100km distance for congested traffic was utilized for design and operation of Traffic in Tshwane.For the first segment of the trip, the fuel consumption rate was taken as 8.241 litres for a distance of 100km while for the second segment, the fuel consumption rate was taken as 14.71 litres for a distance of 100km in the morning. The inverse was taken for afternoon trips.For the determination of carbon emitted for a litre of fuel, the average value of emissions of petrol and diesel was used. Hence, $2.48kgCO_2e$ was utilized as the fuel emission factor of vehicles entering and exiting the region of Tshwane for the calculation of Carbon emitted. The available spaces were used to determine the capacity of the facility. The total number of passengers a bus could take was 65. All park and ride facilities were assumed to be operating at full capacity.

The value of the emission factor used for standard buses was $2.6kgCO_2e$ while 26 litres of fuel was assumed to be consumed for 100 km distance for unrestricted traffic flow. The assumption for the consumption factor was that the bus rapid transit would be travelling on its dedicated lane. The energy department of the region of Tshwane gave the data for results of air pollution within the city.TablesIII and IVshow the records of estimated carbon emitted in Tshwane and South Africa respectively between years 2005 and 2014. The results indicate increment in the greenhouse gas emitted as shown in figure 3.

The city of Tshwane in 2014 contributed 4.439 MtCO2e or 7.2% of South Africa's 61.009 MtCO2e as estimated from

the fuel volume sales consumption data.The total amount of greenhouse gas emitted in Tshwane between 2012 and 2013 was 13.180 MtCO$_2$e. Industrial pollution contributed most to greenhouse gas emission with 4.100 MtCO$_2$e which represents 31.11% of the entire GHG emissions. Transportation activities was second highest contributor to GHG emission with 4.061 MtCO2e emission representing

30.82% of the total GHG emission [15]. This figure is very close to the carbon emissions estimated for the year 2013 at 4.366 MtCO2e as shown in Table III.

TablesV and VI show the carbon emission by cars and buses respectively. The two vehicles moved the same distance from their origin to destination.

Figure 3: Carbon emission estimated from RSA and CTMM Annual Fuel Sales volumes and consumption

TABLE III.   EMITTED CARBON FOR TSHWANE CITY FROM ANNUAL SALE OF FUEL FROM 2005 TO 2014

Year	Diesel (litre)	Petrol (litre)	Carbon produced from Diesel (kg of CO$_{2e}$)	Carbon produced from Petrol (kg of CO$_{2e}$)	Total Carbon produced from Diesel (kg of Co$_{2e}$)	Total Carbon produced from Petrol (kg of Co$_{2e}$)	Total Carbon produced (MtCO$_{2e}$)
2005	455 128374	1 032 522 138	1 183 333 772	2 436 752 245.68	3 620 086 018	3 620 086.018	3.620
2006	537 571 166	1 041 667 593	1 397 685 032	2 458 335 519.48	3 856 020 551	3 856 020.551	3.856
2007	583 543 659	1 047 123 983	1 517 213 513	2 471 212 599.88	3 988 426 113	3 856 020.551	3.998
2008	653 686 754	1 003 270 446	1 699 585 560	2 367 718 252.56	4 067 303 813	4 067 303.813	4.067
2009	597 929 385	1 021 620 026	1 554 616 401	2 411 023 261.36	3 965 639 662	3 965 639.662	3.966
2010	564 580 485	842 620 954	1 467 909 261	988 585 451.44	3 456 494 712	3 456 494.712	3.456
2011	724 834 772	1 055 244 617	1 884 570 407	2 490 377 296.12	4 374 947 703	4 374 947.703	4.375
2012	740 176 729	1 029 548 505	1 924 459 495	2 429 734 471.80	4 354 193 967	4 354 193.967	4.354
2013	753 757 478	993 799 248	2 020 522 296	2 345 366 225.28	4 365 888 521	4 365 888.531	4.366
2014	777 123 960	1 024 607 025	2 020 522 296	2 418 072 578.26	4 438 594 874	4 438 594.874	4.439

TABLE IV.   EMITTED CARBON FOR THE REPUBLIC OF SOUTH AFRICA FROM ANNUAL SALE OF FUEL FROM 2005 TO 2014

Year	Diesel (litre)	Petrol (litre)	Carbon produced from Diesel (kg of CO$_{2e}$)	Carbon produced from Petrol (kg of CO$_{2e}$)	Total Carbon produced from Diesel (kg of Co$_{2e}$)	Total Carbon produced from Petrol (kg of Co$_{2e}$)	Total Carbon produced (MtCO$_{2e}$)
2005	8 116 573 441	11 170 710 222	21 103 090 946.60	26 362 876 123.92	47 465 967 070.52	47 465 967.07052	47.466
2006	8 707 405 264	11 278 412 253	22 639 253 686.40	26 617 052 917.08	49 256 306 603.48	49 256 306.60348	49.256
2007	10 141 584 286	11 568 813 336	26 368 119 143.60	27 302 399 472.96	53 670 518 616.56	53 670 518.61656	53.671
2008	10 385 030 955	11 086 938 407	27 001 080 483.00	26 165 174 640.52	53 166 255 123.52	53 166 255.12352	53.166
2009	9 437 131 324	11 321 186 218	24 536 541 442.40	26 717 999 474.48	51 254 540 916.88	51 254 540.91688	51.254
2010	10 170 466 384	11 454 711 308	26 443 212 598.40	27 033 118 686.88	53 476 331 285.28	53 476 331.28528	53.476
2011	11 224 553 285	11 963 310 914	29 183 838 541.00	28 233 413 757.04	57 417 252 298.04	57 417 252.29804	57.417

2012	11 228 716 399	11 733 080 659	29 194 662 637.40	27 690 070 355.24	56 884 732 992.64	56 884 732.99264	56.885
2013	11 890 350 007	11 152 866 181	30 914 910 018.20	26 320 764 187.16	57 235 674 205.36	57 235 674.20536	57.236
2014	13 168 816 974	11 343 566 879	34 238 924 132.40	26 770 817 834.44	61 009 741 966.84	61 009 741.96684	61.009

TABLE V.   ESTIMATED CARBON EMISSION BY CARS USING PARK AND RIDE FACILITIES

Areas located	Distance from location to CBD (km)	Consumption 1st segment of Journey (ℓ)	Consumption 2nd segment of Journey (ℓ)	Total Journey Consumption (ℓ)	Carbon Emission Factor (kg CO_{2e})	Carbon Emission per Journey per Car (kg of CO_{2e})	Total Available Parking space	Total (kgCO_{2e})	Total (MtCO_{2e})
1	17	0.700	1.250	1.951	2.48	4.838	2000	9676.142	
2	3	0.124	0.221	0.344	2.48	0.854	1000	853.777	
3	26	1.071	1.912	2.984	2.48	7.399	2000	14798.905	
4	16	0.659	1.177	1.836	2.48	4.553	2000	9106.957	
5	7.5	0.309	0.552	0.861	2.48	2.134	2000	4268.886	
Total Carbon emitted in January								38704.5664	
Total Carbon emitted for the whole Journey (monthly – single trip)								774091.328	0.00077
Total Carbon emitted for the whole Journey (monthly – return trip)								1548182.656	0.0015
Total Carbon emitted for the whole Journey (annual – single trip)								9289095.936	0.009
Total Carbon emitted for the whole Journey (annual – return trip)								18578191.87	0.018

TABLE VI.   ESTIMATED CARBON EMISSION BY BUSES USING PARK AND RIDE FACILITIES

Areas located	Distance from location to CBD (km)	Total Fuel consumed (ℓitre)	Carbon Emitted (kg CO_{2e})	Carbon Emission per Journey per Bus (kg CO_{2e})	Total Buses required for available space	Total (kgCO_{2e})	Total (MtCO_{2e})
1	17	4.400	2.60	11.492	31		
2	3	0.780	2.60	2.028	15		
3	26	6.760	2.60	17.578	31		
4	16	4.160	2.60	10.816	31		
5	7.5	1.950	2.60	5.070	31		
Total emission for the whole Journey							
Total emission for the whole Journey (monthly – single trip)							
Total emission for the whole Journey (monthly – return trip)							
Total emission for the whole Journey (annual – single trip)							
Total emission for the whole Journey (annual – return trip)							

If all the car users presented in Table Vutilize the park and ride scheme for their journey within Tshwane, South Africa and move to the central business district by public buses, 96.2 % of the estimated carbon emitted within the Tshwane environments would be prevented.

A bus can take only a little space in the traffic and congestion on the road. Buses have modestdimension, they are light and manoeuvrable. They can aid quick, smooth and convenient response to prevailing or changing demands without requirement for specialised infrastructure [16].

IV. CONCLUSIONS

This paper shows that the carbon emission as estimated from the fuel volume sales indicate that the emissions are on the increase annually. The city of Tshwane in 2014 contributed 4.439 MtCO_{2e} or 7.2% of South Africa's 61.009 MtCO_{2e} as estimated from the fuel volume sales consumption data.
The use of park and ride transportation system will reduce 96.2% carbon emission by cars traveling along the A Re Yeng BRT line. Buses emit only 3.8% of the emissions by cars. Park and ride can be used to effectively reduce the problems of traffic congestion and the resulting emission of greenhouse gas which have a negative effect on the environment of Tshwane. It will ameliorate inadequate parking facilities within the City.

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Sustainable Non-Motorized Transport for Ga-Rankuwa and Rosslyn Transport Corridor, City of Tshwane, South Africa

Jantjies, M., Ndambuki, J. M., Kupolati, W. K., Adeboje, A. O. and Kambole, C.
Department of Civil Engineering, Faculty of Engineering and the Built Environment
Tshwane University of Technology (TUT)
Pretoria, South Africa.
Corresponding Author: AdebojeAO@tut.ac.za

Abstract—**A sustainable transportation system is safe, affordable and accessible. It connects different modes of transportation in order to achieve efficient movement. A sustainable transport system is one that is economical and friendly to the environment. All trips in private and public transport begin and end with walking. Non-Motorized Transport (NMT) plays a key role in completion of any journey from origin to destination. However, this mode of transport is not used optimally to enhance sustainable transport, especially where public transport is concerned. The main objective of the research was to evaluate an optimal combination of transport modes for trips made by BMW employees residing in Ga-Rankuwa north of Pretoria, in order to reduce cost of transport. The travel behaviour of BMW employees was investigated by first studying secondary data on the Municipal Household Survey (MHS) and Integrated Transport Plan (ITP) of Tshwane City. The secondary data was supplemented with primary data which was sourced by interviewing the BMW's human resources department and conducting trip studies between Rosslyn and Ga-Rankuwa. The trip pattern of workers of BMW was evaluated to know the origin-destination, journey period and transportation cost of the trips. The movement patterns of the BMW workers were grouped into four categories. The patterns were subjected to optimization using linear programming which included the subsisting movement pattern. The trip patterns developed were based on relevant literature. The BMW workers' movement from home to work was optimized. Their movement to work constituted a transportation challenge or problem; and was solved using simplex technique, a linear programming approach. The model was subjected to a sensitivity analysis and the results were analysed. It was found that the most patronized transportation mode for the trips between Rosslyn and Ga-Rankuwa was taxi. It was further discovered that BMW workers expended R18.47 averagely on movement from home to work through taxis. The recognition of cycling, a means of movement within short distances, allows for additional trip patterns as available options for commuters. The integration of cycling as a feeder system to trains resulted in 36% trip cost reduction for the commuters. The research revealed that while less than 45% of the employees may continue to use the present scenario, more than 55% of the employees may use a combination of cycling and trains. The study suggested that similar work should be done to cover other economic and important routes in order to encourage the use of cycling as a link to other transportation modes in other industrial areas of the City of Tshwane.**

Keywords – sustainable transport; non-motorized transport; origin-destination; simplex technique; travel time.

I. INTRODUCTION

Connection of different modes of transportation is essential for the development of a sustainable transportation system. This will enhance effective, safe and accessible transportation system for road users. Achieving an effective transportation system is challenging in developing countries as the needs of people must be taken into consideration in the design and construction of transportation facilities, even with diverging interest and trip purposes. There is no universally acceptable definition of sustainable transport [1] as quoted by [2]. However, the European Conference of Ministers of Transport (ECMT) in 2004 [3] as quoted by [2], defined sustainable transport as one that is safe, accessible, affordable, and environmentally-friendly.

Non-Motorized Transport (NMT) includes walking, bicycling, skates and wheelchair travel. The non-motorized transport provides recreation and transportation of persons, goods and services. A road user may choose to walk or cycle instead of driving just because he preferred walking or cycling and either is enjoyable to him though it may take more time [2]. According to [4], Non-Motorized Transport affords mobility of persons and goods by means other than automobile combustion engines.

Though users of NMT are many and at different places, they are not considered in the design, construction and improvement of transportation facilities. Physical infrastructures such as overpasses and shoulders are usually not provided for existing NMT users in the upgrade and new development of transportation facilities. The non-integration of NMT facilities in new developments and existing transportation facilities results in high rate of accidents involving automobile and NMT users, delayed travel time and segregation of non-motorized traffic [4]. Despite that NMT modes such as cycling and walking are regarded as sustainable transport modes, their disadvantage is that they are restricted to short journeys [5].

All trips in private and public transport begin and end with walking. NMT plays a key role in the completion of any journey from origin to destination [6]. However, this mode of transport is not used optimally to enhance sustainable transport, especially public transport. The taxi exploits this reality for profits by providing pick-up and drop-off spots as close as possible to passengers' origin and destination points. The rail transportation system is utilized by the public but operates below capacity level because of lesser patronage compared to the taxis. The taxi triumphs over rail because of the perception that rail is the least accessible form of public transport in the City of Tshwane [7].

Many residents of Tshwane have challenges such as high transportation cost and inefficient feeder modes of transport connecting the different types of transportation modes. This is also prevailing in the North Western parts of the City, in areas such as Soshanguvhe, Mabopane and Ga-Rankuwa [8].

An extensive network of rail transportation system is available in the City of Tshwane but is not used to its maximum potential. However, the rail system may be more patronized to enhance accessibility, ease and economy of movement; and effective transportation. Movement to work through public transport is done mainly by taxis, buses and trains. A target set was to ensure that workers spend less than 10% of their income

on transportation to and from work. This situation shows that about half (41%) of workers spent more than the stipulated 10% on transportation [7]. A more flexible and cheap mode of transportation is required to enable workers to spend less than 10% of their income on transportation. This research investigated bicycle and walking as the alternative transportation modes to the existing ones. More than half (52%) of the people using train in Tshwane showed dissatisfaction to the long distances between the train stations and their homes [7].

The rail transportation system requires an effective, accessible, comfortable, safe and economical feeder system which would be proximate to homes; time saving; cost effective and more secured than what we have now. This will enhance more patronage, increase the market share obtained through rail services and promote sustainable transportation system [7]. According to [9], low train fares do not only discourage car-owners from using their cars but also divert walkers and cyclists towards train stations.

In order to ensure time and cost minimization when trips are undertaken, the role of NMT as a feeder mode of transport has to be fully comprehended. Full comprehension, optimization and implementation of NMT will result in integration of cycling and walking into other transportation modes which will enhance sustainable transportation system.

The study objective is to determine an optimal combination of transport modes for trips made by BMW employees residing in Ga-Rankuwa, with the aim of reducing transport costs. The investigation of the transportation problem of BMW employees that commute between Rosslyn and Ga-Rankuwa was done to evaluate the effects of integration of cycling into other public transportation means.

II. METHODOLOGY

The travel behaviour of BMW workers commuting between Ga-Rankuwa and Rosslyn within the City of Tshwane was investigated. Analyses were done on the information obtained to determine the following:

- Origin-destination;
- Cost of travel;
- Trip duration;
- Travel distance;

The ITP and MHS of Tshwane were used as secondary data to understand the travel patterns of BMW employees. Consultation with human resources department of BMW and the study trips undertaken were used to verify the information obtained from [7]. The study trips were done through taxis, bicycles and trains. Desk study was further conducted using information obtained from secondary data.

The reliability of the information was evaluated based on the source of the information. The information from the study trips and interviews weighed the most and the secondary data from other documents, weighed the least. The evaluation technique used helped in making judgement on the travel behavior, as the data that were collected varied.

Alternative Transport Scenarios

Cycling and walking had been identified as the most dominant forms of NMT by the South African government. Non-motorized transportation has the potential to become a feasible and sustainable mode of transportation [10]. It is projected as a potential mode of sustainable transport. Integration of cycling into public transport such as taxis, bus

rapid transit, buses, SARCC Metrorail and Gautrain will result in the development of an alternative transport mode [10].

The alternative transportation mode was developed based on relevant literature as highlighted in Table I.

The following trip patterns were examined:

- Walk for leg 1 to taxi stop, take taxi for leg 2 and 3, and walk leg 4 to BMW Gate 1 (Trip pattern 1 – Status quo).
- Cycle leg 1 to taxi rank, take taxi for leg 2 and walk the final leg to BMW Gate 1 (Trip pattern 2).
- Cycle leg 1 to train station, take train for leg 2 and walk leg 3 to BMW Gate 2 (Trip pattern 3).
- Cycle leg 1 to train station, take train for leg 2 and cycle leg 3 to BMW Gate 2 (Trip pattern 4).

TABLE I. RELEVANT LITERATURE FOR ALTERNATIVE TRANSPORTATION MODES

Materials	Submissions
Tshwane ITP, 2007 [7]	Recommended affordable and reliable feeder transportation modes.
National DoT NMT Policy, 2008 [11]	Recommended guidelines for planning and implementation of NMT infrastructures.
National DoT, 2003 [12]	Proposed design elements of NMT facilities.

Trip pattern 1, which is the status quo, has only one trip with a total duration more than an hour. The one outlying trip is due to travel distance which is in excess of 70 kilometers. Trip pattern 2 has trips from four areas with total duration of travel more than an hour. The areas in question are located more than 10 kilometers away from the taxi rank, therefore resulting in longer cycling time. Hence, the cycling mode is not feasible for the four areas under trip pattern 2. In trip pattern 3, there are six areas with trip duration more than an hour. This is due to longer walking and cycling times. This implies that walking and cycling for those six areas under trip pattern 3 are not feasible. Trip pattern 4 has two areas with their trip duration more than an hour. This implies that cycling is not feasible for the two areas under trip pattern four.

III. TRANSPORTATION OPTIMIZATION

The optimization of transportation cost for BMW workers was approached as a transportation problem. The research was conducted in order to minimize the total cost of transportation by exploring the linear programming approach using the simplex technique method. The problem was solved by building a Microsoft excel model and using a "solver" for the solution. Excel solver is a tool available in excel to solve nonlinear equations, a system of linear / non-linear equations and optimization problems [13]. The model was tested for a number of different trip patterns with their sensitivity analysis results captured and discussed.

Mathematical Formulation

Hypothesize the BMW employees originating from *m* zones and having *n* trip patterns to reach their destination. Workers must be transported from their homes to work. Each zone has an *s* employees residing in it and all employees should use *n* trip patterns to get to their destinations. The cost of transportation of the different trip patterns is linear. The characteristics of the transportation problem are as follows:

- Total number of workers using trip pattern j for transport is d_j, where $j = 1,2,3...n$

- Total number of workers from unit i is S_i, where $i = 1,2,3...m$
- The travelling time for one employee from origin unit i using trip pattern j is Tij, where $i = 1,2,3...m$ and $j = 1,2,3...n$. The total travelling time is linear with respect to the distance to be travelled.
- Total transportation cost for one employee from origin unit i using trip pattern j is c_{ij}, where $i = 1,2,3...m$ and $j = 1,2,3...n$. The total transportation cost is linear with respect to the number of employees.
- The maximum cycling distance K for scenario j is 5km, where $j = 1,2,3...n$.
- The maximum trip duration *is* Tij for scenario j is 60 minutes, where $i = 1,2,3...m$ and where $j = 1,2,3...n$.

$Tij \leq 60min$ is a constraint and benchmark set by [7].

$K = 5km$, is a constraint recommended by [14] stating 5 km as the maximum acceptable cycling distance.

Let Z be the total cost and x_{ij}, the number of workers to be moved from source i using trip pattern j, the formulation for this problem gives a linear programing as follows:

minimze Z

$$= \sum_{i=1}^{i=m} \sum_{j=1}^{j=n} c_{ij} \, x_{ij} \qquad [1]$$

Dependent on:

$$\sum_{j=1}^{j=n} X_{ij} = S_i, \qquad (i=1 \text{ to } m) \qquad [2]$$

$$\sum_{i=1}^{i=m} X_{ij} = d_j, \quad (j=1 \text{ to } n) \qquad [3]$$

$$K_j \leq 5km, \quad (j=1 \text{ to } n) \qquad [4]$$

T
$ij \leq 60min, \quad (i=1 \text{ to } m \text{ and } j=1 \text{ to } n) \qquad [5]$

and:

$$X_{ij} \geq 0, \quad (i=1 \text{ to } m \,; j=1 \text{ to } n) $$

The Objective Function

The objective function contains costs associated with each function as that of the variables. It is a problem of minimization. Considering transportation from origin unit i using trip pattern j. For any arrangement of i and j, the cost of travelling per worker c_{ij} and the number of workers to be shipped is X_{ij}. Given the hypothesis that there is a linear function for cost, the overall trip cost is $c_{ij} \, x_{ij}$

The sum of all i and j yields the total transportation cost for all origin and trip pattern combinations. The objective function can therefore be as given in equation [1]

The Constrictions

The Constrictions or Constraints are the conditions that ensures demand and supply are fulfilled. A Transportation Problem (TP) has one constraint for each node. The constraints are therefore:

i) Number of workers from all origins that have to be moved:

$$\sum_{j=1}^{j=n} X_{ij} = S_i, \qquad (i=1 \text{ to } m) \qquad [2]$$

ii) Number of workers that should get to the end point:

$$\sum_{i=1}^{i=m} X_{ij} = d_j, \quad (j=1 \text{ to } n) \qquad [3]$$

iii) Limit for cycling distance K is 5km on any pattern:

$$K_j \leq 5km, (j=1 \text{ to } n) \qquad [4]$$

iv) Total journey time Tij from unit i using trip pattern j should not exceed an hour:

$$Tij \leq 60min, \quad (i=1 \text{ to } m \text{ and } j=1 \text{ to } n) \qquad [5]$$

v) Non negativity:

$$X_{ij} \geq 0, \quad \forall \, i \text{ and } j \qquad [6]$$

An essential and adequate condition for existence of a viability solution to the transportation problem is:

$$\sum_{i=1}^{i=m} S_i = \sum_{j=1}^{j=n} d_j \qquad [7]$$

the implication is that all workers to be moved from each origin must get to their desired destinations.

Formulating the Transportation Problem using Excel

In order to solve a transportation problem, two separate tables were created. The first table was for parameters while the other for the solution. The number of workers from each point of origin was allotted to different trip patterns (Table II).

Five constrictions (constraints) were built-in into the spreadsheet. They are demand; supply; maximum travelling duration; maximum cycling distance and non-negativity constraints.

For supply constraint, total number of worker from each area equaled total number of workers moved through all trip patterns, that is total number of workers between columns C and F equaled total number of workers in column B in the solution table (Table II).

For demand constraint, total number of workers to be moved equaled total number of workers originating from various zones. At the end of row G, a formula (G49 = SUM G30:G48) which calculated total number of workers was inserted to add up the total number of workers moved (Table II).

Cell H49 shows calculated total cost of all trips. The inserted formula calculated the total cost of all corresponding cells in the body of the parameter and solution table. Thus, the formula embedded in cell H49 sums product of cells in the costing worksheet shown in the parameters table and the corresponding cells in the solution table (Table II).

A simplified calculation was done to know if any of the trip patterns would be possible using cycling distance constraint. It was achieved by adding columns of all trip patterns and including cycling one or more of their legs, showing the cycling distances for each scenario and origin (columns E to G, refer to Table III).

TABLE II.   DATA FOR TRIP PATTER BETWEEN GA-RANKUWA AND ROSSLYN

	A	B	C	D	E	F	G	H
1			Parameters Table					
2			COST					
3								
4	Source / Origin	No. of People / Supply	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1		
5	Barseba	1	R 49,00	R 16,00	R 10,50	R 12,50		
6	Garankuwa View	3	R 42,00	R 48,00	R 25,50	R 31,50		
7	Garankuwa Zone 1	3	R 42,00	R 48,00	R 25,50	R 31,50		
8	Garankuwa Zone 16	6	R 84,00	R 96,00	R 51,00	R 63,00		
9	Garankuwa Zone 17	1	R 14,00	R 16,00	R 8,50	R 10,50		
10	Garankuwa Zone 2	4	R 56,00	R 64,00	R 34,00	R 42,00		
11	Garankuwa Zone 20	2	R 28,00	R 32,00	R 17,00	R 21,00		
12	Garankuwa Zone 21	2	R 28,00	R 32,00	R 17,00	R 21,00		
13	Garankuwa Zone 25	2	R 28,00	R 32,00	R 17,00	R 21,00		
14	Garankuwa Zone 3	2	R 28,00	R 32,00	R 17,00	R 21,00		
15	Garankuwa Zone 4	2	R 28,00	R 32,00	R 17,00	R 21,00		
16	Garankuwa Zone 5	1	R 14,00	R 16,00	R 8,50	R 10,50		
17	Garankuwa Zone 6	3	R 42,00	R 48,00	R 25,50	R 31,50		
18	Garankuwa Zone 7	8	R 112,00	R 128,00	R 68,00	R 84,00		
19	Garankuwa Zone 8	2	R 28,00	R 32,00	R 17,00	R 21,00		
20	Garankuwa Zone 9	2	R 28,00	R 32,00	R 17,00	R 21,00		
21	Hoekfontein	1	R 14,00	R 16,00	R 8,50	R 10,50		
22	Mmakau	2	R 78,00	R 32,00	R 17,00	R 21,00		
23	Mothutlung	5	R 195,00	R 80,00	R 42,50	R 52,50		
24		52						
25			Solution Table					
26								
27		DISTRIBUTION OF PEOPLE PER SCENARIO						
28								
29	Source / Origin	No. of People / Supply	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Total number of people	Cost
30	Barseba	1	0	0	0	0	0	R -
31	Garankuwa View	3	3	0	0	0	3	R 42,00
32	Garankuwa Zone 1	3	0	0	3	0	3	R 25,50
33	Garankuwa Zone 16	6	0	0	6	0	6	R 51,00
34	Garankuwa Zone 17	1	1	0	0	0	1	R 14,00
35	Garankuwa Zone 2	4	0	0	4	0	4	R 34,00
36	Garankuwa Zone 20	2	2	0	0	0	2	R 28,00
37	Garankuwa Zone 21	2	2	0	0	0	2	R 28,00
38	Garankuwa Zone 25	2	2	0	0	0	2	R 28,00
39	Garankuwa Zone 3	2	0	0	2	0	2	R 17,00
40	Garankuwa Zone 4	2	0	0	2	0	2	R 17,00
41	Garankuwa Zone 5	1	0	0	1	0	1	R 8,50
42	Garankuwa Zone 6	3	0	0	3	0	3	R 25,50
43	Garankuwa Zone 7	8	8	0	0	0	8	R 112,00
44	Garankuwa Zone 8	2	2	0	0	0	2	R 28,00
45	Garankuwa Zone 9	2	2	0	0	0	2	R 28,00
46	Hoekfontein	1	0	0	1	0	1	R 8,50
47	Mmakau	2	2	0	0	0	2	R 78,00
48	Mothutlung	5	5	0	0	0	5	R 195,00
49		52	29	0	22	0	51	R 768,00

Next to columns E to G, additional columns were inserted with a simple formula to determine which trips were viable with a constraint of maximum cycling distance of 5km (columns K to M, refer to Table III). In column K the formula was "IF (G3<5,1,0)", this implies if the distance in cell G3 is less than 5km, then the result should be 1 if not, then it should be 0. The result obtained from k is multiplied by the cells having number of workers from each zone. In solver, the corresponding cell in the solution table must be equal or lesser than the product.

Hence, when the trip pattern is impossible, a zero is allotted to cells in the column K to M and the product is also zero would be zero (refer to Table III for ease of reference).

A simplified equation was used to make a determination if any of the trip patterns was possible with the trip duration constraint. It was done by the addition of columns for all trip patterns showing their total trip durations (columns O to R, in Table IV). Next to the columns O to R, other columns were inserted with a simple formula to determine which trips were feasible with a constraint of a certain trip duration. In these columns (columns S to V, in Table IV), a rule was applied. In column S the formula "IF(O3<60,1,0))", implies if the trip time in cell O3 is below one hour, the result would be 1, if not, the result would be 0. The result would be multiplied by the cells containing number of workers from each unit. The corresponding cell in the solution table must be not be more than this product. When the option is impossible, zero is allotted to cells in columns S - V and the product of multiplying with zero gives zero (Table IV).

The non-negativity constraint was added via an option in solver that may or may not be selected, by checking a box to *"Make Unconstraint Variables Non-Negative", as* shown in Figure 1.
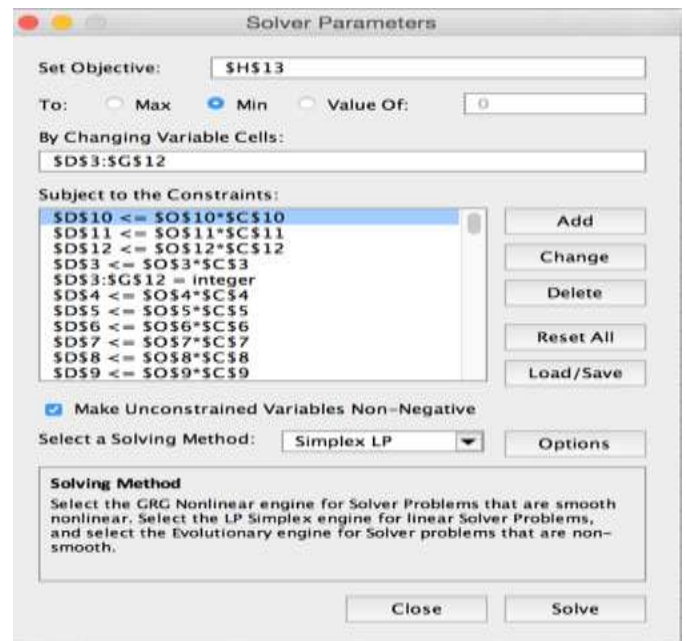
Figure 1: Excel Solver extract for ease of reference

(Non- negativity constraint)

TABLE III.   EXTRACT OF CYCLING DISTANCE CONSTRAINT

A	B	C	D	E	F	G	K	L	M
1		CYCLING DISTANCE					5	5	5
2	AREA	No. of People	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Trip Pattern 2 Possible	Trip Pattern 3 Possible	Trip Pattern 4 Possible
3	Barseba	1	n/a	64	35	35	0	0	0
4	Garankuwa View	3	n/a	10,6	10,5	10,5	0	0	0
5	Garankuwa Zone 1	3	n/a	3	1,1	1,1	1	1	1
6	Garankuwa Zone 16	6	n/a	4,7	4,4	4,4	1	1	1
7	Garankuwa Zone 17	1	n/a	6,7	6,6	6,6	0	0	0
8	Garankuwa Zone 2	4	n/a	1,5	2,6	2,6	1	1	1
9	Garankuwa Zone 20	2	n/a	7	6,8	6,8	0	0	0
10	Garankuwa Zone 21	2	n/a	5,8	7,1	7,1	0	0	0
11	Garankuwa Zone 25	2	n/a	7,5	7,4	7,4	0	0	0

TABLE IV.   TRIP DURATION DISTANCE CONSTRAINT

	A	B	O	P	Q	R	S	T	U	V
1	ORIGIN AREA	No. of People	TOTAL DURATION (MINUTES)				Trip duration constraint possible? 1=Yes, 0=No			
2			Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1	Trip Pattern 1 Possible	Trip Pattern 2 Possible	Trip Pattern 3 Possible	Trip Pattern 4 Possible
3	Barseba	1	79	276	195	188	0	0	0	0
4	Garankuwa View	3	44	63	72	65	1	0	0	0
5	Garankuwa Zone 1	3	31	32	34	27	1	1	1	1
6	Garankuwa Zone 16	6	35	39	48	40	1	1	1	1
7	Garankuwa Zone 17	1	39	47	56	49	1	1	1	1
8	Garankuwa Zone 2	4	28	26	37	29	1	1	1	1
9	Garankuwa Zone 20	2	39	48	57	50	1	1	1	1
10	Garankuwa Zone 21	2	37	43	58	51	1	1	1	1
11	Garankuwa Zone 25	2	40	50	60	52	1	1	1	1
12	Garankuwa Zone 3	2	32	34	48	41	1	1	1	1
13	Garankuwa Zone 4	2	33	35	44	37	1	1	1	1
14	Garankuwa Zone 5	1	31	31	43	36	1	1	1	1
15	Garankuwa Zone 6	3	29	28	39	31	1	1	1	1
16	Garankuwa Zone 7	8	38	47	61	54	1	1	0	1
17	Garankuwa Zone 8	2	40	49	64	57	1	1	0	1
18	Garankuwa Zone 9	2	39	47	62	54	1	1	0	1
19	Hoekfontein	1	33	37	40	33	1	1	1	1
20	Mmakau	2	48	71	60	53	1	0	0	1
21	Mothutlung	5	50	74	65	58	1	0	0	1
22		52								

The Solver calculations in cell H49 (Table II) were set up to minimize the trip cost, using a simplex linear programming method, by changing variable cells C30 to F48 subject to the constraints as explained earlier. The numerical values of X_{ij} decision variables are contained in cells (C30:F48). The optimized result obtained using the simplex method was calculated in the solution cells and the associated cost is obtained in cell H49 (Table II).

Solver is limited to solving problems with less than 200 variables and 100 constraints, hence the problem was divided into two, but the results were combined to accurately and reliably obtain similar results with Solver in Excel as if the whole dataset were used together (without a split) for all trip origins and trip patterns.

The data that were collected and summarized in Tables V and 6 were utilized for the optimization exercise.

TABLE V.   SUMMARY OF DIFFERENT TRIP PATTERNS DATA

Trip pattern	Average Distance	Average Duration	Total Cost
Trip pattern 1	18 km	39 minutes	R 938.00
Trip pattern 2	17 km	57 minutes	R 832.00
Trip pattern 3	20 km	60 minutes	R 444.00
Trip pattern 4	20 km	53 minutes	R 548.00

TABLE VI.   TRANSPORTATION DATA FOR WORKERS RESIDING IN GA-RANKUWA

Zone of Origin	Number of Employees	Trip pattern 1		Trip pattern 2		Trip pattern 3		Trip pattern 4	
		**Cost	*Time	**Cost	*Time	**Cost	*Time	**Cost	*Time
Barseba	1	49.00	79	16.00	276	8.50	195	12.5	188
Garankuwa Unit 1	3	14.00	31	16.00	32	6.50	34	10.5	27
Garankuwa Unit 16	6	14.00	35	16.00	39	6.50	48	10.5	40
Garankuwa Unit 17	1	14.00	39	16.00	47	6.50	56	10.5	49
Garankuwa Unit 2	4	14.00	28	16.00	26	6.50	37	10.5	29
Garankuwa Unit 20	2	14.00	39	16.00	48	6.50	57	10.5	50
Garankuwa Unit 21	2	14.00	37	16.00	43	6.50	58	10.5	51
Garankuwa Unit 25	2	14.00	40	16.00	50	6.50	60	10.5	52
Garankuwa Unit 3	2	14.00	32	16.00	34	6.50	48	10.5	41
Garankuwa Unit 4	2	14.00	33	16.00	35	6.50	44	10.5	37
Garankuwa Unit 5	1	14.00	31	16.00	31	6.50	43	10.5	36
Garankuwa Unit 6	3	14.00	29	16.00	28	6.50	39	10.5	31
Garankuwa Unit 7	8	14.00	38	16.00	47	6.50	61	10.5	54
Garankuwa Unit 8	2	14.00	40	16.00	49	6.50	64	10.5	57
Garankuwa Unit 9	2	14.00	39	16.00	47	6.50	62	10.5	54
Garankuwa View	3	14.00	44	16.00	63	6.50	72	10.5	65
Hoekfontein	1	14.00	33	16.00	37	6.50	40	10.5	33
Mmakau	2	39.00	48	16.00	71	6.50	60	10.5	53
Mothutlung	5	39.00	50	16.00	74	6.50	65	10.5	58
***TOTAL	52	938.00		832.00		444.00		548.00	

* Duration is in minutes
** Cost is in South African Rands and it is cost per person
*** Total cost for all 52 employees

Table VI shows that the total cost for the existing single trip of all BMW workers resident in Ga-Rankuwa and its environs is R938.00. Trip patterns 1, 2 and 3 cost R832, R444.00 and R548.00 respectively. The objective was to determine the best trip patterns or combination of patterns for all BMW workers to ensure safety and economy.

TABLE VII.   RESULTS OF THE SENSITIVITY ANALYSIS

Constraints (minutes and kilometers)	Total number of workers	TP 1	TP 2	TP 3	TP 4	COST
80 min. & 2.5 km	52	35	0	10	7	R 683.50
80 min. & 5.0 km	52	23	0	29	0	R 603.50
80 min. & 7.5 km	52	16	0	36	0	R 565.00
60 min. & 2.5 km	51	41	0	3	7	R 848.00
60 min. & 5.0 km	51	29	0	22	0	R 768.00
60 min. & 7.5 km	51	15	0	29	7	R 530.00

An optimal solution was obtained using solver in excel. The solution was for 29 workers to continue using the current trip pattern of using taxis to get to work while 22 people would use trip pattern 3 of cycling to the nearest train station, joining train and walking the last 1200 meters to their office in Rosslyn. The original trip cost of R938 between Rosslyn and Ga-Rankuwa has been cut or reduced to R768 by 18%.

Following the detailed analysis, the 60-minute constraint cannot be satisfied by any of the trip patterns because of long distance from Barseba. The existing trip duration for Barseba is 79 minutes, hence increasing the trip duration to 80 minutes satisfies all requirements. Other trip durations are lesser than an hour using at least one of the possible trip patterns. The optimized solution was to keep the maximum cycling distance at 5km and increase the trip duration to 80 minutes. The result gave 23 workers moving via trip pattern 1, 29 workers via trip pattern 3 and only one trip will have a duration more than 60 minutes.

Adjusting time and cycling distance constrictions will allow for further optimization of the result. When cycling distances are halved, the cost increases by 10%. The increase is largely due to cycling being viable only to 10 people as opposed to 22, where the cycling distance is 5 km. However, when cycling distance are increased by 50% to 7.5 km, the cost reduces by 31%. The discount is largely due to cycling being viable to 36 people as opposed to 22, where the cycling distance is 5 km.

Table VII shows the results of the sensitivity analysis that was conducted by reducing and increasing cycling distance and time constraints.

IV. RESULTS AND DISCUSSION

Average trip distances and durations are 18km and 39 minutes respectively, whilst the average trip cost R18.47.

The taxi trip was 35 minutes long and costs R14.00. The trip that was undertaken using a combination of cycling and train services was 33 minutes long and costs of R16.50. Train services charge an extra R10.00 for taking a bicycle into the train, this therefore increases the trip cost. The average distance travelled was 15km for both trips. The optimal solution costs R603.50 which is 36% discounted when compared to the current cost of R 938.00. This implies that the use of NMT as a feeder mode leads to reduced transportation costs. Moreover, when the acceptable cycling distance is increased, the cost of transport is reduced.

In other words, when cycling becomes a viable option to more people, the result would be cheaper transport costs and sustainable transport system. Rahul and Verma [15] had similar findings, where they expressed NMTs contribution to sustainability in India, in economic terms. A saving of 2 626 USD per day is made on congestion costs and another saving of 1 145 USD is made on vehicle costs when 1% of motorized trips with distance less than 5 kilometers dumps transportation through buses and taxis for cycling or walking.

The best solution is that 56% of the commuters should make use of trip pattern 3 and 44% should continue travelling using trip pattern 1 as shown in Figure 2. The different trip durations for the different trip patterns are presented in Table VI. Table 6 also shows the different trip costs for the different trip patterns. Trip costs consist costs of different legs of the trip. Table VI shows higher trip costs for trip patterns 1 and 2 but lesser trip costs for patterns 3 and 4. It can be noted that longer distances cost more than shorter ones. This was evident in the trip from Barseba to Rosslyn with higher cost than other areas within the Tshwane region studied.
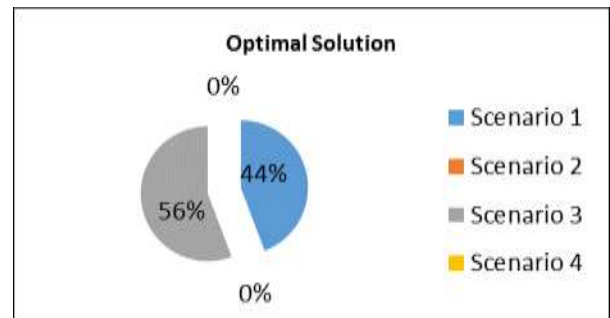
Figure 2: Optimal Solution

V. CONCLUSION

Non-motorized transport as feeder mode of transport opens up opportunities for transportation means other than the automobile combustion engine. Three additional trip patterns were developed as a result of the introduction of NMT as a feeder mode of transport to taxis, buses and trains. The one-hour trip duration constraint was not satisfied in the optimization exercise because trip from Barseba to Rosslyn is more than 70 km. The best solution to

the transportation problem is such that 29 employees shift to using trip pattern 3 for their work trips, whilst 23 continue using trip pattern 1. The cost of the trip was reduced by 36% when trip pattern 3 is compared with trip pattern 1, which is the subsisting practice.

The results of the study indicate that when cycling becomes a viable option to more people, it results in cheaper transport cost and enhances sustainable transport. The study recommends that similar study should be undertaken on a wider scale to broaden knowledge and widen horizon on the impacts of cycling, a non-motorized transport mode, as a feeder mode for transportation in other industrial areas of Tshwane and beyond.

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A MODEL FOR TRANSMISSION GRID DECONGESTION

SANNI, Timilehin Fiyinfoluwa
Electrical and Information Engineering dept.
Covenant University, Ota
Ogun state, Nigeria.
timilehin.sanni@covenantuniversity.edu.ng

AIROBOMAN, Abel
Electrical and Information Engineering dept.
Covenant University, Ota
Ogun state, Nigeria.
abel.airoboman@covenantuniversity.edu.ng

ADOGHE, Anthony
Electrical and Information Engineering dept.
Covenant University, Ota
Ogun state, Nigeria
adoghe.tony@covenantuniversity.edu.ng

AMAIZE, Peter
Electrical and Information Engineering dept.
Covenant University, Ota
Ogun state, Nigeria
amaize.peter@covenantuniversity.edu.ng

Abstract—**Nigeria as a nation has suffered from epileptic power supply which has affected negatively the economic activities of the citizen. For a sustained development, a constant power supply is needed. Available and reliable electric power supply promised as one of the major benefits of unbundling of nations' own utility is yet to be realized, five years after privatization of the power sector.**

This paper presents an approach that consider the Nigeria power sector in three models: power sector before privatization, current power sector during privatization, the recommended model that consider the reduction of transmission grid congestion.

This model supports helpful technologies such as micro-hydro in rural community, solar power and photovoltaics in regions endowed with sun shines, wind farm in coastal region and energy efficient appliances. These technologies when developed in these regions, is capable of reducing system load, site generation close to load centers, and thereby expand effective grid capacity to more rural community.

A common indicator of an economically inadequate grid is congestion, which by definition implies the cheapest availably supply cannot be used; therefore a less-congested system can lead to lower electricity prices and less frequent power outages. This model offers significant benefits such as reduced transmission cost, lower congestion and generation costs, increased economic activities of the people and create a sustainable pollution free environment.

Keywords—power supply; grid decongestion; transmission grid; sustained development; privatization.

I.   INTRODUCTION

Electricity has been said to be the fuel of development in any place; local or national. The nation, Nigeria has always has it as one of its agenda in every change of governance but has been incapable to fulfil its promise.The installed generation systems are not producing up to their capacity and many of the equipment need maintenance.

The interrupted power supply has greatly affected the economy of the nation which can be seen in the fact that most of the industries and enterprises in the nation; large or small depend more on the fuel-based generators. Generating electricity through this means increases the cost of electricity which affect the turnover of these businesses. Even the man by the road side making his own way of living uses fuel-based generation. This is because there is little or no supply from the grid.

With the solution that comes from renewable energy, there comes the challenge of connecting it to our old installed transmission system. This is the system that was singularly monitored compared to the other two counterparts; generation and distribution. For a reliable transmission system, it will take some time and also high financial budget which can cause a lengthy delay [1]. An alternative therefore to grid connection is to have multiple smaller generating facilities.

A sustainable power supply with development will have to come therefore from smaller generation units which are closer to the consumers. This will also help the local community aware of environmental sustainability and their part in uninterrupted power supply. The consumers will be able to monitor and manage the electricity that is produced which will also come with other benefits; developments of the local community, mutual relationship, environment sustainability, long time uninterrupted power supply and also reduced load on the transmission lines.

II. POWER SECTOR BEFORE PRIVITISATION

Power generating plants in Nigeria is shown in the table below, with their installed capacity and what is being produced.

It has been single-handedly managed by the government under the name Nigeria Electric Power Authority (NEPA) which was later changed to Power Holding Company of Nigeria (PHCN).
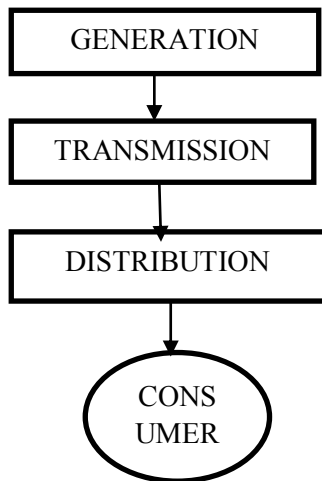
Figure 1: The model before privatisation.

The highest generating units are shown below;

TABLE 1: Top quality Generation stations

Generating Station	Type	Installed capacity	Available capacity
Egbin	Thermal	1320	650
Jebba	Hydro	540	482
Kainji	Hydro	760	450
Shiroro	Hydro	600	450
Afam VI	Thermal	650	450
Okpai	Thermal	450	361
Ughelli	Thermal	812	320

Some of the highest producing generation stations [1] having three of them to be hydro which is renewable.

It varies from hydro, natural gas, to coal generating systems [2] and they are expected in total to generate 6426 MW. This section of the power system has been challenged because of the following;

- Inadequate planning and maintenance
- Wrong costing and pricing
- Lack of energy mix
- Lack of adequate training

- Lack of local contribution.
- Non-conservative consumer
- Cost of energy efficient devices

Opportunities for smaller generation by individuals and industries will help for proper conservation and management, investing in power business open to all.

III. POWER SECTOR DURING PRIVITISATION

It presently consists of 10 generation units with available capacity of 4500 MW, a transmission grid (132kV and 330kV) which was managed by NEPA and also when the name of the body was changed to Power Holding Company of Nigeria.

For transmission company and generating and distributing industries to be accepted has reliable, the following has to be in place [3].

i. Independent natural monopoly to operate
ii. Large capital base
iii. Strategic planning
iv. Enforcement of policy
v. Management and maintenance
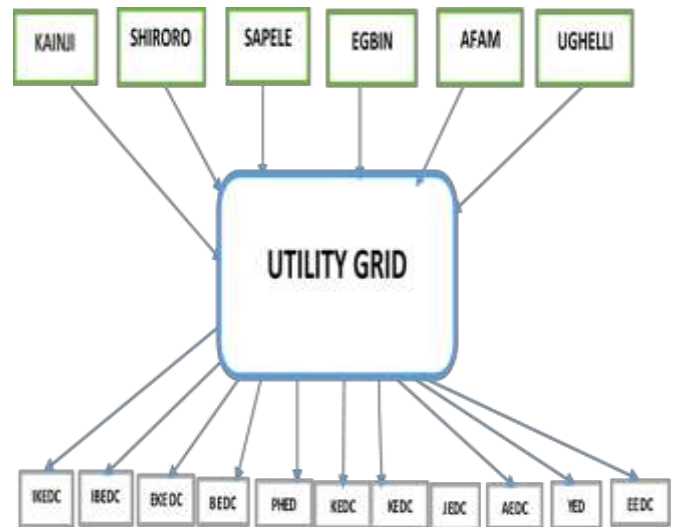
Figure 2: The power sector at privatization.

- Ikeja electricity distribution company plc.
- Eko electricity distribution company plc.
- Ibadan electricity distribution companyplc.
- Benin electricity distribution company plc.
- Port Harcourt electricity distribution company plc.
- Kaduna electricity distribution company plc.
- Kano electricity distribution company plc.
- Jos electricity distribution company plc.
- Abuja electricity distribution company plc.
- Yola electricity distribution company plc.
- Enugu electricity distribution company plc.

Figure 2 shows what is achieved especially from the transmission company at the time of commercialization.

At a count, we have 5650 and 6687 kilometers of 330kV and 132kV lines which has no redundancy therefore not reliable and not sufficient [3].

IV. PROPOSED MODEL FOR THE POWER SECTOR

A suggestion that was once made from[1] for reliable power supply in the country is the removal of congestion on the grid and also development of human capacity. This is well achieved when we have the society aware and trained to help themselves with the supply of electricity [3].

With the nation's population, the generated capacity of approximately 4500 MW is not sufficient for a population of approximately 170 million even if we generate at installed capacity of 8876 MW. An estimation of 1MW to 1000 persons is estimated for a developed country. With most of our generation from thermal, we can do a shift to renewable.

Electricity in Nigeria has always taken a great part of the country's budget year in year out without adding to the economy. We have been successful in privatising which has helped reduce the GDP percentage that goes for electricity but we have to take a step to increasing its contribution to the nation's economy which can be achieved by having individual private smaller generation units [1].

Renewable energy is defined as a source of energy that is capable of reproducing itself without going into extinction, continuous and unending. Renewable energy has been harnessed in the country in the form of hydro-generation, but a combination of the renewable sources can be of help. This include wind, solar, geothermal and also biomass. Renewable is introduced in every country even the developed for future sustainability; long term or medium term challenges. It is a quick and easy to install with a good study of the environment. It is also a stable and constant power supply source.

Nigeria relatively has a good mix of renewable energy sources which can be harnessed. It has hydro power plants, solar and wind spread across the nation. The northern part of the country has high solar radiations and wind and also the coastal regions. For smaller generation, a study is done at the immediate environment to suggest which will give a better efficiency.

The start-up cost of installation is distributed in the community over a period of years and this will be covered for in years to come. This will play a role in poverty elimination and sustained development. It will also reduce energy waste and misuse.

The one opportunity renewables gives is the possibility of installing smaller generating units and also its direct availability to the consumers. The installed capacity will be enough to serve closer community who is the first priority with the left-over sent to the grid. This is defined and modelled in Figure 3.
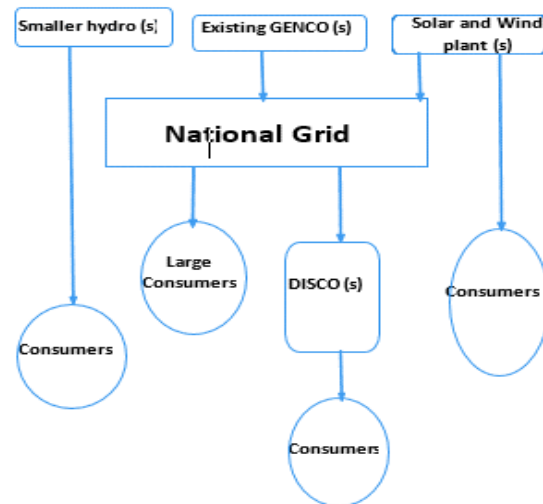
Figure 3: Proposed new model for power sector.

There is also need to have a well-informed statistics of household appliances as to know the capacity needed in a region to know the amount to be generated. Also to help private industries and enterprises [1].

Every nation has its energy policy including Nigeria and it should be practised. There need to be a policy made to enable private generation and distribution. Enforcement of the policies will help to pursue its sustainability.

Though policy interventions have been put forward in exchange for aging infrastructure especially aging transmission systems. These renewable energy based policies will help reduce the load that is being transmitted because needed electricity is generated nearby [3]. This can therefore be sustained by the legal institutions [4]. The following can serve as guides;

- ✓ Energy conservation
- ✓ Green energy production
- ✓ The use of local resources to aid in community development
- ✓ Ecology protection
- ✓ Research institutes and training
- ✓ Inter-community cooperation for generation

Figure 4 is a hierarchy that helps to manage and to see that the policies and operating rules are adhered to.

The above will help to build and sustain a growing economy and also to build a stable, clean and safe energy environment. The business enterprise and social development will also be improved.
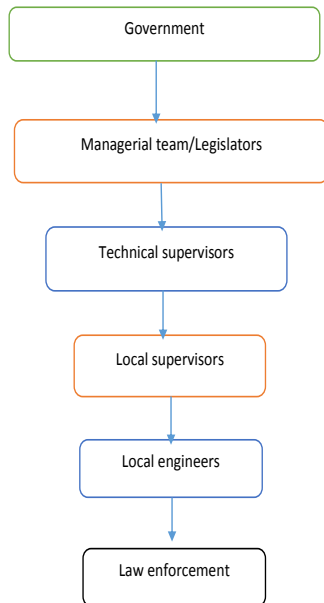
Figure 4: Hierarchy of Policy

Energy efficient devices is also one of the means for constant power supply by reducing power consumption. It is able to reduce home appliance whereby the small capacity that is produced is efficiently managed.

V. BENEFITS OF THE PROPOSED MODEL IN GRID DECONGESTION

Grid connected transmission are most times affected by geographical locations because the consumers are far from the generation centre or mostly favourable locations [5].

a. Proper management of the generation, transmission and distribution

b. Local area development

c. Reliability of power supply with reduced cost

d. Preventive maintenance and quick corrective maintenance of installed equipment.

e. Examples of smaller generation unit

Some locations in the country are more favorable for renewable energy which can be studied and used as generation points. For example, the northern parts.

Constant power supply in local environment will definitely affects business returns, a clean environment, local development and national economy as a whole [1].

VI. CONCLUSION AND RECOMMENDATION

The Nigerian grid which is presently made up of 5650km of 330kV lines and 6687km of 132kV lines are presently operating without redundancy. Therefore, making the grid unreliable in term of transmitting more power. This paper has discussed the various problems arising from a congested grid system as well as highlighting the benefits of decongesting the grid. It is in this wise that if the recommendations made are adhered to then improvement in power supply will be recorded and the overall effect will be an improvement.

The making of policies to admit private distribution and also awareness of the local community on how they can generate electricity and its efficient use is suggested. Recommendations are as listed below;

1. Those capable of generating can be allowed for private businesses.
2. There should be available policy to allow for power business and augmentation from the federal government.
3. Development in every sector is aided by real time services, this should also be encouraged and enforced in the rural community.
4. New transmission line should be constructed for access to areas where the climate doesn't favour electricity generation.

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Female Directors and Tax Aggressiveness of Listed Banks in Nigeria

Oyeleke Oyenike, Erin Olayinka
Department of Accounting,
Covenant University,
Ota, Nigeria
oyenikeoyeleke@yahoo.com, erinolayinka@yahoo.com

Emeni, Francis
Department of Accounting,
University of Benin
Benin, Nigeria

Abstract—*The study examines the relationship between the board of directors' gender diversity and tax aggressiveness of banks listed on the Nigerian Stock Exchange (NSE). Using cross sectional time-series research design as the blue print for data collection in this study, data collected were analysed using Statistical Package for Social Sciences (SPSS) 21. The study provides evidence that a positive and non-significant association exist between female directors and tax aggressiveness after controlling for firm characteristics and governance mechanisms. In addition, the interaction of board size with female directors is significantly associated with the reduced level of tax aggressiveness. The results are consistent with the 'women risk aversion' theory which stipulates that the different attitude of females to excessive risks can project upon corporate policies and decisions. However, the low representation of women in executive positions and on the board limits how their influence is perceived. The study also made some recommendations amongst which include that banks should be encouraged, or otherwise mandated to appoint women as board members to take advantage of their expected benefits.*

Keywords—*Tax aggressiveness, female directors, board size, board gender diversity, risk averse*

Heading 1

The board of directors is widely known to ensure the credibility of the financial reporting process and quality information for the computation of tax liability which is highly significant to public revenue and national development. Even with this, income taxes are seen as major source of cash outflow and significant amount of time, energy, and money may be employed reducing its impact on financial results. Thus, the decisions of managers and tax accountants may possibly favour incorporating actions that decrease taxes [30]. Therefore, tax aggressiveness refers to the aggressive side of tax avoidance practices [21]. Given the oversight role of the board on executive decisions, they may impact on tax reducing activities and should be considered as a key factor in the success or termination of aggressive tax behavior [39].

While much attention has been placed on the effects of board features on firm outcomes, prior theoretical and empirical research have neglected the relevance of diversity in attributes of board members. The board competence is likely to depend as much on the board attributes as on expertise, skills and demographic qualities of the directors in terms of age, nationality, experience, ethnicity amongst others, however, there is a growing interest on gender diversity in recent literature [6][32]. Female board participation connotes when at

least one female director exists on the board. Various suggestions advocate less risky policies and outcomes for female directors given that the higher risk avoidance behaviour of women compared to men could drive financial decisions and results.

On this basis, this study posits that the ability of the board of directors to reduce the tax aggressive behaviour can be potentially increased when a female is present on the board. An alternative view on how gender diversity of the board influences tax behaviour suggests that female directors serve better in controlling and monitoring the actions and reports of management [45][46] through better board attendance and greater monitoring by sitting on audit, nominating, and corporate governance committees which may limit the avenue to perform rent extraction. A substantial number of prior studies have examined whether women involvement within the board can lead to improved corporate governance and company results [33], risk portfolio [36], financial reporting [6], and company acquisitiveness [26]. However, there is a dearth of research addressing the influence of board gender diversity on the tax aggressive behaviour to reflect the extent of tax planning activities. This also opens an opportunity to assess gender diversity on bank board effects on tax planning since extensive research focused on firms in non-financial sectors.

As the increased clamor for gender diversity resulted in greater female participation on the board of directors across countries [33], it is necessary and imperative to identify the benefits of women directors on corporate and financial decisions. Besides, no prior evidence exists on the link between bank female directors and tax aggressiveness in Nigeria. Based on this background, the purpose of the study is to examine the association between female board members and tax aggressiveness. Using listed Nigerian banks between 2012-2014 periods, the empirical evidence revealed that the ratio of women the board, though positively related to effective tax rate, does not have a significant effect on tax aggressiveness. This result provide evidence that the female board members are not significant in reducing tax aggressiveness which may be attributed to the fact that few women on board may be inadequate to drive the expected gender benefits on tax avoidance policies.

Contributing to literature in diverse ways, this study reports on an emerging research related to board gender diversity and tax aggressiveness in emerging economies [3] [32]. This is

necessary to consider whether prior findings can be observed in another environment different in respect of culture, tax policies and governance efficiency. The study is also important to tax policy makers since tax aggressiveness could possibly lead to tax evasion that is detrimental to a country's revenue base and its public spending. The study also improves awareness of the users of financial statement and tax collection bodies on the extent of tax aggressiveness by which huge amounts may be lost [11]. The substantial reduction in the pre-tax earnings of firms which subsequently reduces their distributable profits may incline managerial actions towards tax aggressive behaviour on the basis of the regulatory 30% corporate tax.

The planning of remaining sections of the research is seen as follows: section 2 provides an overview of prior literature and hypotheses developed on gender diversity and tax aggressiveness as well as the theoretical framework. Section 3 indicates the methods, data and model specifications underlying the study while section 4 shows the empirical results and discussions. Section 5 concludes the paper with the contribution, recommendation and limitations.

Heading 2

I. Tax aggressiveness

Tax aggressive practices are usually implemented to minimise the tax burden to achieve greater after-tax earnings per share and cash available for shareholders [31]. Thus, it could also reflect a decline in taxable income when managed through tax planning practices that are legal as well as activities that may be viewed as illegal in some circumstances [13] [31] to reduce tax liability. Reference [28] [32] provide that tax aggressiveness can be substituted with tax avoidance, tax planning and tax sheltering. Since tax aggressiveness is a form of corporate decision and action that could reflect both executives and non executives aversion to risk, it presents a suitable setting to assess gender differences in risk taking for board members [21].

When making board decisions, paramount interest is shifted to the benefits and penalties linked with the engagement of avoidance practices. In other words, engaging in tax aggressive activities is accompanied by costs and benefits. The benefits cut across corporate tax efficiency resulting in larger cash retention for owners or shareholders as well as managerial rewards for obtaining compensations from owners and shareholders for their tax aggressive actions [13]. This indicates that higher net cash flow retained in form of direct tax savings is a major form of marginal gain which favours the shareholders. This is even more obvious in private family firms where the maintenance of public status and socio-emotional wealth are mostly seen as insignificant [42].

On the opposite side, the complexity and obscure nature of tax aggressiveness may promote activities that causes diversion of rent from shareholders such as earnings management, perk consumptions and excessive compensation to be concealed [13][28][42]. This is possible when the shareholders are unable to evaluate the managers' performance as a result of unclear corporate structure from the adoption of elaborate tax planning schemes; this form of actions were prominent in the Enron scandal [18]. Here, the monitoring role of the board is very

significant as managers may tend to over compensate in the event of huge cash savings. Tax aggressive firms may bear implementation costs, political costs, costs of defending aggressive tax positions [5] [37] and adverse public image [24]. Likewise, the reputation of the board members may also be smeared.

Similarly, the survey of [22] also disclosed that in the process of determining the appropriate tax schemes, the opinions of the majority of tax executives were similar on the significance of its impact on the reputation of a company. A major detriment attributed to tax aggressive conduct is the possibility of imposition of tax fines or large penalties by the tax officials or regulatory bodies [43][22] when found guilty. There may be loss of efficiency in internal control and potential stock price discount when the shareholders perceive that the purpose of tax aggressive actions of the firm is for rent extraction and when bad news that have been hoarded are exposed [5] [17].

Moreover, a large body of research focused on corporate governance mechanisms such as board of director features [30], form of ownership [13] [40], ownership structure [34] and tax aggressiveness have led to inconclusive results. However, the strength of existing corporate governance may influence the final outcomes [24]. In comparison to other corporate offences, [24] observe a smaller, significant fall in stock price around the period of tax sheltering reports; but a smaller impact on stock price in high governance firms. Moreover, well-governed (or poorly governed) firms experience significantly higher (or reduced) abnormal stock returns before, during, and after the tax shelter activity [43].

A firm's ownership structure which affects the nature of the agency problems arising in corporate settings also influences the outcomes of tax aggressiveness [5] [13]. These findings suggest that not all shareholders want managers to engage in substantial tax avoidance activities. Reference [28] also observed that the incentives encouraging tax sheltering activities may vary across different groups of shareholders, including institutional shareholders with various investment horizons.

II. Gender diversity of directors

The board is responsible for monitoring and evaluating management to act in the best interest of the shareholders through an effective corporate governance structure. To perform this task effectively, the directors should be adequately diverse to ostensibly mitigate the expropriation of firm resources for example by rent extraction. As [19] [39] indicate that the directors can influence a firm's tax aggressive position, the presence of female directors creates an avenue to study the extent of tax aggressiveness. Therefore, female directors are governance mechanism that shows women represented on the board.

Thus, there have been arguments that diversity could improve the effectiveness of the board and specifically recommends that companies can benefit from the existence of professional women in their boards. Higher participation of women on corporate board is generally promoted as women members are believed to bring important information and

knowledge to the board due to more wide-ranging professional experiences [9] [41]. Given that more alternatives are regarded, [32] [46] suggest that firms with diverse boards regarding gender embody innovation and quality process for deliberations to make board decisions. Thus, such firms encounter quality problem-solving, effective leadership; better understanding of the business market and benefits from global relationships [1] [11].

Reference [45] argued that the chance of gaining more profit and adding to shareholders' value makes gender-diverse board more favoured which improves the image of the firm. Reference [32] also noted that board comprising of female directors are likely promote honesty and high ethical values, greater independent reasoning, more informed decisions that increase the level of transparency at the board level and higher credibility within the board. However, some drawbacks of gender diverse boards suggest that reaching unanimous decisions may take longer periods and conflicts may arise more frequently. Reference [27] concludes that women risk aversion results in low financial performance in the stock market.

Gender-based behavioural differences between women and men are exhibited and observed from the decisions made by directors which tend to impact the major strategic and financial decisions taken [36]. Women are also likely to more compliant with legal requirements and specifically interested in tax matters when present on the board [3] [4]. Linked to gender differences, the interpretations of tax regulations and tax compliance levels may be dependent on the masculine traits: dominance, competitiveness, aggressiveness and feminine characters such as kindness, value for life, risk avoidance [1] [21].

Majority of previous studies have documented the positive influence of gender diversity on the corporate governance activities and firm performance in various contexts of developed countries [33] and developing countries [45]. Reference [6] [41] also suggest that women exercise intense monitoring over manager actions, have a higher attendance and hold more positions in monitoring committees such as the audit, nomination and compensation. Recent studies have also assessed the influence of female directors on environmental reporting and corporate social responsibility reporting [7].

III. HYPOTHESIS DEVELOPMENT

Reference [11] [16] expressed that expansive research has dwelt on gender differences on attitudes toward risk and in risk-related behaviour from psychology and economics. Generally, it is believed that women are more risk averse than men [12] [14]. On the basis of risk attitude, gender differences in economic experiments have been reviewed in the survey of [14]. Moreover, the differences in the behaviour of women and men may have essential effects on corporate financial decisions and outcomes [36]. Providing support for more women in the labour market, the differences in risk attitudes of female professionals have also been established.

In line with this, empirical literatures have found a negative association between the number of women on boards and bank risk. Reference [10] finds that, among other factors, gender diversity helped reduce ex-post risk for Italian banks.

Reference [23] also shows that risk is negatively linked to women directors in OECD banks. Research reports that firms with women directors had lower portfolio risks in Italy [16]. However, on the sample of listed firms in Sweden, [1] survey of directors provide evidence that female directors may be even more risk prone than their male counterparts.

Given that women are generally more cautious and less motivated to bear excessive risks, the gender of the firm's directors have been suggested to affect corporate polices and outcomes. Reference [6] [41] indicate that firms with female directors have lower absolute discretionary accruals (or earnings management). Reference [20] [27]document that female executives and directors are more conservative in financial reporting. Female executives are more cautious in making significant acquisitions and issuing debt [26]. Reference [36] provide robust evidence that banks led by female executive take more conservative policies and maintain higher levels of capital. Reference [16] shows that females on board positively impact on the quality of credit. They support the opinion of women being more inclined to monitor and control activities.

In addition, empirical evidence relating to gender diversity among professionals in the workforce supports the negative relationship. Unlike male investors, [26] observed that more attention is given to downside risk by female professional investors. Reference [9] noted that female loan officers are more risk averse than the male officers and are likely to limit credit to newly established firms. Reference [8] also revealed that loan officers that are women better oversee their loan portfolio and have reduced chances of being unpaid and defaulted on these loans.

Research in the accounting literature has addressed the link between board gender diversity and tax aggressiveness. On a sample 300 S & P 500 firms, [4] examined the effect of gender diversity on corporate tax planning for 1996- 2009. They observed no significant effect of board gender diversity on tax planning. This is in agreement with the notion that the low proportion of women directors and dominance of masculine strategies for tax planning impedes higher gender diverse influence on board decisions. Among other three measures of board attributes, [3] showed that the percentage of women on the board was positively and significantly related to tax planning for 32 listed Tunisian companies during 2000 to 2007.

On the contrary, [2] found that there is a negative effect between board gender diversity and tax optimization. They concluded that the presence of women does not enhance the tax planning strategy within the firm but leads to further increases in effective tax rates. Between the periods of 1988 to 2007, [21] examined the executives' gender effect on tax aggressiveness and compare the extent of tax aggressiveness between the different transition periods for male-to-female CFO turnover firms for most S & P 1500 companies. Using three measures of tax aggressiveness, female CFOs were related to lower tax aggressiveness than their male counterparts. Similar results were obtained for subsequent male-to-female CFO transition.

Reference [11] noted significant evidence of a negative link between board gender diversity and tax aggressive actions

using 39 Tunisian listed firms over the period of 2006–2012. They concluded that the higher percentage of women increases the effective tax rate signifying low tax aggressiveness. Reference [44] also established that the percentage of female directors influences the tax aggressive activities on a sample of SBF 120 index French companies amongst other governance variables. On a sample of U.S firmsover the period of 2006-2009, [32] revealed that a negative and significant association exists between board gender diversity and tax aggressiveness.

Similarly, it is expected that when more women are represented on the board, it is highly probable that monitoring and oversight function over managerial choices on tax liability improves to reflect on the decisions related to tax aggressive activities. Therefore, the paper proposes the following hypothesis that:

Hypothesis 1: There is a positive relation between female directors and tax aggressiveness in Nigerian banks.

On the other hand, the size of the board firm can be argued to be an essential moderator in the perspective of tax aggressive behaviour. The relative sizes of corporate boards can be a key factor for firms thatexhibit tax aggressive tendencies [30] [44]. Small boards of firms may have greater incentives to engage in tax aggressiveness and they are likely to be smaller in size and face less public scrutiny. However, [35] provide evidence that the small boards of directors support the good tax management, while large boards are proving ineffectiveness because of the difficulties in decision-making about tax aggressiveness policy.

In spite of this, extensive prior evidence shows that larger boards should performbetter, efficiently discharge its functions and have more women represented on the board. As well, they should consist of a seasoned group of individuals with adequate knowledge and expertise to supervise firm activities. Hence, the strengthened position of the board from size and gender diversity of the board on managerial supervision should lead to reduce the motivation for aggressive tax policies by top executives. Therefore,

Hypothesis 2: The association between female director and tax aggressiveness will be positively influenced by the relative board size.

Heading 3

The choice of target sample for data collection consists of the 15 listed banking institutions on the Nigerian Stock Exchange because they are under the strict monitoring of the body and are highly regulated. This indicates the relative significance of the banking sector within the economy and prompts their preferred selection. Similar to [32] [34], banks with negative pre-tax income and tax credit were excluded to produce a reduced final sample of 11 banks. The data on the study variables was collected from the annual reports sourced from the company's website and African financials website for the periods of 2012 to 2014 which was the latest and most complete financial period available for data collection at the time this study was carried out.

There has been a number of measures of tax aggressiveness used in the prior literature and are usually centered on the financial statements estimates [5]. Several previous studies assess firms' tax aggressiveness using the degree of their unrecognised tax benefits. Effective Tax Rates (ETR) which is a common proxy has the following measures: accounting or GAAP, current, cash and long-run cash ETR. It could also be measured as the income tax expense divided by operating cash flow; ratio of cash taxes paid by operating cash flow and ETR differential [25] [37].

The dependent variable used, the effective tax rate is defined as current reported tax divided by profit before tax. Firms that allow more aggressive policies should exhibit lower effective tax rates (ETRs) which are aggressive tax planning indicators through permanent book-tax differences [13] [40]. The independent variable, female directors, is also measured as percentage of women on the board to the total directors following [15]. In order to perform the regression analysis, six control variables: firm size (SIZE), financial performance (ROA), capital intensity (CINT), and leverage (LEV); independent board (INDB) and board size (BSIZE) are used that are previously linked to tax aggressiveness. This ensures that firm characteristics and governance mechanisms do not drive the results of the study.

The economic and political power advantage of larger firms relative to small companies makes them more prone to tax aggressiveness [25]. SIZE is measured as the natural logarithm of firms' total assets. Financial performance based on the Return on assets (ROA) is defined as the ratio of profit before tax income to total assets which should lead to an increase in ETRs [2] [31]. Tax aggressive actions may be lower in highly leveraged firms as they sustain tax deductible interest payments. Leverage is measured as total liabilities divided by total assets. CINT is the ratio of property, plant and equipment to the total assets [31] as long term capital investments may produce lower ETRs. Prior evidence mostly indicates that as the strength of governance mechanisms increases, managerial opportunism decreases to reduce tax aggressive behavior [42]. Similar to [35], the percentage of independent outside directors on the board as well as the total board number measure board independence and board size respectively.

To examine the association between the female directors and tax aggressiveness, a fixed effect panel regression model was used in order to perform an analysis regarding various parameters included in our model. Therefore, similar to [4] [25], the following regression model was estimated:

$$ETR_{it} = \propto_0 + \beta_1 DIV_{it} + \beta_2 BSIZE_{it} + \beta_3 INDEP_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 ROA_{it} + \beta_7 CINT_{it} + \mu_{it} + \varepsilon_{it} \qquad (1)$$

Heading 4

This section presents the descriptive and inferential results obtained from the study and findings from the results are discussed on the basis of the literature.

Table I presents the descriptive statistics of the explanatory and dependent variables in the sample firms. The mean and standard deviation of effective tax rate is 0.1210 (12.10%) and 0.8688 showing that the effective tax rate of the sample is under the statutory tax rate of 30%. It can be implied from the low average effective tax rate that Nigerian banks are tax aggressive and the nature of payment of taxes fail to signify the statutory tax rates displayed by the government. The average

proportion of female directors is 18.7% which signals for higher participation of women on bank boards in Nigeria. The highest number of board members that were women is 4 while some boards did not have women presence.

As regards the corporate governance variables, the average board size is 15 and does not surpass the stipulated 20 members and on average, independent directors ratio is 15.44% of board members. This low value shows the need for more directors without direct or indirect financial interest on corporate boards. With the minimum number of 0, some board failed to include independent directors while others had as many as 4. However, the mean of firm size, leverage, ROA and capital intensity was 21.02, 0.8166, 0.0242 and 0.2783 respectively.

TABLE I: Descriptive Statistics

	N	Min	Max	Mean	Std. Dev.
ETR	33	0.0099	0.493	0.1210	0.0869
FD	33	0.00	0.333	0.1869	0.0829
BIZE	33	10	19	14.82	2.443
BIND	33	0.00	0.4	0.1544	0.0853
SIZE	33	19	22	21.02	0.753
LEV	33	0.0035	0.9196	0.8166	0.2112
ROA	33	0.0039	0.0618	0.0242	0.0142
CINT	33	0.0001	0.0438	0.02	0.01

Table II provides a correlation matrix of the variables. The proportion of female director reveals a positive relationship with effective tax rate. The same was observed for board size, firm size, leverage and capital intensity whereas board independence, and Return on assets (ROA) showed opposite relation to ETR in respect of the control variables. However, only capital intensity was significant to ETR.

The analysis also provide evidence that female directors is positively correlated to firm size, implying that higher proportion of women is more likely to belong to larger firms. Furthermore, the significant positive relation with leverage indicates that the higher the leverage, the higher proportion of women on boards. The positive significant relation also denotes that larger boards which tend to fit in with larger firms may lead to higher number of female board members. This implies that firms that are larger in size are more likely to open more opportunities to improve board gender diversity. The intensity of long term investment in property and equipment is related positively to women on boards. This significant evidence suggest that capital intensive banks are prone to possess women as board members; a significant negative relationship also exists for independent boards and ratio of female directors suggesting that more board independence leads to significantly lower women board appointment.

However, in terms of performance, the table II reveals that the proportion of female directors has no significant relationship with ROA. In addition, the correlation coefficient of 0.768 between firm size and leverage carries the highest value. This implies that larger banks are likely to hold higher form of leverage.

TABLE II: Correlation matrix

	ETR	FD	BSIZE	BIND	SIZE	LEV	ROA	CINT
ETR	1							
FD	0.299	1						
BSIZE	0.186	0.360*	1					
BIND	-0.172	-0.439*	-0.556**	1				
SIZE	0.252	0.615**	0.475**	-0.398*	1			
LEV	.318	.565**	0.467**	-0.558**	0.763**	1		
ROA	-0.177	-0.090	-0.251	0.236	-0.018	-0.43*	1	
CINT	0.394*	0.575**	0.535**	-0.497**	0.575**	0.65**	-0.22	1

**Significant at 1% level and *Significant at 5% level

From the regression (1) in table III, the adjusted R square of 0.154 indicates that the independent variables explain 15.40% of the changes in the ETR. The positive sign of the coefficient of the female directors implies that the increase in the percentage of women seating on the board increases the ETR. Even though at 5% level of significance, the coefficient was not significant, the hypothesis of the study is accepted. This is similar to the results of [3][44] for low female presence on boards which provide evidence of no significant effect on tax management. The significant coefficient of the control variable, board independence relates to the opinion that the presence of independent directors can mitigate tax aggressive positions of managers. Similar to [30], the inclusion of a higher proportion of board independence reduces the likelihood of tax aggressiveness. Meanwhile, the studies of [39][35]showed evidence of increased tax planning activities.

However, the study found no significant evidence for the rest of the other control variables. The negative sign for the board size coefficient is not significant to suggest that a larger board size would cause an increase in tax aggressiveness. Finally, the regression coefficients for LEV, FSIZE, ROA and CINT were found to be insignificant. These results are contrary to [32] [35] [38] [44]. As the firm size is also not significant, this indicates that tax aggressive behaviour is not limited as regards to the size of bank operations and smaller banks may even be more tax aggressive than larger banks.

In regression (2), the moderating effect of board size was based on the relationship between female directors and ETR. Including the variable, FD * BS, greatly improved the explanatory power of the model as the adjusted R^2 increased to 30.8%. The FD variable coefficient carried a negative value while the moderating term bears a positive sign, both significant at 10% level. Therefore, the ratio of female directors significantly affects tax aggressiveness when they are occupying positions on large boards. It can be implied that if

women are part of large boards, they are likely to be larger in size which allows the risk avoidance behaviour of women to be significantly felt on the board decisions.

TABLEIII: Regression results

Variables	(1)			(2)		
	β	F-stat	Sig.	B	F-stat	Sig.
FD	0.154	0.076	0.787	-7.191	3.658	0.08*
FD * BS				0.478	3.886	0.07*
BSIZE	-0.020	0.495	0.494	-0.102	4.361	0.05**
INDB	0.944	1.312	0.048**	1.831	4.422	0.05**
FSIZE	0.070	0.053	0.821	0.511	2.095	0.173
LEV	-0.711	0.759	0.399	-1.713	3.651	0.08*
ROA	-5.290	0.954	0.346	-3.166	0.398	0.540
CINT	11.826	1.766	0.207	24.113	5.608	0.03**
Intercept	-1.002	0.021	0.871	-9.119	1.74	0.207
R^2	0.656			0.741		
Adjusted R^2	0.154			0.308		
* and ** significant at 10% and 5% respectively						

Heading 5

This study considers the effect of female directors on corporate tax aggressiveness on a sample of 11 listed banks over the period of 2012 -2014. Employing a panel regression analysis, the higher proportion of female directors does not significantly reduce the possibility of tax aggressiveness. Female directors on bank boards are noted to be positively correlated to effective tax rate, thus, higher ratio of women as directors should lead to lower tax aggressiveness as ETR increases. This study found that the women presence in board of directors has a negative but insignificant effect on managerial tax aggressiveness in banks.

On the basis of the study findings, the percentage of women sitting on corporate boards is negligible in comparison to the men. This inadequacy of female directors stems from the under-representation and insufficiency of professional women in senior and key management positions [4]. Therefore, this may boil down to the reason for women directors to be insignificant in minimising tax aggressive behaviour. As a result of this, the proportion of female sitting on board may be insignificant to cause an adequate influence on the board tax policies. It has been observed that women may be placed on the board as "tokens" to channel no real value to the board. As tokens, firms may just slightly improve gender diversity of the board to satisfy increased support for boardroom diversity. In line with this, a pool of at least three female directors is viewed to be able to influence corporate outcomes to constitute a 'critical mass' [29] [45].

Moreover, the size of the board has a positive moderating effect on the tax aggressiveness of female occupied boards within the banking industry. It can be implied that better governance structure goes favourably with increased board gender diversity; given this, further increase in female directors should be accompanied with adequate governance means required to function at an efficient capacity.

IV. RECOMMENDATIONS

In light of the above findings, banks should strongly apply the policy encouraging or otherwise mandating women as board members to take advantage of their expected benefits. This can be more beneficial when a sufficient pool of qualified women is available to occupy these positions. This indicates the urgent need for gender equalityin accessing education and learning opportunities. Relating to societal influence, the female gender across all age groups has to be encouraged to pursue their work goals and not be constrained by traditional values and customs. Regarding Nigerian policy, the study recommends that the gender and equal opportunities bill should be re-introduced, accepted and become legally binding across the nation.

This research opens an avenue in an emerging research area for future studies to examine gender effect on other sectors or the entire firms listed on the stock exchange. This may be women board members, executives and those in top management. In addition, other measures of diversity can be taken together with gender diversity to study tax aggressive behaviour. The study suggests that empirical evidence on the determinants of tax planning activities among Nigerian banks and other firms is obtained.

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Effect of System Factors on Whistleblowing Attitude of Nigerian Banks Employees: A Conceptual Perspective

Onakoya, Olorunfemi Adebisi; Moses, Chinonye Love
Business Management Department
Covenant University, OtaOgun State, Nigeria
Olorunfemi.onakoya@stu.cu.edu.ng
Chinonye.moses@covenantuniversity.edu.ng

Abstract— **Whistleblowing provides a self-correcting mechanism for an organization to prevent unethical practices. Lessons from collapsed businesses around the world show that organisations do not just collapse, but rather it is a gradual process resulting from a series of inappropriate acts left un-addressed. This paper is based on a conceptual perspective. Past studies on whistleblowing were reviewed, gaps and weaknesses identified to develop a conceptual framework on whistleblowing reporting attitude of bank employees in Nigeria. The conceptual framework is anchored on the Resource Dependence (RD) and Planned Behaviour (PB) theories. The paper provides important lessons for promoting ethical practices in organisations and the society at large. Based on the gaps in literature, this paper recommends among others a performance review system that is tied to rewarding whistleblowing; ways to protect whistle-blowers and the need to strengthen organizational support structures for whistleblowing. Keywords—component; formatting; style; styling; insert (key words)**

I. INTRODUCTION

There are several stakeholders involved in the running of a corporation, with varying interests, but common to their objectives is the sustainability of the organisation. The employees play critical role in ensuring this objective, and as such cannot afford to watch helplessly while the business is about to disintegrate. Hence they act as watchmen and whistle-blower. Corporate frauds and other unethical practices have devastating effects on most stakeholders, as observed in the case of Enron and Arthur Andersen. Employees lose their jobs, shareholders lose their investments and governments lose tax revenue, while the communities lose potential social benefits. Similarly, an employee who brings a potentially hazardous product to the attention of management before it is introduced to consumers, saves the organisation from potential lawsuit and a damaged reputation. In this context, the employee has a duty to ensure the organisation's sustainability is not jeopardised.

KPMG [1] report on Instances of Fraud In Organizations in Europe, Middle East and Africa shows that anonymous tipping by employees was the primary source of detection. A comparison of experiences with other countries revealed a missing link in Nigerian organisations' war against serious wrongdoing. Whistleblowing deters misconduct within institutions by increasing the possibility of uncovering immoral, illegitimate and illegal practices and punishing its perpetrators. By promoting transparency of information exchange in organisation's dealings, whistleblowing brings out in the open unethical practices that are well-hidden and enhances the chances of successful prosecution of wrongdoings. Unfortunately, employees often stay silent, due to a number of reasons, which may include the fear of retaliation, apathy, lack of faith in the system, absence of incentive, lack of protection and support [2]. Nigeria's cultural orientation discourages subordinates from questioning authority. Consequently, organisations need to encourage employees who suspect wrongdoing to take an action that would lead to a halt of the wrongdoing. Upon this premise, this paper seeks to develop a conceptual perspective for examining the relationship between system factors and whistleblowing attitude among employees in Nigerian banks.

A review of literature on whistleblowing revealed a pattern of researchers' focus on issues that involve organisations and whistleblowing. Some of these studies include the work of [3] which focused on the myth and reality of whistleblowing; [4]'s work on whistleblowing in organisations; [5] on meta-analysis of correlates of intentions, actions and retaliation; [6] on influence of reporting channel. These studies observed practices in developed countries thereby ignoring the cultural influence and developmental status relevant to a country like Nigeria. The few studies available in Nigeria include the works of [2] on the fight against corruption; [7] on effects of whistleblowing practices on organisational performance in public sector; [8] on the need for whistleblowing awareness in corporate Nigeria and on the role of accountants in whistleblowing. A general trend of the studies is a focus on why individuals do not blow the whistle, but no study has researched into what factors influence whistleblowing attitude of Nigerian bank employees.

The Central Bank of Nigeria (CBN), in an attempt to improve governance in banks recently introduced the requirement for banks to establish whistle-blowing procedures that encourage all stakeholders to report any unethical activity or breach of the corporate governance code using, among others, a special email or hotline to both the bank and the CBN. This represents the first mandatory initiative for whistleblowing in Nigeria, which has not been considered in available studies. Conceptual models developed in whistleblowing studies have looked at antecedents to the behavioural intention, and the actual behaviour without

considering the influence of post-behavioural evaluation [4]. Specifically, the study aims to (i) identify the relationship between moral sensitivity and employees' satisfaction in whistleblowing; (ii). Analyse the relationship between job characteristics and employees' commitment toward whistleblowing; (iii). Examine the role of organisational culture and ethical climate on employees' loyalty for whistleblowing; (iv). Evaluate the relationship between leadership and employees' trust to encourage whistleblowing; and (v). Review the relationship between support structures and employees' perceived reward toward whistleblowing.

The findings of this paper are useful to the banking industry, academia, and other industry managers in identifying the predictors of reporting intention. This helps in implementing appropriate measures to strengthen the positive factors affecting whistleblowing intentions. This paper contributes to contemporary academic research on whistleblowing by offering insights into factors that promote and hinder whistleblowing intention in the Nigerian context, by going beyond the psychological factors researched extensively in the past, and by applying the cultural lens in understanding employees' behavioural intention. By promoting whistleblowing culture, the organisation is able to forestall losses and other risks. Findings from this paper will also assist government executives (in formulating policies to support whistleblowing culture); legislature (in drafting and passing whistleblowing bills); and the judiciary (in protecting whistle-blowers); and finally, the general public benefits by understanding the concept and practices of whistleblowing, and how it helps the organisation in particular, and the society in general.

II. CONCEPTUAL FRAMEWORK

A. The Concept of Whistleblowing

A common definition of whistleblowing is the 'disclosure by organisation members (former or current) of illegal, immoral or illegitimate practices under the control of their employers, to persons or organisations that may be able to effect action' [9]. There must be a genuine concern about a crime, criminal offence, miscarriage of justice, dangers to health and safety and of the environment – and the cover up of any of these. Whistleblowing is not the same as a complaint, as customer services or other relevant departments in an organisation handle complaints.

Whistle-blowers have a sense of moral standards which passionately drives them over and above other considerations in making a decision on whether to blow the whistle or not [10]. Despite their intent to protect the public good, whistle-blowers are at times viewed negatively and seen as disloyal or disgruntled employees.

An attitude can be defined as a "learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object" [11]. Attitude has been studied from cognitive and experiential perspective. It may also be formed based on an individual's beliefs about consequences from behaviour, or evaluations of consequences from behaviour. Behavioural attitude can be viewed from the possible behavioural inclination of an individual [12]. It refers to the strength of a person's conscious plans to perform the target behaviour. Therefore, whistleblowing refers to an individual's likelihood to report on observed wrongdoing, which in his/her judgment is immoral, illegitimate or illegal. Whistleblowing behaviour therefore refers to the actualisation of the whistleblowing attitude. While whistleblowing intention does not always lead to whistleblowing behaviour, intentions when correctly measured could predict actual behaviour.

Whistleblowing behaviour can be reported internally or externally, while the whistle-blower can choose to report formally, or informally, and to be anonymous or identified [13]. Internal whistleblowing is usually defined as reporting wrongdoing outside the regular chain of command via, for example, confidential hotlines [4]. External whistleblowing refers to reporting wrongdoing to someone outside the organization who may be able to stop or correct it. Most external whistle-blowers first blow the whistle internally [4, 14] as the latter is less risky for the whistle-blower [15] and also less detrimental to the organization. In contrast, external whistleblowing may lead to public embarrassment, government scrutiny, hefty fines, and litigation [16] as it not only exposes internal wrongdoing, but also a failing organization – one which is unable to stop and correct wrongdoing itself. External whistleblowing is considered more effective than internal whistleblowing [17] because it often sparks investigations or other remedial actions by the organization, [18], however external whistle-blowers suffer more severe retaliation. Although internal whistleblowing poses less threat than public scrutiny resulting from external whistleblowing, it is often not welcome [5] and is frequently ignored [19]. Therefore, the choice of an internal or external channel will prompt different results –in form of threat, benefit and reaction to the whistle-blower, the organisation and society.

Benefits of whistleblowing

Despite several key developments in the Nigerian banking sector, the same symptoms of financial recklessness, unethical practices and weak corporate governance [20] are still characteristics of the industry. CBN in response has introduced a code of corporate governance practices for banks post-consolidation, including a mandatory whistleblowing policy among others.

Whistleblowing provides several benefits to the individual, organisation, and the society. For the individual, s/he emerges as an agent of change, with a sense of achievement and satisfaction on the remediation of a negative course of event. The employee thus acts as a partner in ensuring the sustainability of the organisation. The organisation benefits by prevention or termination of fraud, corruption, illegal and illegitimate activities, which reduces exposure to risk, losses and legal action. Also, the shareholders' confidence is increased, while the organisation's image of being responsible is enhanced. In summary, the reputation of the organisation (one of the most important assets it has) is kept intact. An organisation that loses its reputation quickly disintegrates (see Enron, Arthur Andersen). Whistleblowing promotes public good, and a safer society. Nigeria as a country for instance, stands to benefit from whistleblowing as an anti-corruption tool through efficient allocation of resources, preservation of

national wealth, and improved well-being of the citizenry. These benefits lead to positive perception, improved ratings in global indices, and ultimately the attraction of foreign investors.

System Factors

An organisation is an interconnected and interdependent system with several feedback circles, and can best be analysed in how it responds to internal and external forces. Interaction in organisations involve people, culture, processes, structure, technology, institutions, and government among others. To study whistleblowing attitude of employees, it thus makes sense to consider the factors surrounding the organisation as a system. These factors may be individual-related (such as moral sensitivity); job-related (such as job characteristics); and the organisational environment (such as organisation culture and climate, leadership, and support structures). Analysing system factors thus helps us to understand why people behave as they do.

B. Theoretical Framework

Theory of Planned Behaviour (TPB)

TPB [12] holds that the human behaviour is guided by three types of considerations: (i). Behavioural beliefs- beliefs about the likely outcomes of the behaviour and the evaluations of these outcomes, (ii). Normative beliefs - beliefs about the normative expectations of others and motivation to comply with these expectations, and (iii). Control beliefs-beliefs about the presence of factors that may facilitate or impede performance of the behaviour and the perceived power of these factors. These beliefs produce respectively, attitudes toward the behaviour (which may be favourable or unfavourable), social pressure or subjective norm, and perceived behavioural control. The underlying assumption of the TPB theory is that intention is the immediate determinant of behaviour, even though studies have shown a weak relationship between intention to act and the actual performance of a behaviour[21]. It however suffices for our study of whistleblowing attitude among employees. The TPB has been used by several researchers in the study of behavioural attitude and intention – For instance, "how consumers view green hotels" [22]; academic-entrepreneurial intention [25]; fertility intentions [24]; predicting sleep intentions and behaviour of undergraduate college students [23] among others.

Based on the TPB, whistleblowing behaviour will be directly influenced by the employee's attitude towards whistleblowing. Attitude is formed by various factors such as moral sensitivity, beliefs, background among others. The subjective norm emphasises the influence of peers and significant others (i.e. reference groups) in forming a whistleblowing intention. This leads to the employee's motivation to comply with the expectations of the reference group. Perceived control (the third and last component of TPB) which is defined as the perception of a person of the ease or difficulty of performing the act of interest [12] is suitable in this paper because a potential whistle-blower needs to consider the personal cost of reporting, the fear of retaliation, possible loss of job etc. before taking a decision to blow the whistle. The TPB is however limited in explaining fully the whistleblowing decision-making process, as it completely ignores the influence of institutional structures, and environmental factors, as well as the power play in organisations.

Resource Dependency Theory

The Resource Dependency Theory [26] views organisation in a cyclic process with three major points- every organisation needs resources to survive and this leads to interdependence; interdependence leads to uncertainties; and in order to reduce uncertainty, organisations form coalitions, pool resources and change their strategy to survive. These coalitions (or claimants) can be both internal and external, with each claimant having some power over the organisation based on their resources. This power may be in form of possession of resources, control of the use of resources, and or regulating the possession of critical resources. The underlying assumption therefore is that resources are controlled by some parties, who are in turn depended on by other members. The theory has been used in various studies – corporate governance [27], whistleblowing [28]; power base in churches [54] among others.

Organisations are dependent on a number of key players for needed resources, which in turn leads to power relations within the organisation. Powerful employees in an organisation are in a better position to influence the organisation (management) to terminate wrongdoing. Thus, employees with more experience, tenure, and better job performance may be considered more valuable to an organization, thus giving them some leverage to report misdeeds [15]. Conversely, organisations may find it difficult to take action against powerful employees, where they are the ones involved in the wrongdoing, especially in a corrupt organisation or organisation of corrupt individuals [29]. The organisation may therefore consider it beneficial to dispense with the whistle-blower rather than the valued and powerful employee. Consequently, a potential whistle-blower may be forced to assess his/her power base, either over the wrongdoer, or over the organisation before making a whistleblowing call. Where they lack the power to change unethical practices, they may have to rely on informal power such as external whistleblowing channel, which may damage the organisation's reputation. Alternatively, they may exit the organisation, carrying along experience and knowledge valuable to the organisation. For effective whistleblowing therefore, organisations need to recognise the less powerful employees, and treat their whistleblowing reporting seriously, as it may be meritorious, or carry a potential reputation risk.

III. METHODOLOGY

This study is based on a conceptual framework. A structured approach was used to determine the source of materials for review. The peer-reviewed literature was the main source of information and data about whistle-blowing attitude. In addition, we consulted with other materials outside the main scope of the subject database. Different literature were reviewed to identify gaps and weaknesses in the literature so as to develop a conceptual framework for encouraging employees in whistle-blowing.

A. Empirical Framework Based On Specific Objectives

Proposition 1: Moral sensitivity has a positive effect on employees' satisfaction in whistleblowing attitude.

Moral sensitivity is critical towards forming an attitude about a wrongdoing [30,31], and therefore whistleblowing intentions. It can be moulded by several factors such as religious beliefs, family background, demographic factors, peer influence, and cultural orientation. An employee needs to consider how easy or difficult it is to form an attitude through its moral intensity [32]. Demographic characteristics of the employee play important role in forming an intention - For instance, on gender, women are assumed to have a greater moral burden than men, while men are perceived to take more risks [21]; and [33]; on age, older employees are assumed to have acquired greater moral sensitivity than younger employees as a result of having dealt with more moral conflicts situation at work and non-work setting. Lee [52], [33]Heilmann and Near, 2004; Zhang et al., 2009); and on tenure, employees that have stayed longer in an organisation tend to have more attachment to the organisation[52,39,33]. Influence of peers and the employee's significant others also have effect on shaping the employee's moral sensitivity.

The type and severity of wrongdoing; magnitude of consequences, probable effects, and the status of the wrongdoer also influence the employee's moral sensitivity, and therefore have significant implications in the decision to blow the whistle [5,3,34,32]. A morally sensitive employee therefore will attempt to cleanse his conscience by reporting unethical practices, knowing that his action will bring a termination of the wrongdoing, and enhance the sustainability of the organisation. This gives the employee a sense of achievement and a moral victory for helping to bring a culprit to book. The employee's satisfaction may both come from extrinsic (such as recognition) and intrinsic values, such as making employees feel effective in their roles that they can positively influence organisational outcomes [35].

Proposition 2: Job characteristics has a positive effect on employees' commitment toward whistleblowing attitude.

Job characteristics here refers to the employee's job status, satisfaction, performance, growth, and achievement orientation. It is assumed that the high level of unemployment in Nigeria tends to ensure employees value job security and do all within their legitimate capacity to retain their highly remunerative jobs. An average banker has financial responsibility, not only towards his immediate family, but also the extended family members. The high remuneration and other job characteristics stimulate increased job satisfaction [36] and increased job performance [35]. High flyer employees [5], and those with great "attachment to the organisation are also known to exercise the whistleblowing behavioural intention" [3].

Another dimension of job characteristics relates to the employee's role responsibility (also called personal reporting responsibility), which refers to the degree to which a potential whistle-blower has a formally prescribed responsibility to report. Employees such as internal auditors, compliance officers, external auditors, ethics officers etc. for instance see whistleblowing as their role responsibility and are more likely to blow the whistle than employees assigned to non-compliance related work. Miceli[15] found a positive correlation between those who view whistleblowing as part of their role description, and that such individuals consider their action to blow the whistle as more effective because of the perceived role responsibility.

In Nigerian banks, employees with compliance function as their role description are generally perceived as "policemen", whose motive is to "nail" employees in the organisation. They are "not to be trusted or confided in". They are also generally frowned at, as employees tend to tip-toe around them, or shut-off conversations on sighting them. By job definition, they are considered the first line of defence against wrongdoing, and it is not uncommon to find these officers belonging to professional associations guided by rules and regulations. They are therefore considered to have a responsibility as a watchdog to protect the organisation against wrongdoing, which in turn is driven by their commitment to live up to the organisation's expectations. Their commitment comes from their perception of compatibility of interests and values with the organisation; sense of belonging and obligation; feeling of job satisfaction; and the belief of being engaged in a fair economic exchange [53].

Proposition 3: Organisational culture and ethical climate has a positive effect on employees' loyalty for whistleblowing attitude.

Organisational culture and climate focus on how employees perceive, experience, and make sense of their work environment [37]. They are important concepts in describing and analysingorganisational phenomena [38] such as whistleblowing in this study.

There is a consensus that individuals in organizations with strong organisational culture, and ethical climates are more likely to engage in whistle-blowing when they observe a wrongdoing [39,14,33]. One way of providing a friendly and transparent atmosphere is through Perceived Organizational Support (POS), which refers to "employees' perception concerning the extent to which the organisation values their contribution and cares about their well-being. POS has been found to have important consequences on employee performance and well-being" [40].

Employees who have managerial or supervisor support [31, 18, 5] are more likely to ignore inhibitions such as the fear of retaliation, fear of loss of job, and status of the wrongdoer because they perceive the organisation to be responsive to complaints [41], which in turn encourage loyalty to the organisation.

Another way of promoting an ethical climate is through the provision of ethical codes and guidelines in the organisation. An ethical code is a "distinct and formal document containing a set of prescriptions developed by and for a company to guide present and future behaviour of its managers and employees toward one another, the company, the external stakeholders and /or society in general with the purpose of removing ethical ambiguity and providing clear direction for ethical conduct". Jones [42] found that managerial responses to ethical decisions

are influenced by the ethical stance of the organization. Pimentel [43] highlighted the role and significance of organisational ethics – compliance to codes of conduct.

An organisation that provides a friendly and transparent atmosphere will encourage employees' loyalty. The employee holds the duties of loyalty and confidentiality to his employer, and therefore whistleblowing in an ethical climate is an act of loyalty. Furthermore, since an organisation's goal is to maximise profit, whistleblowing and loyalty serve the same goal, which is the moral good of the employer.

Proposition 4: Leadership has a positive effect on employees' trust to encourage whistleblowing attitude.

An ethically strong leadership helps to project the organisation's values, create an ethical climate, and foster value alignment. Relevant characteristics of an ethical leader include, identified support for others, honesty, personal accountability, and fairness to others. Beenen[29] described the lack of ethical leadership in explaining the corruption in Enron. According to [44], corruption may be institutionalised by the organisation for its benefit (i.e. Corrupt Organisation), or perpetuated by key figures for personal benefits (i.e. Organization of Corrupt Individuals). Eseoghene [45] identifies "greed, lack of personal ethics and weak corporate governance as managerial factors that help propagate frauds in Nigerian banks; and for which top management should be held responsible". An antidote to a pervasive culture of unethical practices is strong ethical leadership. Employees who serve under ethical leaders are able to build trust in the judgment of the leaders, and the organisation at large. Their trust is derived from the concept of organisational justice [46], which relates to a perception of fairness: "of the outcome that an employee receives; of the procedures used to determine those outcome allocation decisions; and of communications or interpersonal treatment that accompanies organisation formal procedures".

Proposition 5: Support structures has a positive effect on employees' perceived reward toward whistleblowing attitude.

We describe support structures to include professional codes, functional judicial system, organisational ownership type, national culture and cultural orientation.

Employees belonging to professional associations, such as the Nigeria Bar Association (NBA), Institute of Chartered Accountants of Nigeria (ICAN), Nigeria Medical Association (NMA) etc. subscribe to the association's codes, which generally promote ethical behaviour among members.

While the whistleblowing culture is yet to be rooted in Nigeria, ICAN established a N50million Whistle-blower Protection Fund to protect its members and the public from any form of reprisal when a wrongdoing is reported. The fund is also aimed at assisting whistle-blowers in reasonably incurred litigation expenses [47]. While the amount may appear low, and the modalities for drawing from the fund may not be attractive to employees, it creates a motivation of a perceived reward for members to disclose wrongdoing in the organisation.

A functional judicial system also serves as an incentive for employees, especially where there are statutes protecting the whistle-blower. Organisational ownership type also influences employees in whistleblowing intentions. While corporate governance policies and procedures are known to be weak or non-existent in Micro Small and Medium Enterprises (MSMEs) in Nigeria, and therefore whistleblowing may not be formally instituted as a company policy, yet, an employee will be motivated to report unethical practice knowing that the business owner desires a sustainable organisation. The recent introduction of a mandatory whistleblowing policy in Nigerian banks is an incentive for employees to report wrongdoing, more so the policy makes room for anonymous reporting. A positive cultural orientation also influences the employee's morality and judgment.

Pay may make employees remain in an organisation because of mutual dependence, but add-on benefits establish foundation for richer form of commitment by creating dependence [36]. A reward system that consists of pay, and add-ons serves as a motivation for an employee's commitment, and influences future decision-making. An organisation that expects a certainbehaviour must consider a reinforcement of the behaviour. This is in line with the social learning theory, which posits that past decisions impact future decision-making.

B. Hindrances to whistleblowing practice in Nigeria

Notwithstanding the desirability and benefits of whistleblowing, we provide below some of the hindrances and suggestions for organisations:

    i.   Fear of retaliation

While the highly-ethical employees may perceive whistleblowing as the right course of action in the interest of others, quite a number of others see it as an act of betrayal, snitch, or "dissent that challenges an organization's authority structure and creates animosities" [9]. Consequently, whistle-blowers face a significant risk of retaliation, even when their disclosure benefits the organization. External whistle-blowers appear to experience more retaliation than internal ones [5]; [18]; [48]. Retaliation is also more common when the organisation is dependent upon the wrongdoing or when it is not dependent upon the whistle-blower. Retaliation takes several forms, including harassment, isolation of employee, changed responsibilities, poor performance evaluation and termination [49]. Studies therefore show that employees who fear a threat of retaliation are less likely to report a wrongdoing [3], and this may also affect others' willingness to blow the whistle in the future [50].

In Nigeria, the lack of statutes on whistleblowing plus the weak institutions (legal and political) constitute a huge hindrance for potential whistle-blowers. Considering research findings that corroborate retaliation on whistle-blowers, an average employee is likely to consider self-preservation first before other considerations. Legislation, and organisation policies providing assurance and support for whistle-blowers will therefore help in promoting whistleblowing culture.

    ii.   Social stigma – Snitch, "amebo" "tatafo" are some of the terms reserved for whistle-blowers, hence most employees would rather avoid the negative tag. Employers need to educate staff on the cost of keeping quiet, as an unreported singular

case may turn out to be a monster in the near future threatening the existence/sustainability of the organisation.

iii.   Cost of reporting – The cost of reporting includes the potential for a lawsuit by the wrongdoer, the distraction or nuisance value of providing evidence, and time for interview/questioning. Organisations should have personnel policies pronouncing stiff sanctions for employees who keep silent in the face of a serious wrongdoing, and reward for whistle-blowers (e.g. reimbursement of whistleblowing cost, legal services etc.). Providing valued employer rewards for internal whistle-blowing would increase its frequency. More importantly, organisations should consider implementing performance review systems that specifically assess employee reporting of questionable activity through appropriate channels and reward systems that provide incentives for valid whistle-blowing.

iv.   Fear of job loss – This may result from the supervisor not approving the whistleblowing plan of the junior staff, or the high unemployment rate-induced fear. Organisations should have policies allowing employees to by-pass their supervisors in order to report wrongdoing. Employees' jobs should also be guaranteed against threats for reporting wrongdoing.

v.   Absence of company policies and procedures – Employees may not know what to do, or what processes to follow in reporting wrongdoing. This is more so in organisations without whistleblowing policies and procedures. Organisations should therefore have documented policies and procedures.

vi.   Lack of education – This may manifest in the form of not knowing what to report. It could also be related to lack of knowledge on how to gather quality evidence to support the reporting. Employers should provide training to all workers to ensure that they are familiar with the organisation's whistleblowing arrangements, and additional training to individuals whom they appoint as recipients and investigators of concerns.

vii. Absence of support – This may come from management, co-workers, or significant others. The organisation needs to show support to the whistle-blower and reward successfully established cases.

IV.   CONCLUSION

Whistleblowing has proved to be a useful tool in exposing wrongdoing in other countries, yet the cultural factors, weak institutions, and other external environmental factors have limited the whistleblowing practice in Nigerian banks. This study concludes that: (i). The employee plays a critical role in preventing and, or exposing unethical practices. (ii). A culture of keeping silent risks the sustainability of the organisation (iii). Influencing behavioural change towards whistleblowing requires strengthening the system factors – moral sensitivity, job characteristics, leadership, culture and climate, and support structures. (iv). Employees' attitude can be positively influenced when benefits of whistleblowing become apparent. (v). Policy makers have a critical role in enacting supporting statutes and strengthening the judiciary towards promoting whistleblowing.

This conceptual framework examined the whistleblowing decision-making process, and thereby provides opportunities for organisations to identify the predictors of reporting intention with a view to implementing appropriate measures to strengthen the variables positively affecting whistleblowing intentions, while at the same time adopting appropriate measures to address the hindrances to whistleblowing practice.

A.   Recommendations

Whistleblowing on wrongdoings in organisations is critical in preventing scandals, crises, corporate frauds etc. To develop a roadmap for whistleblowing culture in Nigerian banks, an advocacy campaign is a first step in creating awareness and sensitising employees to the benefits of whistleblowing.

ii.   Employers need to educate staff on the cost of keeping quiet, as a threat to the sustainability of the organisation; develop personnel policies pronouncing stiff sanctions for employees who keep silent in the face of a serious wrongdoing, and reward for whistle-blowers; implement performance review systems that specifically assess employee reporting of questionable activity through appropriate channels; and provide training to all workers on whistleblowing arrangements, and investigations of concerns.

iii.   Organisations should implement the whistleblowing culture by first designating a few employees as whistleblowing champions, using the diffusion of innovation model propounded by [51].

iv.   Government executives and policy makers need to drive a positive attitude towards whistleblowing by introducing legislations, as well as providing societal and organisational support structures for whistleblowing (such as a functional legal system, responsive regulatory bodies, and national code of conducts etc.).   Other supports include the role of the mass media, training on documentation of evidence, and a reward system for whistle-blowers.

v.   By promoting a whistleblowing culture in the society at large, whistleblowing can improve Nigeria's Corruption Perception Index, with multiplier effect on other indices such as Human Development Index, Doing Business Report, and Global Competitiveness Index among others. Improvement in these indices has huge potentials to open up investment opportunities (be it Foreign Direct Investment or Foreign Portfolio Investment).

vi.   Education is an important tool to shape the cultural orientation towards a desired goal. To this extent, it is recommended that ethics should be incorporated in Nigerian school curricular.

vii.   From our review of literature, no study considered feedback as a variable to influence whistleblowing intention and behaviour. This study considers feedback as a construct which can be measured by reward system, correction program, and communication.

B. Expected Contribution to Knowledge

Based on the review of literature and the gaps identified, this research expects to contribute to knowledge by developing a model for encouraging employees in whistleblowing. The Framework (Fig. 1) is built on constructs and variables propositioned in this study, which applied the cultural lens to the study of bank employees.

Fig. 1. Proposed Conceptual Framework for Whistle-blowing.
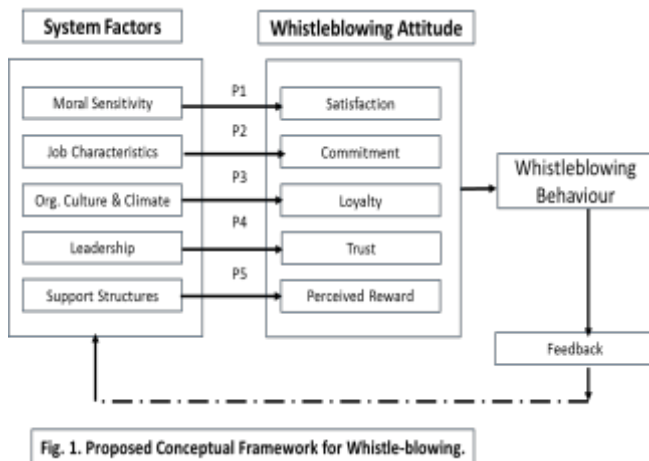
C. Limitations and Future Research Directions

A limitation of the conceptual framework proposed is in the methodology adopted in this paper. Our review of literature is impacted by the few studies on whistleblowing in Nigeria, being a practice in its infancy. We thus had to rely on empirical findings from other countries, which may not approximate the local conditions, especially considering the role of cultural influence and weak institutions.

ii. Researchers have used whistleblowing intention as a proxy for understanding the actual behaviour. This limitation is accounted for, by the challenges of carrying out investigations into unethical conduct in actual organizations (Chiu, 2003), censored information by whistle-blowers to protect the confidentiality or anonymity of their organisation, finding whistle-blowers for interview, and inherent biased data generated from such exercise. These limitations invariably call for caution in attempting to generalise the inferences from the conceptual framework.

iv. Future research may focus on (a). Empirical studies of intention and actual behaviour, (b) Studies of whistleblowing in different industries, and sectors (public versus private sector) (c). Effect of organisation's location and community culture on whistleblowing (d) Test of alternative theories – for instance institutional theory, organisational justice theory – on whistleblowing.

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Graph-Theoretical Approach for Solving Loss Allocation Problems in Interconnected Power Grids

A. S. Alayande[†], C. O. A. Awosope[††] and Ademola Abdulkareem[††]

[†]Department of Electrical Engineering, Faculty of Engineering and the Built Environment,

Tshwane University of Technology, Private Bag X680, Pretoria 0001, Staatsartillerie Road, Pretoria South Africa

[††]Department of Electrical & Information Engineering, College of Engineering, Covenant University, Canaanland, Ota, Nigeria

E-mail: alayandeas@tut.ac.za, coaawosope@yahoo.co.uk, adekaree@gmail.com

Abstract— **A Fair and transparent allocation of transmission loss to network generators and loads has been a major challenge for efficient transmission pricing in the open access environment. In this paper, the application of graph theory in solving loss allocation problems in highly interconnected and large-sized practical power networks is investigated. The relevant mathematical formulations for solving such problems in power networks are presented. A General Allocation Factor (GAF) matrix, which relies on Kirchoff's laws, for any given power network is formulated. The transmission line loss is obtained, based on the ac power-flow solution, using Newton Raphson iterative technique. The transmission line losses that are obtained are allocated to the generators within the network according to GAF matrix. The efficiency of the approach is demonstrated using a s standard IEEE 5-bus system and tested on a practical Nigerian 28-bus network. The results obtained, from the simulations, show the effectiveness of the method in solving loss allocation problems in real-time power networks.**

Index Terms— Generator Contribution, Transmission Pricing, Graph Theory, General Allocation Factor Matrix, Kirchoff's laws, Loss Allocation**.**

1. INTRODUCTION

The total transmission loss within power systems accounts for up to ten percent of the total generation within the systems which amounts to millions of dollars every year [1]. The allocation of transmission losses to the network participants in a fair and transparent manner is therefore a major concern to power system regulators, operators, researchers and engineers in recent times. This is necessary because efficient allocation of resources within power networks demands a fair and transparent transmission pricing. Furthermore, the solution to such a problem becomes more tedious due to the nonlinear nature of the problem formulation most especially in large-sized practical power networks. In solving this problem, it is necessary to determine the contribution of each generator and load to the network losses. Different approaches have been proposed and documented in solving the problem. Unfortunately, there is no unique method of solution to the problem [2]. Moreover, the existing approaches to the problem and their applications to large-scale practical   power networks are yet to be demonstrated holistically. As proposed in [3], the network losses are usually allocated to the generators and loads using a well-known incremental transmission loss coefficient. The limitation of this approach is hinged on the fact that it is solely dependent on the slack bus within the network and no loss is assigned to the slack bus. Application of proportional sharing method with graph theoretical approach and its application is demonstrated in [2]. Although, this approach gives promising results, it assumes that power at nodal inflows is shared proportionally between nodal outflows. In other words, this approach does not present a justifiable relationship between the power flow tracing and the electrical behaviour of the network. In [1], a Z-bus approach for loss allocation based on the power-flow solution is presented. The formulation of the approach is based on complex network impedance and the nodal injections [3]. In [4], game theoretic approach is proposed,   which is found to be an acceptable and independent solution tool that satisfies the individual network players. However, it is computationally demanding as it requires handling a large amount of data for the solution of a single case in practical power systems. In [5], optimization approach is considered with loading conditions of the system. However, the time required to obtain the results may be of significant value. This may take longer time in large practical networks.

An attempt is therefore made in this paper to investigate the viability of graph theoretical-based approach, based on a solved power-flow analysis, in solving network loss allocation problem in large practical power networks. Section 2 presents the relevant mathematical formulations of the graph theoretical-based approach to the solution of transmission loss allocation problem. Section 3 gives the description of the standard IEEE 5-bus network as well as the Nigerian practical power system studied. The numerical illustrations of the approach are also presented in this section. The results and discussion of results are presented in section 4 while section 5 concludes the study.

2. LOSS ALLOCATION BASED ON GRAPH THEORY APPROACH

The mathematical formulation of the graph theoretical-based solution to transmission loss allocation problems within power systems is network dependent. This makes it to be much easier for the tracing of the power flow within the network. It is, therefore, possible to determine the participation of each network participant to the transmission losses based on the power-flow solutions whose detail has been well documented in the literature. The application of graph theory approach [4] to large practical power networks is revisited in this paper.

A power system can be considered as a complex network consisting of several nodes and links. The Kirchoff's matrix for such a network graph G can be defined by

$$K_{ij}(G) = \begin{cases} d^-(v_i) & for\ i = j \\ -a_{ij} & for\ i \neq j \end{cases} \quad (1)$$

where $d^-(v_i)$ is the in-degree of bus i

a_{ij} is the $(i, j)^{th}$ element in the adjacency matrix A, which is defined as

$$A_{ij}(G) = \begin{cases} 1 & if\ buses\ i\ and\ j\ are \\ & connected\ and\ bus\ i\ is \\ & directed\ towards\ bus\ j \\ 0 & otherwise \end{cases} \quad (2)$$

In this paper, a GAF matrix of a network graph G whose elements are determined based on the adjacency matrix given in equation (1), is defined as

$$GAF_{ij}(G) = \begin{cases} -P_{ij} & for\ i \neq j\ and\ P_{ij} > 0 \\ P_{Ti} & for\ i = j \\ 0 & otherwise \end{cases} \quad (3)$$

where

$$P_{Ti} = P_{gi} + \sum_{k=1}^{n} P_{ki}$$

for $P_{ij} > 0$, $j = 1, 2, ..., n$ (4)

Close observation of equation (4) shows the following characteristics about GAF matrix:

i. it is a square and invertible matrix.
ii. the active power generated at bus k equals the algebraic sum of the kth column elements of GAF matrix.
iii. the active power demanded at bus k equals the algebraic sum of the kth row elements of GAF matrix.

Based on the above stated characteristics of the GAF matrix, we can write

$$GAF^T \times U = P_G \quad (5)$$

$$GAF \times U = P_L \quad (6)$$

where

U is a unit vector

P_G is the vector of generator outputs and

P_L is the vector of the network loads.

The individual load on the system is given by

$$P_L = P_{LL} U \quad (7)$$

Using (5) in (7) gives

$$P_L = D P_G \quad (8)$$

where D is the allocation factor matrix given by

$$D = P_{LL}(GAF \quad (9)$$

where

$$)^{-1}$$

$$P_{LL} = diag(P_{L1}, P_{L2}, P_{L3}, ..., P_{Ln}) \quad (10)$$

The allocation of the transmission losses to the network participants, as determined from the power-flow solution, can therefore be obtained from the matrix D given in (9). In other words, matrix D gives the

contribution of the generators and loads to the losses across the transmission links within the network.

The allocation of transmission line losses associated with the branch connecting any two buses j and k to any network participant whose location is at any bus i, is given by

$$P_{Li \to j-k} = D_{ij} \times P_{j \to k} \qquad (11)$$

where $P_{Li \to j-k}$ is the loss allocated to load bus i by the line connecting buses j and k and $P_{j \to k}$ is the active power loss on the line connecting buses j and k.

Therefore, the total loss allocated to any network participant located at bus i equals the sum of all the losses allocated to that participant by every link within the network.

3. NUMERICAL ILLUSTRATION

Two numerical examples are considered as case studies in this paper; a simple standard IEEE 5-bus system and a practical 28-bus Nigerian power network.

4. RESULTS AND DISCUSSION

Case Study 1: Standard IEEE 5-Bus Network

The standard IEEE 5-bus system considered consists of two generators placed at buses 1 and 2 while buses 3, 4, and 5 are load buses. Table 1 presents the line data for the standard IEEE 5-bus system.
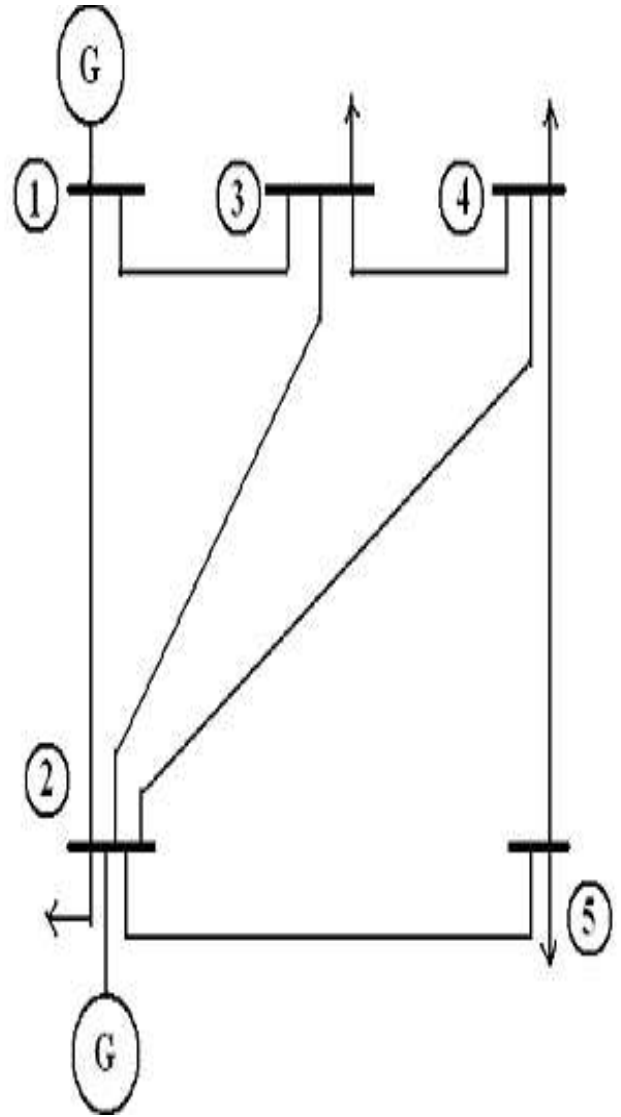
Figure 1: One-line diagram for the standard IEEE 5-bus network

Table 1: Transmission Line Data for the standard IEEE 5-bus network

Line	Resistance (Per Unit)	Reactance (Per Unit)	Suceptance (Per Unit)
1-2	0.0200	0.0600	0.0300
1-3	0.0800	0. 2400	0.0250
2-3	0.0600	0.1800	0.0200
2-4	0.0600	0.1800	0.0200
2-5	0.0400	0.1200	0.0150
3-4	0.0100	0.0300	0.0100
4-5	0.0800	0.2400	0.0250

Table 2 presents the converged power-flow results for the standard IEEE 5-bus network obtained after three iterations using Newton-Raphson iterative method. The simulation results obtained when the approach is applied are presented in

tables 3 and 4. Tables 3 presents the results obtained for the General Allocation Factor (GAF) Matrix for the network under consideration. The results of the GAF matrix presented in table 3 are determined based on the structural interconnections of the buses and the admittances of individual lines within the network.

Table 2: Power-flow Solution for the standard IEEE 5-bus network

Bus	Voltage Magnitude	Voltage angle	Generator		Load	
	Per Unit	Radians	MW	MVAR	MW	MVAR
1	1.0600	0.000	0.578	0.500	0.000	0.000
2	1.0300	-0.0073	0.908	7.666	0.000	0.000
3	1.0110	-0.0576	0.000	0.000	0.450	0.149
4	1.0093	-0.0613	0.000	0.000	0.400	0.050
5	1.0010	-0.0704	0.000	0.000	0.600	0.100

Tables 4 gives the results obtained for the transmission line loss allocation to the generators G1 and G2 within the network under study.

From the 5-by-5 GAF matrix results given in table 3, it can be seen that the sum of each column equals 1. This indicates that the contribution of all the generators to each load is 100%, which is logically true. Therefore, structurally, it can be inferred that 100 percent of the L1 will be supplied by G1. In a similar manner, 23.5% of L2 will be supplied by G1 and 76.5% will be supplied by G2.

Table 3: General Allocation Factor (GAF) Matrix for the standard IEEE 5-bus network

		Load Bus				
		L1	L2	L3	L4	L5
Generators Bus	G1	1.0000	0.2350	0.6188	0.3468	0.2431
	G2	0.0000	0.7650	0.3812	0.6532	0.7569
	None	0.0000	0.0000	0.0000	0.0000	0.0000
	None	0.0000	0.0000	0.0000	0.0000	0.0000
	None	0.0000	0.0000	0.0000	0.0000	0.0000

However, considering the data for the case under study, the network loads are on buses 3, 4 and 5 and no load is attached to buses 1 and 2. Hence, it implies that G1 contributes 61.88%, 34.68% and 24.31% of its output power to loads at buses 3, 4 and 5 respectively while G2 contributes 38.12%, 65.32% and 75.69% of its total power to loads connected at buses 3, 4 and 5 respectively.

From the results presented in table 4, it can be seen that the highest transmission line loss of 1.6 MW is observed on the line 2-5 out of which the least power loss of 0.3761 MW is allocate to G1 and the remaining 1.2239 MW is allocated to G2.

Table 4: Line loss Allocation for the standard IEEE 5-bus network

Line	Total Line Loss from power-flow solution	Allocation of Transmission Line Loss to Generators (MW)		Total Line loss Allocated to Generators (MW)
	(MW)	G1	G2	G1 + G2
1-2	0.8000	0.8000	0.0000	0.8000
1-3	1.4000	1.4000	0.0000	1.4000
2-3	0.5000	0.1175	0.3825	0.5000
2-4	0.6000	0.1410	0.4590	0.6000
2-5	1.6000	0.3761	1.2239	1.6000
3-4	0.0000	0.0000	0.0000	0.0000
4-5	0.0000	0.0000	0.0000	0.0000

Furthermore, higher portion of the losses within the network is allocated to G1 with 2.8346 MW out of which the highest part with 1.4 MW is allocated to line 1-4. In a similar manner, 2.0654 MW of the total network losses is supplied by G2 out of which 1.2239 MW is allocated to line 2-5.

Case Study 2: Nigerian 28-Bus Network

A practical Nigerian 28-bus network, whose structure consists of 10 generator buses and 18 load buses. The bus codes LG1 to LG10 in the first column of table 5 represent the network generator buses while the bus codes L11 to L28 represent the network load buses.

The power-flow solution for the practical Nigerian 28-bus network, using Newton-Raphson method, converges after five iterations. The converged power-flow results obtained for the network are also presented in table 5.

As can be observed for the case of the standard IEEE 5-bus network, the base matrix is the GAF matrix. In the same manner, for the Nigerian 28-bus network, the GAF matrix is determined which also serves as the basis for the network under consideration. The network loss obtained from the power-flow solution is then allocated to the network generators. Based on GAF matrix for the Nigerian 28-bus system, the simulation results obtained for the allocation of transmission line loss to the network generators are presented in table 6 presents.

It can be seen from table 6 that the transmission line connecting Okpai and Calabar, has the highest power loss of 41.7230MW allocated to it and it is ranked number 1. The transmission line connecting Benin and Onitsha has the least part of the loss of 0.040MW allocated to it and it is ranked number 31. It can be observed that the burden of the cost for the loss allocated to Okpai-Calabar will be borne on the Okpai GS based on table 6. In a similar manner, cost associated with the transmission loss allocated to Benin-Onitsha will be responsible for by the generators G2 (Delta) with 0.0237MW and G4 (Sapele) with 0.0163 MW respectively.

The participation of the generators in the apportionment of total transmission line loss is shown graphically in figure 2.

Table 5: Power-flow Solution for the Nigerian 28-bus network

Bus Code	Bus Name	Voltage Magnitude Per Unit	Voltage angle Radians
LG1	Egbin	1.050	0.00
LG2	Delta	1.030	21.341
LG3	Okpai	1.040	59.306
LG4	Sapele	1.020	17.894
LG5	AES	1.030	8.003
LG6	Afam	1.040	24.412
LG7	Calabar	1.020	35.045
LG8	Shiroro	1.030	23.034
LG9	Kainji	1.050	37.875
LG10	Jebba	1.040	32.103
L11	Ajah	1.044	-0.599
L12	Akangba	1.003	2.254
L13	Ikj-West	1.006	3.227
L14	Ajaokuta	1.030	14.317
L15	Aladja	1.022	19.939
L16	Benin	1.014	14.881
L17	Jebba	1.038	31.583
L18	Ayede	1.001	5.264
L19	Jos	1.027	25.366
L20	Kaduna	1.024	19.304
L21	Osogbo	1.007	12.406
L22	Kano	1.001	10.823
L23	Alaoji	1.019	23.034
L24	New Haven	1.004	11.547

L25	Onitsha	1.010	14.294
L26	Katampe	1.009	18.540
L27	Birnin Kebbi	1.010	32.356
L28	Gombe	1.027	18.905

Figure 2: Allocation of Transmission line loss to generators for the Nigerian 28-bus network

It can be seen that the highest percentage of the total loss contributed by all the lines within the network is allocated to generator G3, which corresponds to Okpai with a loss of 68.6367 MW. In a similar way, the least percentage of the total loss is apportioned to generator G1 (Egbin) with a loss allocation of 0.0633MW. In other words, based on this analysis, it is much easier to determine the cost allocation of the network losses to the generators.

Table 6: Transmission line loss allocation to network generators based on GAF matrix for the Nigerian 28-bus system

Bus-Bus	Line Loss Allocation (MW)										Line Loss (MW)	Loss Ranking
	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10		
Egbin GS– Ajah	0.0633	0.0505	0.0000	0.0347	0.2357	0.0000	0.0000	0.0000	0.0441	0.0436	0.4720	26
Ikj-West - Akangba	0.0000	0.1025	0.0000	0.0704	0.4782	0.0000	0.0000	0.0000	0.0895	0.0884	0.8290	25
Ikj-West - Egbin GS	0.0000	0.4773	0.0000	0.3281	2.2279	0.0000	0.0000	0.0000	0.4171	0.4116	3.8620	14
Benin - Ikj-West	0.0000	3.9348	0.0000	2.7052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6.6400	8
Ayede - Ikj-West	0.0000	0.0182	0.0000	0.0125	0.0000	0.0000	0.0000	0.0000	0.1954	0.1929	0.4190	28
Osogbo - Ikj-West	0.0000	0.1972	0.0000	0.1356	0.0000	0.0000	0.0000	0.0000	2.1205	2.0927	4.5460	11
Benin - Ajaokuta	0.0000	0.0480	0.0000	0.0330	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0810	30
Delta GS – Benin	0.0000	5.6810	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.6810	10
Delta GS – Aladja	0.0000	1.0230	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0230	23
Aladja – Sapele GS	0.0000	0.9470	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9470	24
Benin – Onitsha	0.0000	0.0237	0.0000	0.0163	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0400**	**31**
Benin - Osogbo	0.0000	0.2027	0.0000	0.1393	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3420	29
Sapele GS – Benin	0.0000	1.3268	0.0000	1.2702	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.5970	16

Osogbo - Ayede	0.0000	0.2601	0.0000	0.1788	0.0000	0.0000	0.0000	0.0000	2.7959	2.7593	5.9940	9
Kainji GS - B' Kebbi	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.6370	0.0000	1.6370	21
Jebba - Osogbo	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	16.6087	16.3913	33.0000	2
Afam GS – Alaoji	0.0000	0.0000	0.0000	0.0000	0.0000	1.9120	0.0000	0.0000	0.0000	0.0000	1.9120	20
Alaoji – Onitsha	0.0000	0.0000	3.1158	0.0000	0.0000	3.2977	0.4154	0.0000	0.0000	0.0000	6.8290	7
Onitsha - N' Haven	0.0000	0.0486	0.4791	0.0334	0.0000	0.5071	0.0639	0.0000	0.0000	0.0000	1.1320	22
Jos - Gombe	0.0000	0.0000	1.7426	0.0000	0.0000	0.0000	0.2324	0.0000	0.0000	0.0000	1.9750	19
Jebba GS – Jebba	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4570	0.4570	27
Jebba – Shiroro	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.1757	2.1473	4.3230	13
Kainji GS – Jebba	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	7.3060	0.0000	7.3060	6
Jos – Kaduna	0.0000	0.0000	2.2297	0.0000	0.0000	0.0000	0.2973	0.0000	0.0000	0.0000	2.5270	17
Kaduna – Kano	0.0000	0.0000	1.6597	0.0000	0.0000	0.0000	0.2213	1.5985	0.4558	0.4498	4.3850	12
Shiroro GS - Kaduna	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.3316	0.3797	0.3747	2.0860	18
Shiroro GS–Katampe	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0223	0.5766	0.5691	3.1680	15
Calabar GS - Alaoji	0.0000	0.0000	9.8956	0.0000	0.0000	0.0000	1.3194	0.0000	0.0000	0.0000	11.2150	3
Calabar GS – Jos	0.0000	0.0000	7.7912	0.0000	0.0000	0.0000	1.0388	0.0000	0.0000	0.0000	8.8300	4
Okpai GS – Calabar GS	0.0000	0.0000	41.7230	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**41.7230**	**1**
AES GS - Ikj-West	0.0000	0.0000	0.0000	0.0000	8.7740	0.0000	0.0000	0.0000	0.0000	0.0000	8.7740	5
Total	0.0633	14.3413	68.6367	4.9576	11.7159	5.7168	3.5885	4.9524	34.8019	25.9775		

5. CONCLUSION

In this paper, the application of a graph theoretical-based approach for solving loss allocation problem has been presented. The relevant mathematical formulations based on the traditional power-flow equations are presented. Application of this approach to both the standard IEEE 5-bus network and a practical network of Nigerian 28-bus system is investigated. The simulation results obtained with MATLAB environment as the simulation tool show the strength of the method in handling loss allocation problem among power network participants. The method is simple for solving loss allocation problem within interconnected power grids. This method could, therefore, serve as a good price signal for a reasonable cost allocation and transmission loss pricing within practical power systems in deregulated electricity markets.

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Malaria Diagnosis: Current Approaches and Future Prospects

Onile-ere Olabode, Openibo John and Olasehinde Grace
Department of Biological Sciences,
Covenant University,
Ota, Nigeria

Abstract- **Scaled up efforts by a consortia of organisations in the diagnosis, treatment and prevention of malaria have led to a significant reduction in the overall malaria mortality and morbidity in the past few years. Malaria has, nonetheless, remained one of the world's most burdensome diseases with the over 214 million cases and 438,000 deaths recorded in 2015 (2.68% of global DALYs). This burden is unevenly domiciled in sub-Saharan Africa where 89% of all cases and 91% of all deaths occurred. These figures however, only represent a fraction of the actual global burden of Malaria as surveillance fails to cover most cases in sub-Saharan Africa where the majority of malaria endemic regions lack facilities for diagnosis, case management and active surveillance. The emergence of drug resistant strains of the *Plasmodium* species prompted WHO to recommend a confirmatory diagnosis of each case of Malaria before treatment. The workability of this recommendation however, begs to be questioned as the majority of all malaria diagnosis is done via Clinical diagnosis; which lacks precision, is still the major form of diagnosis in many malaria endemic regions, and contributes to the over-diagnosis of malaria and subsequent under-diagnosis of other febrile illnesses. Of higher import is the risk of the emergence of drug resistant species due to the unregulated antimalarial use caused by inaccurate clinical diagnosis. Microscopy, which is the gold standard of malaria diagnosis, and the Rapid Diagnostic Tests (RDT) for malaria antigens have proven to be very useful in the diagnosis of malaria giving high levels of specificity and sensitivity. They however have the downside of having relatively high limits of detection, invasiveness, being labour intensive and expensive in the light of the low income countries where malaria is endemic. More sophisticated tools such as those that employ nucleic acid techniques (Polymerase Chain Reaction and Gene probes) are not field deployable and are mostly applied for research purposes. This necessitates the need for new diagnostic approaches that are suited to the conditions found in malaria endemic regions. A range of novel diagnostic tools with a do-it-yourself approach, leveraging on previously untapped diagnostic material such as urine are currently being assessed. These novel tools promise great results if successful. This review presents an overview of current diagnostic methods, the prospects in malaria diagnostics and finally makes an effort to recommend what an ideal malaria diagnostic tool should be made up of, all the while focusing on sub-Saharan Africa.**

Keywords- Malaria, Diagnosis, sub-Saharan Africa

I. INTRODUCTION

The end of the Millennium Development Goals (MDGs) necessitated the switch to Sustainable Development Goals (SDGs). A great deal of progress was made during the 15 years ofMDGs as it relates to malaria. The world saw a 37% and 60% reduction in malaria incidence and mortality with increased coverage of key interventions such as Insecticide Treated Nets, preventive treatment in pregnancy and increased use of rapid diagnostic tests[1], there is however a great deal of work to be done as there are still many issues threatening the new goal of eradicating malaria by 2030.

The WHO in its recent strategy forelimination has identified malaria diagnosis as a major factor in getting to zero come 2030 as prompt and accurate diagnosis is the mainstay for effective disease management and surveillance[2]. Currently, malaria diagnosis rests majorly on the Microscopic detection of parasites and Rapid Diagnostic tests (RDT)[3]. These two tools have proven really effective in times past but may fall short in playing their role towards malaria elimination viz-a-viz their shortcomings.

A. Objectives

This review considered the status of currently used diagnostic methods as well as prospective tools in delivering the information which will help inform policy in a bid to eliminating malaria in sub Saharan Africa where the bulk of the burden lies.

B. Methods

In this review, keywords such as 'malaria', 'diagnosis', 'issues' and 'prospects' were put into the google scholar databases to find relevant papers. Papers with a focus outside sub-Saharan Africa or falciparum malaria were excluded from this review.

II. MALARIA LIFE CYCLE & DISTRIBUTION

The malaria life cycle is summarized in Figure 1. It typically begins when an infected female Anopheles mosquito takes a blood meal injecting sporozoites into the human bloodstream. These sporozoites travel to the liver, infecting hepatocytes to initiate the pre-erythrocytic phase. About 2 weeks after, the hepatocytes rupture, releasing merozoites which go on to infect erythrocytes, initiating the erythrocytic

phase of the infection which is responsible for the symptoms observed during malaria infection. This phase is also marked by the breakdown of haemoglobin into an insoluble malaria pigment of diagnostic importance called haemozoin. Merozoites become ring-like trophozoites, which form the basis for malaria diagnosis via microscopy. Subsequently, trophozoites divide repetitively to give schizonts which go on to develop into merozoites. The new merozoites burst out of the erythrocytes and infect other erythrocytes. Some merozoites, however develop into male and female gametocytes which lay dormant until picked up by a mosquito during a blood meal. The gametocytes fuse to form a zygote in the stomach of the insect vector after which the zygote develops into sporozoites which travel to the salivary gland from where they are injected into a human during the next blood meal starting the cycle again[4].

Malaria symptoms include fever, headache, chills and vomiting and in severe cases severe anaemia, respiratory distress in relation to metabolic acidosis, or cerebral malaria[5].

Malaria is currently endemic in most of sub-Saharan Africa (Fig. 1).There were 214 million cases of malaria and 438 000 deaths globally with about 90% of all global cases occurring in the sub-Saharan region[3]. Of particular risk are children and pregnant women who suffer the most from the scourge of malaria.
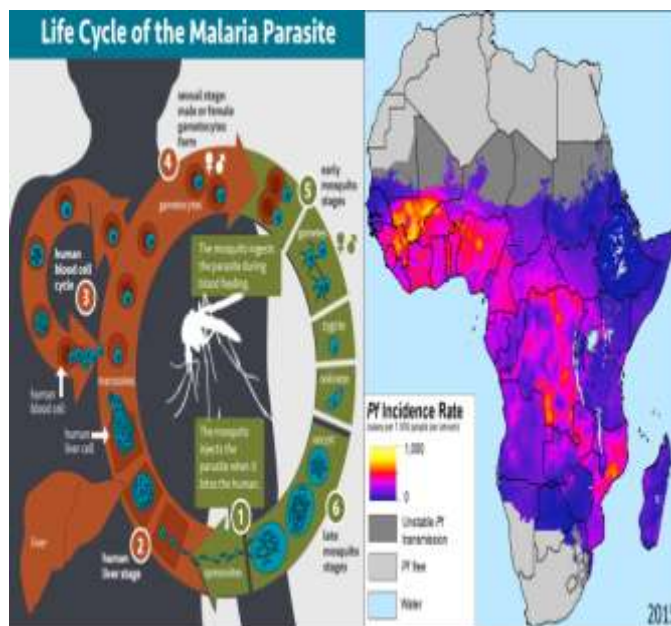

Figure 1: Life cycle of malaria (right), *P. falciparum* incidence in 2015 [6]

III.   MALARIA DIAGNOSTIC TARGETS

Malaria diagnosis has been predominantly invasive, utilizing whole blood as its primary diagnostic material. Recent efforts, however have been given to the application other non-invasive materials such as saliva and urine as

diagnostic materials in malaria diagnosis[7]–[10].Malaria diagnosis targets whole cells, such as infected Red blood cells (iRBCs) and leukocytes that have ingested parasites or detectable analytes such as parasite antigens, haemozoin crystals and nucleic acids. These targets have effective thus far in malaria diagnosis but not without their individual limitations. The ability and accuracy at which these targets are detected is dependent on the technology used and such factors as reagents, operator proficiency, sample quality and volume. Whole cell targets are especially useful as they give current information on the state of the parasite in the human body as such, they inform treatment and intervention decisions.

Antigenic targets of malaria diagnosis include the *Plasmodium falciparum* histidine rich protein-II (HRPII), lactate dehydrogenase(pLDH) and aldolase. Aldolase is not expressed by*P.falciparum*as such it won't be considered here. HRPII is a water soluble protein antigen expressed by *P.falciparum* trophozoites and localized in several cell compartments. The parasite releases a substantial amount of the protein into its host's blood stream making it detectable in blood stream[11], [12], cerebrospinal fluid and urine[13]. HRPII however persists in the blood stream for up to two weeks[14] after parasite must have been cleared greatly limiting its diagnostic efficacy as a diagnostic target. This persistence has the implication of contributing to the over diagnosis and subsequent over treatment of malaria[15], [16]. pLDH isis the last enzyme in the glycolytic pathway essential for ATP generation. As opposed to HRPII, the amount of pLDH in the blood stream reduces as parasites clear from the blood stream as such it can be used to monitor treatment outcome[17].

The most suitable diagnostic targets, however would be one that accurately tells the current condition of infection viz-a-viz parasite biomass and species identification

IV.   CURRENT METHODS IN MALARIA DIAGNOSIS

A.   ClinicalDiagnosis

Clinical diagnosis, also known as presumptive diagnosis, is the most practiced method of diagnosing malaria as it is very cheap and rapid[18]. It is based on the signs and symptoms presented by the patient. These signs and symptoms are often non-specific and include fever, headache, dizziness, cold, nausea, pruritus and anorexia [19]. Clinical diagnosis however possess many problems due to the overlap of malaria symptoms with those of other common infections found in endemic regions such as bacterial infections. This overlap of symptoms with other diseases greatly reduces the specificity of clinical diagnosis ergo contributing to the over diagnosis and over treatment of malaria as shown in various studies with one reporting as high as 83% over diagnosis and over treatment of malaria in children in the age group of 1-5 years of age[20], [21]

Clinical diagnosis is most useful in areas where there is no laboratory support which is often the case in many areas in sub-Saharan Africa, it is especially useful, and has been recommended by the integrated child management initiative(IMCI), in treating children, 5 years and below, in these areas as malaria infections can quickly become fatal for this age group[19], [21]–[23].

The sensitivity of clinical diagnosis is determined by factors such as endemicity, season and age group with accuracy of clinical diagnosis increasing with prevalence and endemicity[19], [21].

The combination of clinical diagnosis with other parasite based methods greatly increases the accuracy of malaria diagnosis.

B. Microscopy

Microscopic examination of Giemsa-stained blood smears remains gold standard for the diagnosis of malaria.Diagnosis is done by the examination of Giemsa stained thin and/or thick blood smear. When performed under optimal conditions by a competent microscopist, microscopy can detect as low as 5 iRBCs, however its sensitivity can go as low as 200iRBCs when conditions are not optimal [24], [25].

Microscopic examination of blood smears allows for the diagnosis of infection in symptomatic and asymptomatic persons depending on the skill of the microscopist, parasitemia and the number of high powered fields observed[26], [27]. It also has the advantage being both qualitative (species, stage identification) and quantitative hence it's preferred use in the monitoring of patient response to treatment. Microscopy, however falls short in that it requires expertise for accurate results, maintenance costs, need for constant supply of electricity and others as summarized in table 1.Sampling preparation also greatly affects the sensitivity of this test as the quality of the film, duration of staining and quality of stain affect the ability to visualize the different stages of the parasite [18].

Recent advances in technology have given rise to new ways of manipulating blood in a bid to concentrate cells before analyses. The exposure of blood samples to a magnetic fields helps concentrate iRBC as a result of the presence of haemozoin[28], [29]. This increases the sensitivity of the test by as much as 100 fold. Other methods to increase sensitivity include the centrifugation of heparinized blood to concentrate the different stages of parasite growth before making a film[30] however, its application in Africa is not well documented.

The advent of power packs and solar batteries have made microscopy more field deployable hence increasing its efficacy in resource poor areas. Nonetheless, there is still a dearth of experienced mciroscopists in the sub-Saharan African region making microscopy a less effective method in these parts [31].

C. ImmunochromatographicRapidDiagnosticTests

The Rapid Diagnostic Test (RDT) is a very effective tool in malaria diagnosis and forms the mainstay of diagnosis in many resource poor areas where there is no access to a laboratory. It is especially useful as it requires no electricity, infrastructure, minimal sample preparation, technical expertise and interpretation of results is relatively easy.

The RDT detects malaria antigens in 5-15 μL of blood using monoclonal antibodies, impregnated on a test strip, specific for the targeted antigens, in an immunochromatographic assay. Test results are interpreted by the absence or presence of a coloured line on the strip and can be obtained in 5-20mins.RDTs detects three plasmodial antigens; *P.falciparum* histidine rich protein II (PfHRPII), *Plasmodium* lactate dehydrogenase (pLDH) and aldolase [17], [32]. Most RDT products incorporate two of these three antigens in a bid to distinguish falciparum from non-falciparum infections.

HRPII antigen is specific for *P.falciparum* and is a major constituent of RDTs in sub-Saharan Africa, it however has the shortcoming of persisting for up to 2 weeks after parasite must have cleared from the blood stream as such it is not effective in monitoring treatment[33], [34]. There have been reports of false negatives from HRPIIRDT kits as a result of a mutated or deleted HRPII gene [35]. It is recommended that regions with more than 10% prevalence of HRPII deletion should seek alternatives such as microscopy for the diagnosis of*P.falciparum* malaria[34]. The presence of the rheumatoid factor has been shown to give false negative results due to a cross reactivity between the factor and HRPII[36], [37]. These issues greatly undermine the suitability of HRPII as an ideal antigen for the diagnosis of malaria as such RDTs containing just HRPII are not advisable for use.pLDH on the other hand is highly effective for monitoring treatment outcomes as it reflects the current status of parasites in the blood stream [17], [38]. pLDH is however not specific to *P.falciparum* hence its combination with HRPII on RDT kits.

RDTs have a detection limit as low as 200-2000 iRBCs/μL[32] depending on the quality of the RDT. The sensitivity of RDTs are affected by such factors as storage conditions, temperature, and time of assay.One pertinent issue militating against the effectiveness of RDTs in sub-Saharan Africa is compliance to manufacturer's instructions and to results. A meta-analysis of health workers compliance showed that compliance to negative results was low contributing to over treatment of malaria [39]

RDTs for sub-Saharan Africa should be able to withstand the conditions found therein. RDTs nonetheless have the unique advantage of being field deployable and is especially effective in resource poor regions.

D. NucleicAcidTechniques

Tests that target nucleic acids have proven to be one of the most specific and sensitive methods with the ability to detect parasitemia of 0.005 iRBC/μL [34]. They especially come in handy in detecting sub-microscopic infections which greatly threaten the elimination strategies that abound. Nucleic acid techniques are not yet field deployable as they are expensive, require expert personnel and specialized equipment as such, their use is limited to clinical research in population diversity studies[40] and monitoring of drug resistance[41].

Nucleic acid techniques target gene sequences such as the 18S ribosomal RNA gene sequences[42], *P.falciparum*stevor multigene family[43], mitochondrial DNA, and telomere-associated repetitive element-2[44]. Nucleic acid techniques include the Polymerase Chain Reaction and its various methods (real time PCR. Nested PCR) which use specific primers to make many copies of a small amount of template DNA, followed by post-PCR methods such as gel electrophoresis. The PCR has the advantages of being able to process many samples at once.

Another nucleic acid technique is the Loop-mediated isothermal amplification (LAMP) technique. This technique has the potential to make nucleic acid strategies field deployable, as it requires lesser instrumentation than PCR and is easy to use. LAMP in contrast to PCR is an isothermal technique requiring a constant temperature for amplification. The amount of DNA produced in LAMP rivals that of PCR as LAMP using two to three sets of primers. Amplification is detected by turbidimetry due to an increasing quantity of magnesium pyrophosphate and as such can be followed in real time[45]. Some studies have reported the technique's ability to detect SMI and sensitivities that surpass that of RDT and rival that found in PCR[45]–[47]. LAMP is easy, sensitive and cheaper than PCR, it however has the downside of the need for cold storage of reagents [18].

V. PROSPECTSINMALARIADIAGNOSIS

Recent efforts in malaria diagnosis have been targeted towards utilizing other non-invasive diagnostic materials in a bid to making testing procedure less painful for most. Saliva[7], [8], [48] and urine[9], [13] have been assessed as diagnostic material with promising results reported thus far.

A cheap urine based RDT with the ability to deliver results in 25 minutes, is currently undergoing evaluation and has shown positive reports with a reported limit of detection of 125parasites/μL[13] which is well within the range recommended by the WHO [32]. If successful, this new tool could finally usher in the era of non-invasive diagnosis of malaria. Some studies have also shown the detection of parasite DNA in saliva and urine howbeit in smaller quantities

than those found in the blood[9]. They have however be shown to be suitable alternatives to blood where blood samples are not available [49]–[51].

TABLE 1: Summary of currently used diagnostic techniques

	Advantages	Disadvantages
Clinical Diagnosis	•Useful in resource poor areas •Particularly useful in preventing infant mortality in resource poor regions	• Sensitivity depends on endemicity • Leads to over diagnosis and subsequent over treatment.
Microscopy	•Low Tech, simple and inexpensive •Field Deployable •Identifies parasite itself •Useful in monitoring treatment outcome	• Requires expertise • Labour intensive • Low throughput • Rigorous sample preparation • Requires maintenance
RDT	•Fielddeployable •Easy to use •Requires no expertise •Can detect *P.falciparum* •Zero to minimal sample preparation required.	• Quality control is necessary and expensive • Environmental condition sensitive • Antigen can persist beyond infection • Can't be used to monitor treatment outcome
Nucleic Acid Techniques	•Highly sensitive •Ability to detect SMI •Can be used to investigate population diversity and distinguish between new and recrudescent infections •High throughput	• Time consuming • Expensive • Highly skilled personnel required • Requires provisions to avoid cross contamination • Generally not field deployable

Other strategies seek to exploit the electromagnetic and physical properties of haemozoin crystals formed during the malaria life cycle [28], [52], [53]. Haemozoin based detection strategies have the added advantage of giving adequate diagnosis during sequestration of parasites. They may however not be field deployable as some strategies do not detect haemozoin in early ring stage parasites [54] while most other techniques require specialized equipment and personnel.

Another emerging diagnostic tool are the aptamers. Aptamers are single-stranded oligonucleotides made *in-vitro* which possess a specific three-dimensional structure depending on its sequence [55]. Aptamers interact specifically with their targets by binding to them and altering their activity. Aptamers targeting pLDH have been designed and tested with promising results[56], [57]. It is expected that this technology will be perfected and field deployed in the nearest future.

VI. CONCLUSION

The conventional microscopic examination of blood films remain the gold standard as it is cheap and offers sensitivity unrivalled by any other field deployable method.RDTs are convenient but could lead to over diagnosis and over treatment. Nucleic acid techniques offer the best sensitivities, they are however expensive, out of reach to most and are limited to clinical research.Getting to zero would require

diagnostic tools that are non-invasivehighly sensitive, robust and suited to the conditions found in the endemic regions.

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Increasing the Performance of Physical Infrastructure:

An Architectural Perspective

ElenwoChisa Grace; NwakuduIfeoma Amanda; OladunniIzobo-Martins
Department of Architecture,
Covenant University,
Ota, Nigeria
chisa_g@yahoo.com; amanda_nwakudu@yahoo.com; Oladunni.izobo-martins@covenantuniversity.edu.ng

Abstract- **Infrastructure development is the source of determining the performance of democratic leaders and it is the substance of good democratic power. Sufficiency of the physical infrastructure is paramount for economic integration and development. This study aims to investigate the efficiency of physical infrastructure from an architectural perspective through public buildings performance evaluation. The paper observes previous studies which have identified valid problems relating to the performance of physical infrastructure especially in public buildings. Using secondary data from literature and existing conditions of two public buildings in South-west Nigeria, this paper examines observations on the selected buildings. Each building was visited and the spaces observed were public spaces within the buildings as access to all parts were restricted. Respondents were the occupants and building users within these public spaces. Questions were asked to the respondents and the answers were recorded by the researcher. The building condition rating scale provided the framework for observations. The finding shows that the challenges in the public buildings are abundant and comprise of funding, technology for development, maintenance and design. The study concludes that Nigeria Government has the power to put the buildings in place and providing good infrastructure will brand our environment as habitable for the end users. Infrastructure development in democratic power or governance involves ascertaining the veracious development, executing feasibility and sustainability studies and implementing the physical development of the project. Based on the findings, it is recommended that sustainability, inclusivity and technology should be prioritized in all national sectors in order to brave the efficiency challenges of the 21st century society.**

Keywords*: Building performance, Democratic governance, Infrastructure challenges, technology and sustainability*

I.   INTRODUCTION

Today's building industry has complex global socio-economic and environmental connections, which brands it as one of the popularly studied subjects in academia [1]. By way of openly addressing basic human needs within a city (portable water, a consistent supply of electricity, suitable plumbing and other services), infrastructure is a chunk of this course relating between these impending questions and architectural "answers" [2].

In the sustainability discourse a recent debate is on how to make buildings and infrastructures more eco-efficient with help of technology while integrating the social-cultural and aesthetic dimensions and considering the lifestyles and interests of different stakeholders[1]. There are a lot of good new building projects taking form nowadays, devaluing the performance level of more typical construction developments, and provoking us to questionthe length to whichour regular buildings are dwindling below the standard[3].

In a bid to promote the building performance, and energy usage of public buildings, the rising problem of actually expressing what constitutes high performance is yet to be addressed properly. Other problems relating to promoting the performance of buildings in the future are present but defining what high performance is and attempting to rate its performance and profits is the focus here [4].

The larger cities get, the more practitioners in design fields tussle to understand and reposition the effect made by infrastructure on the urban sphere. Aimed at architects specifically, the definition of what might establish an *architectural* approach to infrastructure is still unanswered since the effects of infrastructure at the architectural scale are almost absent from modern-day conversation and understanding at the urban scale and frequently emphases on the fading implication of form and boundaries [2].

This study aims to investigate the efficiency of physical infrastructure from an architectural perspective through public buildings performance evaluation. The approach builds on research of improving building performance and reciprocally reducing carbon dioxide emissions both in existing and new buildings, thereby pushing forward a more sustainable system.

II.   INFRASTRUCTURE DEVELOPMENT IN DEMOCRATIC GOVERNANCE

In reply to burdens in Nigeria in lieu of improved governance and primary infrastructure, institutions that support inclusion and promote accountability and fiscal

progress can only be built on the firmest fundamentals of fair, clear and able governance and organizations run by the government—for example, reinforcement of the abilities of legislators, the mass media and domestic people societies [5]. Infrastructure development in democratic governance involves ascertaining the veracious development, executing feasibility and sustainable studies and implementing physical development of the project.

All team members that are part of the project sourcing and construction development can learn from building performance evaluation , chiefly the client (usually government) that gives better brief structure, architectsthat prescribe better design solutions to performance and engineers who cognize the makings of a comfy, energy proficient and dynamic building. The crucial goal is aimed at building performance being addressed in the procurement, design and construction levels [6].

The relationship among architect, clients, consultants, and end-users brings forward more important questions and a variety of conceivable answers. The aptitude to process various qualitative data toproper answers — to reason architecturally — is an essential strong point of architectural approach, free from the type and magnitude of the answer [2]. Several evolving African nations is supposed to be able to fund infrastructural developments needed if the nation capital and budget is appropriately and judiciously used[7].

III. THE EFFICIENCY OF PHYSICAL INFRASTRUCTURE FROM AN ARCHITECTURAL PERSPECTIVE

Africa still has colossal infrastructure necessities. It devotes merely 4% of its Gross Domestic Product in infrastructure, paralleled with 14% in China. Tying the infrastructure breach could upsurge Gross Domestic Product growth by a probable 2% points annually [5]. Infrastructure acts as the bridge among social life and the architecture that houses it, that is, architects work by blending an incongruent range of data in order to yield physical form [2].

The principled quest to promote sustainability in developing nations is just as green infrastructure seeks to combine social struggles in providing answers through the development of infrastructure with the extra necessities of landscape. Fiscal advancement of African countries is measured by the degree of, and efficiency of the utilization of e-governance, e-technology to back infrastructural development ambition[7]. There's a massive claim for infrastructure in Africa and yet the cash and support coming from benefactors and administrations is not enough. As a consequence, African administrations need to consider innovative options to fund the infrastructure breach, plus being involved in more public-private partnerships (PPPs) [8].

IV. THE BUILDINGS PERFORMANCE OF PHYSICAL INFRASTRUCTURE AND ITS PROBLEMS

Building performanceevaluation is a scheme for improving the performance of buildings from the initial phases of work. This includes pointing out issues such as energy use and user comfort**.** Building performance evaluation involves the method of gaining data about building performance and exhausting responses to advance innovative structures and update the design of upcoming projects [6]. According to research by (Nigerian Society of Engineers (NSE), 2014),the problem of low performance in the design and construction of physical infrastructure supply in evolvingnations stems from the small consideration of environmental conditions and maintenance demands.

Consequentially, frequent costs, disasters, depletions and low performanceis the order of the day. Cooperation between public and private agenciesfor supply of physical infrastructure in developing countries is very poorand this affects national capacity for delivery in most developing countries. Hence the present effort of the Nigerian government to develop an integrated long-term infrastructure masterplan is to be applauded.

V. THE BUILDING CONDITION RATING SCALE AND ITS APPLICATION TO EXISTING CONDITIONS OF PUBLIC BUILDINGS IN SOUTH-WEST NIGERIA

The Infrastructure Concessioning& Regulatory Commission (ICRC) is burdened with the responsibility of improving infrastructural development in Nigeria and its capability to share such know-how with the state and other Africa countries would go a long way in guaranteeing sustainable and worthy infrastructure in Africa [7]. Infrastructure performance management involves quantifying the efficiency and effectiveness of infrastructure elements and their effect on user satisfaction. For this study, two areas have been identified that form a minimum basis for performance evaluation of buildings.

This is shown in Fig. 1 below and they are the physical and functional areas or strategies which work together with the input of the government.
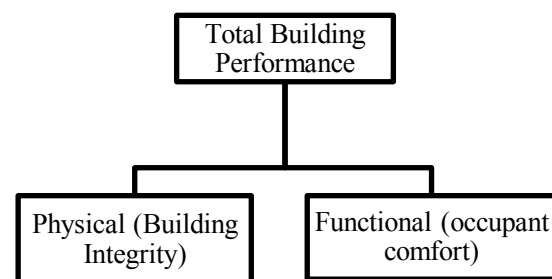
Figure 1: Building Performance Strategies

The physical area involves the protection of the physical structure by maintenance, design and construction methods. The functional area involves occupant comfort issues such as physiological, psychological, sociological and economic responses. Both areas work in relation to the other and their efficiency is determined by the presence and quality of the government participation or input in total building existence.

Much importance is presentlyset in evaluation factors that are related to planned, calculated, active and informational phases of the business that affect the society. Organization musttrack positive stages that will allow them have a sound performance measurement framework which include planning what to measure, choosing what to measure, determining how to measure, data utilization and implementation [9].

In order tohave a building performance framework, first categorize diverse approaches and methods that will be used in measuring building performance. Recognized approaches and methods are then connected with structural and non-structural building facilities (which includes; physical, functional, financial and survey-based performance) to make a consistent building performance measurement conclusion.

VI. METHODOLOGY AND RESULT

Data for the study is collected based on observations on two selected public buildings in South-West Nigeria. Each building was visited and the spaces observed were public spaces such as the reception, conveniences, and circulation areas within the buildings as access to all parts were restricted. Respondents were the occupants and building users within these public spaces. Questions were asked to the respondents and the answers were recorded by the researcher. General physical observation on the buildings were also carried out. The building condition rating scale provided the framework for observations.

The finding shows that the challenges in the public buildings are numerous and include finance, technology for development, maintenance and design. Strategies and techniques linked with structural building facilities which include physical and functional performance are used in measuring building performance by rating the frequency of efficiency in percentages.

In the survey, the attributes are rated on a three point scale of efficiency measured by the amount of satisfaction or experience by the respondents and the author's observation.

Physical Performance Strategies
Result depicted in Table 1 showing, a higher rating in the inefficiency of resource consumption, adequacy of infrastructure and quality of space than in other areas

Table 1: Physical Performance Strategies

Strategies	%very efficient	% fairly efficient	% inefficient	Ranking
A. Resource Use (energy, water, and material)	-	-	35	1st
B.	-	-	20	2nd

Adequacy of infrastructure				
C. Quality of space (spatial, environment and amenities),	-	-	10	3rd
D. Quality and durability of the land base,	-	15	-	4th
E. Accessibility (site, location, and building design),	15	-	-	5th
F. Adequacy of building space to support the desired function	-	5	-	6th
Total (100%)	15	20	65	

Source: Author's Survey, 2016
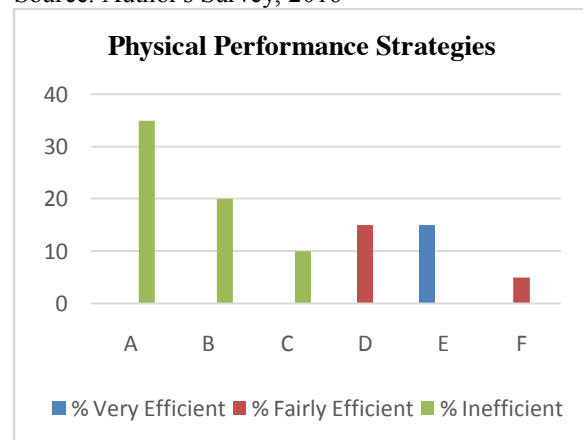
Figure 2: Bar Chart Showing the Percentages of Efficiency forPhysical Performance Strategies

Functional Performance Strategies
Result depicted in table 2 showing standard that enhances building users with human and psychological comfort by the proficient supply of functional related structure strategies

Table 2: Functional Performance Strategies

Strategies	%very efficie	% fairly	% ineffic	Ranking

	nt	effici ent	ient	
A1. Heating	-	-	35	1st
B1. Systems and technology	-	-	25	2nd
C1. Cooling	-	-	15	3rd
D1. Workspace s and Living areas	-	15	-	4th
E1. Lighting	-	10	-	5th
F1. Air distribution (artificial and natural ventilation)	5	-	-	6th
Total (100%)	5	25	75	

Source: Author's Survey, 2016
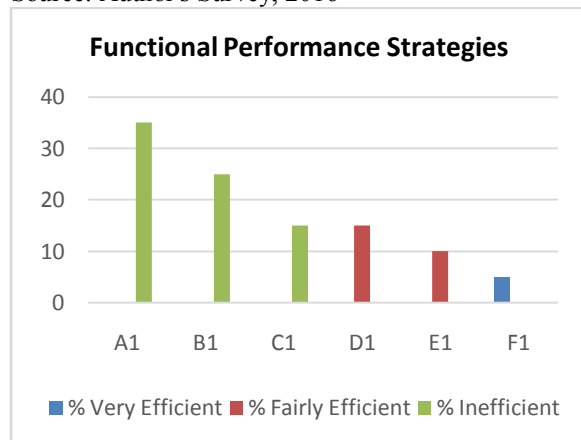

Functional Performance Strategies

Figure 3: Bar Chart Showing the Percentages of Efficiency forFunctional Performance Strategies

Government's Involvement in Building Performance
The knowledge of government's involvement in building performance is gotten from interview with public building users and national news publications.

Table 3:Governments Involvement in Building Performance

S/N	Description	Yes (%)	No (%)
1	Existence of building Insurance for Public Buildings	40	60
2	Payment of Health and Safety Insurance to accident victims	40	60
3	Compliance to Building	30	70
	Maintenance Plan		
4	Monitoring and periodical inspection of public building	50	50
5	Positive efforts towards user comfort	80	20

Discussion
a. More than half of the respondent complained about the inefficiencies in energy provision and consumption
b. They have all witnessed or experienced indiscriminate fare collection by government officials meant for maintenance.
c. Majority of these buildings do not have any insurance in place for the users.
d. The performance of each area cannot be understood or estimated independently.
e. a design response to the physical performance required will alter the physical environment and thus the perceived function and level of comfort by occupants.
It may be concluded that effective building performance practices in Nigeria are yet to be fully activated.

VII. RECOMMENDATIONS AND CONCLUSIONS

The study concludes that Nigeria Government has the power to put the buildings in place and providing good infrastructure will make our environment conducive for the users. If we invest in infrastructure that unlocks the potential of the private sector, championing community participation, it will help improve skills for competitiveness, ensuring that those skills better match the opportunities and requirements of local job markets.
Ensure that inclusive growth is sustainable, by helping Africa gradually transition to "green growth" that will protect livelihoods, improve water, energy and food security, and promote the sustainable use of natural materials for construction.
Based on the findings, it is recommended that sustainability, inclusivity and technology should be prioritized in all national sectors in order to brave the efficiency challenges of the 21st century society.

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Pinus glabra: As a Potential Source of Anti-*Mycobacterium tuberculosis* Agent: Phytochemical and antimicrobial Studies of its Stem Extracts

Ifedolapo O. Olanrewaju
Department of Chemistry
Covenant University
Ota, Nigeria
ifedolapo.olanrewaju@covenantuniversity.edu.ng

Johnbull O. Echeme
Chemical Science Department
Federal University of Technology
Umudike, Nigeria
jb.tbulle@gmail.com

Egaogheneverere E. Adjere-Taunu
Department of Chemistry
Covenant University
Ota, Nigeria

Raphael C. Mordi
Department of Chemistry
Covenant University
Ota, Nigeria
raphael.mordi@covenantuniversity.edu.ng

Joan I. Ayo-Ajayi
Department of Chemistry
Covenant University
Ota, Nigeria
joan.ayo-ajayi@covenantuniversity.edu.ng

Abstract—**With the increasing incidence of tuberculosis and rated second to HIV-AIDS by the World Health Organisation as a leading cause of death from infectious disease and increased resistance to drugs currently in use, there is therefore the need for alternative sources of drugs for the treatment of this disease. *Pinus glabra* presents as a potential candidate for such drugs discovery. Concoctions derived from the plant have been used to treat cases of rheumatism, cough, piles and catarrh. Sample extraction was performed by soaking the stem samples in ethanol for 172 h, which gave reddish-yellow oil after removal of the ethanol solvent. The oil was partitioned between 1:1 water/chloroform mixture. The aqueous layer was further partitioned separately with ethyl acetate and hexane. The phytochemical screening of the crude ethanol extract revealed the presence of alkaloids, saponins, tannins and flavonoids. Antimicrobial tests were performed on the crude ethanol extract, ethyl acetate and hexane fractions against clinical isolates *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa* and *Klebsiella sp.* by measurement of zones of inhibition. All test samples exhibited significant antimicrobial activity against the organisms albeit to different extent.**

Keywords—*Phytochemical studies; antimicrobial studies; anti-Mycobacterium tuberculosis; isolation and extraction; pinus glabra*

I. INTRODUCTION

This template, You may ask why we need new TB drugs, when there are several drugs out there in the market.

There are three main reasons why we need new TB drugs: there is the complexity and toxicity of the current TB drug regimens; the issue of TB drug resistance; and the problem of the interaction of current TB drugs with antiretroviral drugs taken by HIV positive people [1].

So what are we looking for in the new drugs?

1. Shorter and simpler, but still affordable multi drug regimens for drug sensitive TB;

2. Shorter, more effective, less toxic and less expensive regimens for drug resistant TB;

3. Short, simple, easily tolerable and safe regimens for latent TB;

4. Drugs with few drug interactions so they can be safely provided to people with people with HIV.

Mycobacterium tuberculosis of the genus mycobacterium is the major cause of tuberculosis, which is the leading cause of death after HIV [2]. There was an estimated 8.8 million incidence of TB globally in 2010.

Nigeria has the fourth largest cases of tuberculosis in the world with more than 460,000 cases in 2007 [3]. The mortality cases of TB in Nigeria have been put at 320 in every 100,000.

Majority of the peoples of the developing countries of the world still rely on traditional medicine derived mainly from

medicinal plants. Medicinal plants remain important sources for finding new active drugs or new therapeutic agents [4]. Phytomedicines have shown great promise in the treatment of intractable infectious diseases including tuberculosis [5] [6].

Pinus glabra has been used to treat chronic rheumatism, catarrh and swollen testicles [7].

The failure of the Directly Observed Therapy, Shot Course Strategy (DOTS), the prevalence of multi drugs resistance tuberculosis (MDRTB) and the emergence of extensively drug resistant tuberculosis (XDR-TB) it has become necessary to look for alternative sources of drugs and the screening of herbal plants with anti-mycobacterial effect therefore needs to be paid serious attention.

With these observations in mind, it was decided to extract, isolate and characterise the secondary metabolites from the stem of *Pinus glabra* and to determine their anti-microbial potential.

Previous studies on the *Pinaceae* family have revealed that the chemical constituents were mostly terpenoids, flavonoids, phenols, steroids, fatty acids and fatty alcohols [8] [9] [10] and the extracts were found to possess bioactivities as anti tumour, anti-hypertensive and antitussive agents.

The family were also found to possess antimicrobial activity against *Bacillus megatherium*, *Bacillus subtilis*, *Bacillus cereus*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Staphylococcus aureus*, *Mycobacterium smegmatis*, *Proteus vulgaris*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*, *Candida albicans*, *Candida tropicalis* and *Penicillium italicum* [11].

II.   MATERIAL AND METHOD

Pinus glabra used in this study was harvested from the university grounds and authenticated in the biological sciences department of the university.

The sample stem (1000 g) was soaked in ethanol (6.10 L) for 168 h. After which time the solution was decanted and filtered. The filtrate was distilled on a rotary evaporator to give yellow/red oil (189.5 g). The ethanolic extract (50 mL) was partitioned between water:chloroform mixture (1:1) in a separators funnel. After separation the chloroform fraction (F1) was kept and the aqueous layer was further partitioned between water and ethyl acetate.

After separation the ethyl acetate fraction (F2) was kept and the aqueous layer was again partitioned between water and n-hexane. After separation the aqueous layer (F3) and n-hexane fraction (F4) was kept for analysis.

Phytochemical screening was carried out on the crude ethanolic extract using standard methods as described by Trease and Evans [12]. A summary of the screening result is shown in Table 1.

Bacterial cultures of E. coli, Staphylococcus aureus, Klebsiella sp., Pseudomonas aeruginosa were maintained on nutrient with broth at 37oC for 24 h prior to testing, used for antimicrobial analysis on an agar well diffusion technique.

Ethanol extract, n-hexane extract and ethyl acetate extract at 50 mg/mL was introduced into the wells. Chloramphenicol (100 mg/mL) was used as a positive control and 20% nutrient agar as negative control.

The outcomes of the measurements of the zones of inhibition for antimicrobial tests are recorded in Table 2.

III.   RESULTS AND DISCUSSION

The phytochemical screening of *Pinus glabra* stem revealed that crude ethanolic extracts of *Pinus glabra* stem contained flavonoids, alkaloids, tannins, saponins, phenol, cardiac glycosides and saponin glycosides at very high intensity while anthraquinones were moderately present.

The antimicrobial potential of crude extract and fractions during partitioning were assessed in terms of zone of inhibition of bacterial growth. The result antimicrobial activities is presented in Table 2. Activity were studied at 50 mg/ml concentration against four pathogenic bacterial strains, one Gram-positive (*Staphylococcus aureus*) and three Gram-negative (*Escherichia coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*). As compared with standard drugs, the results revealed that majority of the extracts were sensitive while Ethyl acetate extract showed no sensitivity towards *E. coli*.

Table 1. Summary of Phytochemical screening of ethanol extract of *Pinus glabra*

Test	Intensity
Flavonoids	+++
Alkaloids	+++
Tannins	+++
Saponins	+++
Anthraquinones	+
Cardiac glycosides	+++
Phenol	+++
Saponin glycosides	+++
Key: + = mild, ++ = moderate, +++ = intense	

Table 2. Zones of Inhibition

Test organism	Zone of inhibition (mm)		
	Ethanol	Ethyl acetate	n-hexane
E. coli	16	-	15
Staphylococcus aureus	15	10	13
Pseudomonas aeruginosa	25	22	19
Klebsiella pneumoniae.	15	10	13

IV.   CONCLUSION

The Phytochemical screening which revealed the presence of secondary metabolites and the antimicrobial activities of the various fractions against selected bacteria show that Pinus glabra is a potential candidate for the treatment of various ailments as has been reported for other members of the plant family [7].

We are therefore working on isolating and characterising the individual components of the extract and testing for their biological activity and tuberculosis in particular.

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GEOGRAPHIC INFORMATION SYSTEMS APPLICATION IN SUSTAINABLE BUSINESS INTELLIGENCE ANALYSIS

*Adeyemi Gideon Adewale
Department of Civil Engineering
Covenant University
KM 10 Idiroko Road,Ota, Canaan Land
P.M.B 1023 Ota,Ogun state,Nigeria
gideon.adewale@cu.edu.ng

Anthony Ede
Department of Civil Engineering
Covenant University,
KM 10 Idiroko Road,Ota, Canaan Land,
P.M.B 1023 Ota,Ogun state,Nigeria
anthony.ede@covenantuniversity.edu.ng

Bamigboye Gideon Olukunle
Department of Civil Engineering
Covenant University,
KM 10 Idiroko Road,Ota, Canaan Land,
P.M.B 1023 Ota,Ogun state,Nigeria
gideon.bamigboye@covenantuniversity.edu.ng

Abstract: Today, the corporate growth and development requires planning and taking the right decisions at the right time.In order to be excellent and be above in service delivery and gaining of competitive advantage over other competitors, available information has to be well analysed.

Engaging the cutting edge and the driving force of Information Technology to overcome barriers around business growth and development through adequate data collection,storageand analysis is therefore vital for business success.

In addition,the need to engage in sustainable businesses cannot be overemphasized because of their intimate connection to healthy economic, social and environmental systems. These businesses create economic value and contribute to healthy and vibrant ecosystems in addition to building stronger communities.

***GIS: (Geographic Information System)*is an "organized collection of computer hardware, software, geographic data and personnel designed toefficiently capture, store, update, manipulate, analyze and displayall forms of geographically referenced information"**

This paper considers the role of Geographic Information Systems in Business development,Sustainable businesses, awareness level about Geospatial data utilization in Nigeria.

Conclusion: Information Technology application is therefore necessary in business intelligence analysis to harness the full economic and environmental benefits

Key words: Sustainable Businesses, Business Intelligence analysis, GIS in Business,development Economic and environmental benefits

1 INTRODUCTION

Information Technology has been observed to change the pace and ways businesses are being done most recently. The role of Information Technology particularly Geographic Information Systems in solving the plethora of problems associated with successful business operations cannot be overemphasised.Both intra and international business dealings and outreaches has been significantly affectedthrough the application of instrumentality of cutting edge and the driving force of Information Technology to overcome barriers around business growth and development.GIS has greatly contributed to Business intelligence through adequate data collection, storage, analysis and display of spatially referenced data to enhance qualitative decision making, whichis vital to business development and success. Effective service delivery and gainingofcompetitive advantage over other competitors is rooted in engaging the adept potentials of Information Technology to overcome barriers around business growth and development. GIS supports mapping, data visualisation and a better understanding of data which is important to business success.

Geographic Information Systems (GIS) could be defined as organized collection of computer hardware, software,data, procedure and personnel efficiently organized to capture, manage, analyse, store, retrieve and display spatially referenced data. Data collection and analysis plays a very significant role for organisations to fulfill their roles and objectives. 'Businessintelligence is a priority for organisations interested in gaining a competitive advantage' ESRI (2012).In addition, GIS enhances adequate and intelligent analysis of underutilized data in ways not typically seen in traditional Business intelligence applications to generate qualitative decision supports output. We are able to understand data more through adequate visualization and analysis of key business data.

2.0 Areas of GIS applications:

GIS has a place in nearly every field of human endeavours, Government, Engineering, Agriculture, Environmental management, security and other areas with inherent benefits. In addition, its ability to perform integrated analysis of locational data together with social economic data sets that may be of different scale, age and origin makes it a good planning and decision supports tool. Additionally, Geostatistical analysis with robust modeling capability of GIS makes it a veritable tool to enhance its predictive capability.

2.1 Location Analysis: Adequately answering the question of where to site a business, factory, offices warehouse etc. is one of the main success factors in business operations and growth, Information about best customers location, customer locations and distribution over space, understanding of changes in trend of customers demand and request on a regional basis, would go a long way in effective production and for excellent service delivery.For a business to thrive well. Location analyses, also known as suitability analyses, use overlay and Boolean logic to perform queries whose results are locations that meet very specific sets of criteria Juliana Maantay, John Ziegler (2006).GIS provides the ability to see people and opportunities in better, clearer and well informed ways.It has the ability to perform integrated analysis of data sets that may be of different sources, scale and time to answer the questions of what? , Where? , When?And If.

2.2 Transportation and network analysis: Nearly everything that we do exists in space. According to (AngelaIonita, Marcel Foca and Marius I.(2016) GIS is becoming a part of mainstream business and management operations around the world in organisations as diverse as cities, state government,utilities,telecommunications, railroads, civil engineering ,petroleum exploration, retailing,vehicles routing,site selection, research and analysis.

2.3Planning: Planning involves the assessment of trends and development patterns in both space and time and the formulation of plans to address future problems and opportunities "Maantay and Ziegler (2006).GIS could be used to predict the most viable and profitable land uses, define sales territories,support decisions making based on the spatial distribution/locations of consumer needs anddemand. With analytical capacity of GIS, location intelligence could be effectively combined with Business intelligence for routing and logistics, effectivecustomers service, fleet management, facilities and assets management, Risk

management and insurance,Retail and marketing, Telecommunication andreal estate development. With application of GIS, development costs and risk could drastically be reduced and more informed decisions are made faster.

3.0Sustainable Business:

A **business practice** that is socially responsible,economically viable, and environmentally friendly could be regarded as being sustainable.The need to engage in sustainable businesses cannot be overemphasized because of their great impact and connection to healthy economic, social and environmental systems. Sustainable businesses create and enhance economic value and contribute to healthy and vibrant ecosystems. Inaddition toconstructive human development andbuilding of strongercommunities. Business and trade opportunities involving the sales of endangered species must be discouraged,illegal lumbering activities has a negative toll on environmental protection. GIS has been found to be useful in biodiversity conservation and environmental impact assessments. Also,sustainable business development involves the application of sustainability principles to business procedures and operations

4.1 **Geospatial data utilization in Nigeria:** The awareness about GIS utilization is increasing in Nigeria. Government establishments that supposed to generate and be a custodian of usable data to enhance public infrastructural planning and resource management needs to be fully involved in data collection, analysis and provision of access to GIS outputs to enhance business sustainability and orderliness in the society. Many constrains to GIS development in developing countries were identified to be caused by lack of appreciation of the technology, limited understanding of GIS principles and associated methodology and inadequate organizational commitment to ensure continuity of these spatial decision support tools Onosemuode Christopher and Dare Olaniyi Timothy(2010).

Conclusion: Information Technology application is therefore necessary in business intelligence analysis to

harness the full economic, social and environmental benefits inherent in it.

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Measures that Enhance Favorable Levels of Service and their Modes of Sustainability on Major Roads in Akure, South-Western Nigeria.

AJAYI Samuel Akintomide

Nigerian Building and Road Research Institute
NBRRI,
Ota, Nigeria.
samuel.temitope@ymail.com

OWOLABI Adebayo Oladipo

Department of Civil Engineering, Federal University of Technology
FUTA,
Akure, Nigeria.

BUSARI Ayobami Adebola

Department of Civil Engineering, Covenant University
Covenant University,
Ota, Nigeria.

Abstract—large cities in developing countries are characterized by a continuing growth in automobile ownership and insufficient transportation infrastructure and service development. The research provided information on the important parameters that engender various regimes of Levels of Service in Akure, Nigeria and brought out factors that enhance favorable Levels of Service and their modes of sustainability. This was achieved by collection of traffic metering parameters such as traffic composition and volume-capacity ratio; these were evaluated to determine the levels of services on the selected major roads such as Oke-Aro, Oke-Ijebu and Hospital which are critical in Akure metropolis. The traffic composition analysis revealed passenger car / taxi as the predominant mode for the entire route. Besides, the result also revealed increased volume of traffic, poor parking system, ribbon development /street trading, bad roads, poor geometric or operational constraints as factors affecting the level of service. Ultimately the result of this research will help transportation agencies and the government in proffering adequate measures for the reduction of traffic congestion on major roads in Akure and similar capital cities in Nigeria.

Keywords— traffic composition; level of service; traffic; volume-capacity ratio;

I. INTRODUCTION

Cities in developing countries are characterized by increasing growth in automobile ownership and insufficient transportation infrastructure to meet the demand. These cities most often suffer from congestion, poor mobility and accessibility, significant economic waste, adverse environmental impact and safety problems. Assessing the degree of congestion, should be a major task for developing countries transportation professionals. Congestion occurs when traffic demand approaches and exceeds highway / road capacity. To characterize congestion and other nature of traffic, it is necessary to determine the level of service.

According to [1]; road traffic congestion is one of the major indicators of a city socio-economic vibrancy. It has continually challenged the efforts of city and transport planners on the highways, the problems associated are longer travel time and delays over time and space. It has equally created an artificial barrier to a cost effective flow of goods and persons along our highways linking major towns together. The traffic conditions across highways in Nigeria are in a grim situation caused by daily congestion and daily accidents. "Reference [2] defined Level of Service (LOS) as a designated term used to qualitatively describe the operating conditions of a roadway based on parameters such as volume/capacity ratio, speed, travel time, maneuverability, delay, and safety. It designates six levels of service for each type of facility, from A to F, with LOS "A" representing the best conditions and LOS "F" the worst.

"Reference [3]; shed lighter on defining the operating conditions for these six levels of service selected by [2]:

Level of Service "A": Free flow, with low volume and high speed. Traffic density is low, with speed controlled by drivers' desired speed limits and physical roadway conditions. Individual users are virtually unaffected by others in the traffic stream; v/c =0.00 to 0.60.

Level of Service "B": represents the range of stable flow but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected but there is a slight decline in the freedom to manoeuvre within the traffic stream from LOS A; v/c = 0.61 to 0.70.

Level of Service "C": represents the range of stable flow but the selection of speed is affected by the presence of others. Manoeuvring within the traffic stream requires substantial

vigilance on the part of the user, v/c =0.71 to 0.80. This is the target LOS for some urban and most rural highways.

Level of Service "D": Approaches unstable flow, with tolerable operation speed being maintained through considerably affected changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operation speeds. Drivers have little freedom to manoeuvre; comfort and convenience are low, but conditions can be tolerated for short periods of time. Minor incidents are expected to create delays, v/c=0.81 to 0.90.

Level of Service "E": unstable flow, operating at capacity, Cannot be describe by speed alone but represent operations at even lower operating speeds than in level D with volumes are or near the capacity of highway. At capacity speed are typical but not always in the neighborhood of 50 km/h. Flow is unstable, and there may be stoppage of momentary duration. Drivers' level of comfort becomes poor. Freedom to manoeuvre within the traffic stream is extremely difficult, v/c=0.91 to 1.00.

Level of Service "F": Forced flow operations at low speeds, where volumes are below capacity. Conditions result from queues of vehicles backing up from a restriction downstream. Speeds are reduced substantially and stoppage may occur for long or short period of time, because of downstream congestion. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS. In extreme, both speed and volume can drop to zero, v/c greater than 1.00

"Reference [4] discussed the need for Passenger car equivalence (PCE) to the traffic engineer both in the design of traffic facilities and also in the management of vehicles operations. Each vehicular types such as tricycle, motorcycles, car, buses, trucks/lorry in the traffic stream cannot be considered as equivalent to each other as there is significant difference in the vehicular and flow characteristics of each vehicle class. Therefore a Passenger Car Equivalent is majorly the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. Table I is the passenger car equivalents used to convert the traffic volume to passenger car unit per hour (pcu/hr) as given by [3].

Vehicle Type	Equivalent Passenger Car Units
Pedal Cycle, Tricycles and Motor Cycles	0.5
Motor-car, Station Wagon, Taxi, Kit-Car or Pick-up, Jeep, Land Rover, Light Delivery Van, Minibus Trailer attached to above	1 2
2-Axle Truck Class, Lorry including Timber Lorry, Truck, Mammy Wagon, Petrol Tanker Trailer attached to above	2 3
3 to 5 Axle Combination, Tractor Trailer including Low Loader, Petrol Tanker, Bus (Excluding Municipal)	3
Municipal Bus, More than 5 Axle Combination	4

"Reference [5] also worked on Akure Central business district to analyze traffic volume and revealed the cause of parking problem. From this study, increased volume of traffic, ribbon development /street trading, improper structural layout/land use pattern within the Central Business District (CBD) was factors responsible for these problems. Also the solution to the parking problem has been recommended via provision of adequate off-street parking facilities, abolition of all unauthorized terminals, adjustment of the structural layout /land use in the CBD and the provision of an inner ring road around the central business district.

Oyemekun Oba Adesida and Arakale are the major arterial in Akure metropolis, in order to ease traffic from these arterial, more roads were built by the Government such as Oke-Aro, Oke- Ijebu, Hospital, and Ondo roads. In recent time, these two-lane roads are often congested, resulting in poor mobility, reduced speed and, poor operating condition of service in terms of driver's freedom to maneuver, and delays at intersections. In order to proffer remedies, it is necessary to assess the operating conditions of service, characterize congestion and other nature of traffic and recommend design measures on these routes for the enhancement of free flow traffic, goods and persons. The aim of the research is to provide solution to the problem of traffic congestion on the selected major two-lane roads in Akure with the objectives of determining the nature of traffic such as volume/capacity ratio, and determine the levels of service of these routes. The result of this research will help transportation agencies and the government in proffering adequate measures for the reduction of traffic congestion on major roads in Akure and similar capital cities in Nigeria.

II   DESCRIPTION OF THE STUDY AREA

The town Akure is the capital of Ondo State which is located within 7^0 15′north of the Equator and Longitude 5^0 05′ east of the Greenwich Meridian. It covers approximately 340 square km, having a north- south length of 17km and an east- west stretch of 20km. According to [6], the area extent of Akure grew from 1937 ha in 1976, to 5330 ha in 1986 (34.34%) and 7665 ha in 1996 (66.7%). The city has a population of 387,100 according to 2006 census. This consisted of 175,495 (49.68%) males and 177,716 (50.32%) females who are mainly civil servants, traders and peasant farmer. The town has a good road network system, and the existing major road in Akure is dominated by the Oyemeku-Oba Adesida and Arakale roads

Table I: Passenger Car Units (PCU)

with important transport facilities such as pedestrian walkways, bus stops, parking facilities, tarring of some feeder roads, erection of street and traffic lights.

"Fig 1" is the map of Ondo state while "Fig 2" is the detailed maps for selected major routes.
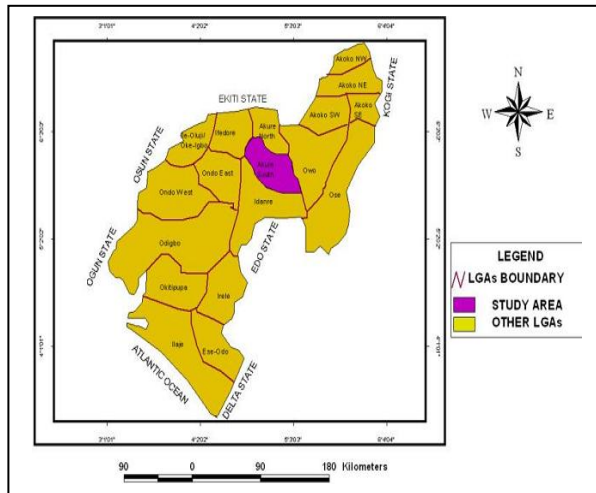

Fig. 1. Map of Ondo State, Nigeria.
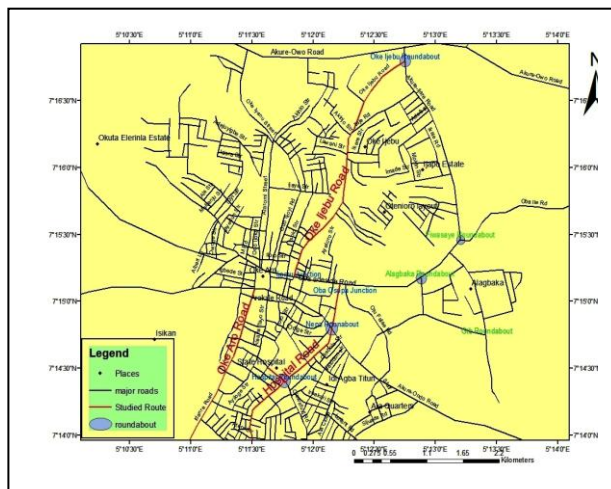Source: Ministry of Works and Housing

Fig. 2. Map of the Routes Selected for the Study
Source: Geographical Information System-2015

III. RESEARCH METHODOLOGY

The research covers three selected major roads:
   a.   Hospital
   b.   Oke – Ijebu
   c.   Oke – Aro
These routes were selected because they are critical to the traffic flow in Akure Metropolis; they help in easing the traffic on the major arterials which are Oyemeku-Adesida and Arakale. A reconnaissance survey of the routes was conducted with a view to selecting possible routes and spots, which might be feasible and appropriate for data collection. These routes were divided for easy traffic data collection as shown in Table II.

Table II. Selected Routes segmentation

Route	Direction 1	Direction 2
Hospital I	Oba-Osupa junction to Nepa roundabout	Hospital junction to Nepa roundabout
Hospital II	Nepa roundabout to Hospital junction	Nepa roundabout to Oba-Osupa junction
Oke – Ijebu	Ijomu junction to Oke-Ijebu roundabout	Oke-Ijebu roundabout to Ijomu junction
Oke – Aro	Arakale Junction to Idanre Garage.	Idanre Garage to Arakale Junction

Traffic volume count was collected through a semi-automatic method that is by mounting digital video recorder on both directions on the roadway to take inventory for the morning, afternoon and evening peak periods. Data from the recorder were then decoded and transferred into recording sheets. A tally sheet was prepared, which contains the types of vehicles i.e motorcycle, cars, vans buses and trucks. These were arranged on the sheet in ascending order of their vehicular capacities. The tally sheet was marked as vehicles passed the reference point on the road. The traffic volume was converted to pcu/hr by multiplying each vehicle with their respective passenger car unit equivalents in order to get the approximate number of vehicles that ply all the selected roads during the chosen peak periods in terms of passenger car. These peak periods were between 7-9am, 12-2pm and 4-6pm for morning, afternoon and evening respectively on weekdays (monday – friday); 9-11am, 12-2pm on Saturdays;7:30-9:30am and 12-2pm on Sundays.

As given by [2], the capacity for two-lane road is 2800 pcu/hr, therefore the Levels of service was determined by the analysis of volume-capacity ratio (v/c). A traffic projection for 10 years would result in Projected Traffic Volume using;

$$Q_n = Q_0 (1 + r)^n \qquad (1) [7]$$

Q_n is the Projected Traffic Volume (pcu/hr)

r = Traffic Growth Rate (%)

n = Number of years for which projection is made;

Q_0 = Observed Maximum Traffic Volume.

Assuming a traffic growth rate of 3% as recommended by [8] for developing countries and substituting the values for known Observed Maximum Hourly Traffic Volume, the Maximum Projected Traffic Volume were obtained for each route. The future levels of service were determined from the ratio of maximum projected traffic volume and capacity.

IV. RESULTS AND DISCUSSION

A. Traffic Composition

  "fig. 3" is the traffic composition of vehicular types that ply Oke-Aro route. The chart revealed that the most predominant mode of transport in dir. 1 were passenger cars / taxi which constituted approximately 51% of traffic followed by motorcycles constituting of 46% and mini buses /vans, buses and trucks/lorries constituting 2.9% , 0.3% and 2.6% respectively. Also on dir. 2 motorcycles constituted 51% and

41% passenger car unlike dir. 1 while and mini buses /vans, buses and trucks/lorries constituting 4.2% , 0.2% and 3.8% respectively. The modal choice is affected by the type of trip which is mostly recreational, population, income of resident as given by [9]. The traffic prevalence of mini buses is low because of the prevalence of motorcycles and taxi to convey people to Idanre garage and out respectively.
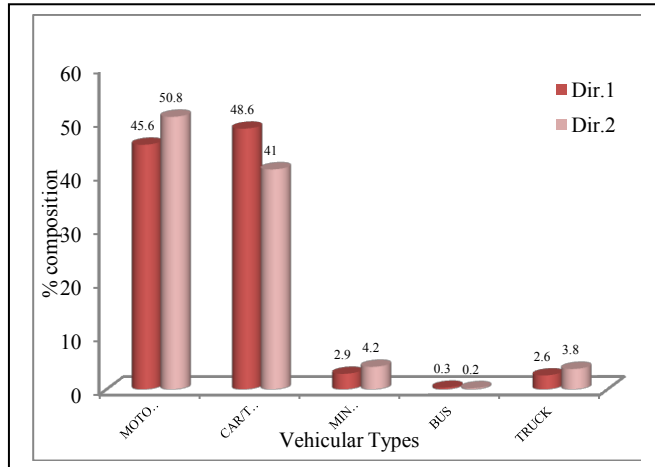
Fig. 3. Traffic Composition for the Week (Oke-Aro route)

Hospital routes: Also in fig. 4, passenger car / taxi have a greater percentage composition of approx. 64%, followed by Motorcycle: 30%, Mini Buses / Vans: 3.0%, Buses: 1.6% and Truck: 1.0% for dir. 1a. Likewise, passenger car is predominance of approx. 57%, followed by Motorcycle: 39%, Mini Buses / Vans: 2%, Buses: 1% and Truck : 1.6% in dir.2a.
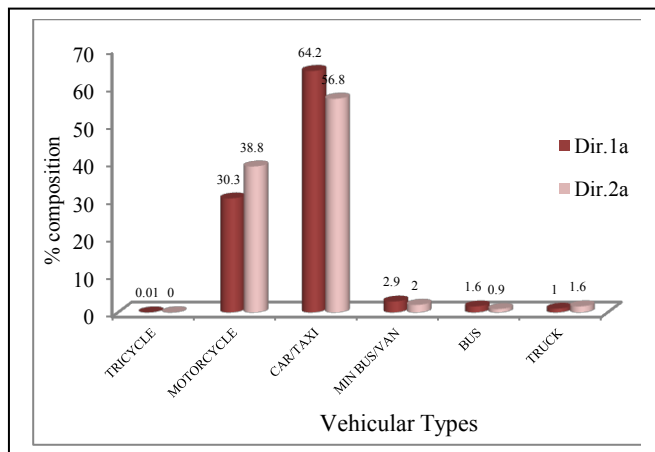
Fig. 4. Traffic Composition for the Week (Hospital I)

For Hospital II, passenger car has a greater percentage composition of approx. 61%, followed by Motorcycle: 36%, Mini Buses / Vans: 1.5%, Buses: 1% and Truck: 0.8% in dir.1b. Also for Dir. 2b, passenger car has a greater percentage composition also in this direction of approx. 61%, followed by Motorcycle: 35%, Mini Buses / Vans: 1.8%, Buses: 1% and Truck: 0.7%. This is shown in fig. 5.
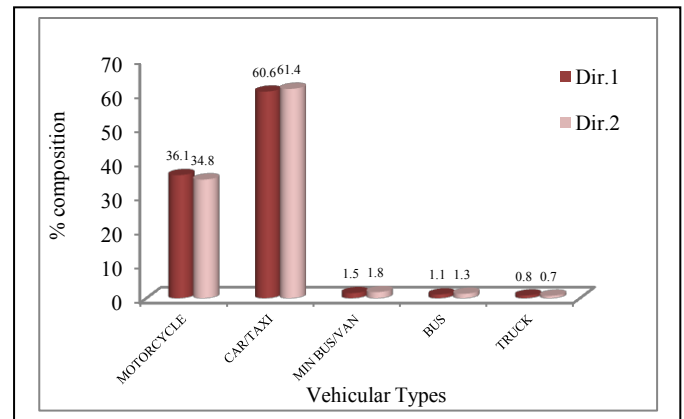
Fig. 5. Traffic Composition for the Week (Hospital road II)

The dominance of passenger car / taxi in Oke-Ijebu is shown in fig. 6 with the highest composition of approximately 50% and 53% for dir. 1 and 2 respectively followed by motorcycles. The dominance of taxi affected the volume /traffic build up / congestion on this route.
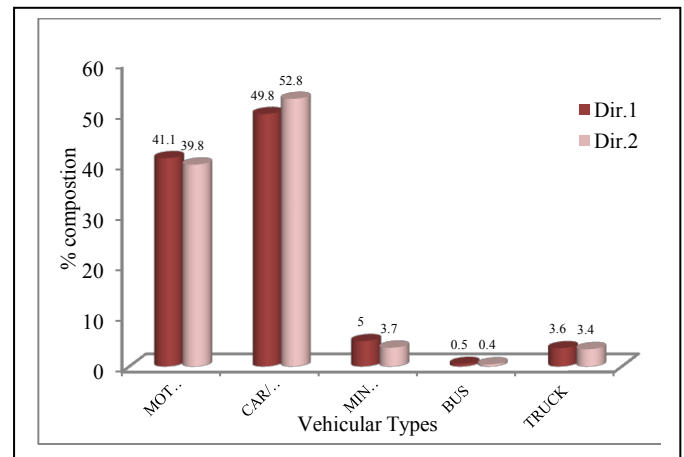
Fig. 6. Traffic Composition for the Week (Oke-Ijebu)

B. *Volume and Levels of Service(LOS)*

"fig. 7 and 8" is the maximum hourly volume for the week, for Oke-Aro, the maximum / highest hourly volume was 1465 pcu/hr and 1201 pcu/hr which were recorded on Friday and Tuesday respectively. Also for Oke-Ijebu, the maximum hourly volume recorded on Friday was 1096 pcu/hr and 1237 pcu/hr for dir.1 and 2 respectively. In the same vein, Hospital I; the maximum volume was also recorded on Friday; 1179pcu/hr and 1304pcu/hr for dir. 1 and 2 respectively, while 1316 pcu/hr and 1312 pcu/hr recorded on Friday for dir. 1 and 2 for Hospital II. The lowest or minimum volume for the week was observed on Sundays for all the routes. The results of the maximum volume on the routes depict high level of socio-economic activities going on in these areas, and the population considered as a factor.
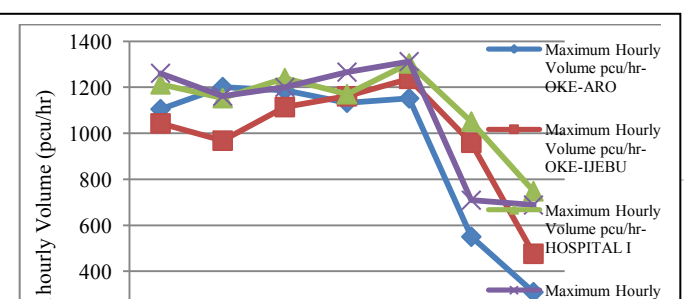
Fig. 7. Maximum Hourly Volume Variation for Weekly Traffic (dir.1)
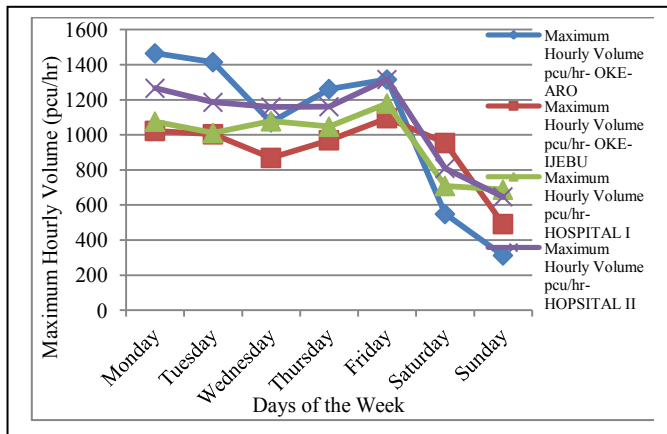
Fig. 8. Maximum Hourly Volume Variation for Weekly Traffic (dir.2)

Table III is the summary results for the LOS determination for the routes. Given that the road capacity is 2800 pcu/hr for two lanes roads as specified by Nigerian Highway Capacity Manual, 2010. With the aid of traffic projection equation as shown aforementioned pages of this paper, the futures Levels of Service were evaluated.

The implication and causes of level of service on each routes has been highlighted in Table IV. Moreover the future Level of Service for all the routes is "F" which signify severe congestion by 2026. However, the highest volume was recorded for Oke- Aro, which as a result of the population, income of residents, type of trips which is mostly recreational; this also influences the levels of service.

Table III: Maximum Hourly Volume and Corresponding Results

Table IV: Summary Result Showing Implication and Causes of the Levels of Service.

Routes	Level of Service (LOS)	PAG Standard	Implication of Level of Service (HCM)	Causes
Oke-Aro	E	Heavy congestion	Unstable flow, operating at or near capacity, operations at even lower operating speeds than in level "D", and any incident l create serious delays. Drivers' level of comfort is poor	Increase volume of traffic which is predominated by passenger car/taxi, increased socio-economic activities poor parking system, ribbon development, width of intersection legs is small.

IV MEASURES THAT ENHANCE LEVELS OF SERVICE FOR THEIR SUSTAINABILITY

It is important to put in place measures that will facilitate favorable enhancement of Levels of Service. The results of traffic analysis and consequent level of service on each route signify traffic congestion, a menace to transportation development especially in urban cities in Africa. The following are recommended as measures to reduce the problem of congestion in urban cities using Akure as a case study;

a. *Replacement of Existing Transport modes*: The existing predominant transport mode in Akure for commercial purpose is taxi; effort should be made by state government and private agencies to provide reliable mass transit buses or BRT in the metropolis which is a major transport facility provided in Lagos to reduce traffic congestion. Due to its vehicular capacity, it will largely decongest the road. Also the volume of motorcycles should be greatly reduced on the routes as their emission is hazardous to the environment and health of residents and road users.

b. *Increase the capacity:* all the routes considered are single carriageway or two-lane road; expansion of the road should be done within the next 10 (ten) years in order to accommodate future traffic. The capacities of these roads are increased by conversion of the single-carriageway to a dual-carriageway.

c. *Maintenance of Road:* frequent and regular maintenance on damage portion on the roadway will ease movement on the roadway while the maneuverability is not influenced and sustain our infrastructural development in Africa.

d. *Restriction of Illegal Activities:* the abolition of unauthorized terminals, illegal parking system, street trading, and abandoned vehicles is necessary to reduce congestion and maintain a favorable level of service on the road; these should be prevented and enforced by appropriate agencies.

e. *Provision of adequate transport facilities:* provision of parking facilities and bus terminals are important facility, also traffic control system such as repair of faulty fixed time signals across each junction/intersection, expansion of intersection legs and circulating carriageway width should be put in place in order to accommodate both present and future traffic.

f. *Diversification of Transportation System:* the over-dependence on only on one mode is a major menace that constitutes the overwhelming traffic congestion in Nigerian cities. The coordination and juxtaposition of Road, Rail, Air and Water transportation systems in Nigeria should be done in tandem with what obtains in the developed and industrialized nations of the world, where all modes of transport operate efficiently. The project could be funded from the huge revenue accruing to the nation from crude oil export, solid minerals and other sources if prudently managed. This would be "saving for the rainy day".

V CONCLUSION

The nature of traffic and corresponding levels of service on Oke-Aro, Oke-Ijebu and Hospital roads were determined through metering parameters such traffic composition and Volume / Capacity ratio. The corresponding present Levels of Service is Poor (E), Fair (D), Fair (D) and Poor (E) for Oke-Aro, Oke-Ijebu, Hospital I and II respectively; the implication is that for all the routes; unstable flow, high density and severe restrictions on a driver's ability to maneuver, with poor comfort and convenience subsists. Increased volume of traffic, poor parking system, ribbon development /street trading were factors responsible for these Levels of Service. Assuming a traffic growth rate of 3% as recommended by [8] and a

projection of ten (10) years for developing countries, the future Levels of Service for all the routes were "F" which would imply severe congestion by 2026. Therefore to sustain, develop and maintain transportation infrastructure in Nigeria, design measures such as expansion, abolition of illegal parking/ trading, provision of adequate parking facilities, repair of traffic control signals and expansion of intersection legs width and roundabout circulating carriageway width are recommended to be taken in order to reduce traffic congestion in urban cities, enhance level of service and other traffic problems. This research has shed light on the important parameters that engender various regimes of Levels of Service in the study areas, and bring out factors that enhance favorable Level of Service for their sustainability.

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Design and Performance Evaluation of Horizontal-Shaft Palm Kernel Cracking Machine

Idowu David Ibrahim
Department of Mechanical Engineering
TUT
Pretoria, South Africa
ibrahimidowu47@gmail.com

Olive Sofuwa
Department of Mechanical Engineering
FUT
Minna, Nigeria

Onyema J Onuoha
Department of Mechanical Engineering
FUT
Minna, Nigeria

Tamba Jamiru
Department of Mechanical Engineering
TUT
Pretoria, South Africa

Rotimi Emmanuel Sadiku
Dept. of Chem., Metal.& Materials Engineering
TUT
Pretoria, South Africa

Williams Kehinde Kupolati
Department of Civil Engineering
TUT
Pretoria, South Africa

Abstract – The need to support the small and medium scale industries involved in palm kernels, led to the design, fabrication and evaluation of a horizontal shaft palm kernel cracking machine. All the materials were sourced locally in Nigeria which makes it affordable for small and medium scale farmers involved with palm kernel. The basic features of the machine include a horizontal shaft, hopper, cracking chamber, pulleys, bearings with housing, discharge outlet and electric motor (prime mover). The mean efficiency of the machine under good operating conditions is 75.5%. The production cost of the machine excluding electric motor was estimated to be one hundred and fifty-one dollar forty-sixcents (US$151.46), based on the exchange rate when it was manufactured. The cost can further be reduced, if mass-produced.

Keywords– Palm kernel;machine efficiency; machine design; performance evaluation

I. INTRODUCTION

The oil palm (Elaeis guineesis) belongs to the Palmae family. Among the oil producing plants, it is the richest vegetable oil plant[1]. Palmae contains about 225 family members with over 3600 species. The oil palm is characterized by a bunch of fruits attached to the upper part of the tree in the region of the palm leaf. There are three common varieties of palm kernel fruit, viz: dura, tenera and pisifera and their characteristics are shown in Table 1. According to Badmus [2], a typical African dura kernel is between 8-20 mm in length and has a fairly uniform shell thickness of 2 mm. The tenera is between 7-15 mm in length with ashell thickness of 1.2 mm. This research employed the use of teneraspecies (Fig. 1) that is commercially planted in Nigeria with varying use, depending on particular applications. The oils (palm oil and kernel oil) are used for margarine, candle, oil paint, polish, soap making, glycerine and medicinal purposes [3]. Palm biodiesel are also produce from oil palm [4].

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The shells are used for brake pad, source of energy by the local blacksmiths and bio-coal [5]. In addition, the kernel cakes are used as one of the ingredients in livestock feeds, which is highly rich in the essential nutrient needed by livestock [6,7].

Malaysia is one of the leading palm oil producing country in the world. These has greatly contributed to their economic growth [8]. The increasing production of oil from the palm fruit gives rise to palm kernel nut. The bye product and utilization of palm kernel shell for biofuel and other application, led to the demand for quick and easy separation of palm kernel nut from it shell.

For more than five to six decades, several methods have been adopted in order to crack palm kernel. The methods include cracking with stone and smashing against a rock. These methods are time-consuming, extend human energy, thedanger of smashing the fingers and low production. Due to the continuous increase in demand for palm kernel nuts for soap, cream, and cooking oil, a result of increasing human population, researchers are forced to come up with better, faster and safer ways of separating the palm kernel nut from its shell. The flowchart in Fig. 2 shows the process involved in the oil extraction of palm kernel fruit [9].

TABLE I. Physical properties of selected oil palm [10,11].

Species	Mesocarp	Endocarp
Dura	Thin	Thick
Tenera	Thick	Thin
Pisifera	Thick	No endocarp

Fig. 1.Tenera Palm Nuts

A prototype centrifugal palm nut cracker was designed, fabricated and tested by Babatunde and Okoli [12], using a horizontal shaft and a vertical rotor at the National Centre for Agricultural Mechanization (NCAM), Ilorin, Nigeria. Their concept was that the nut will hurl against the hard breaker plate by the mill, based on centrifugal principle. The prototype recorded nut cracking efficiencies of 94.50 and 87.50 with 14.70 and 6.0 % kernel damage respectively. Optimum efficiency was discovered to be 77.85 % at a throughput of 115.30 kg/h with minimal kernel breakage. Manuwa [13] and Ologunagba [14] used locally available materials to minimize cost and also ensured that the machine is easy to maintain. The observed challenges were put into consideration during the design and fabrication processes of the nut cracking machine. The electric motor (prime mover) of 2.25 kW power rating was used at a speed of 5,500 rpm. Optimum efficiency of 89 and 10 % mechanical damage on kernel was recorded with amaximum throughput capacity of 1.2 ton/h. The process of hurling the palm kernel nut against a hard surface at a high speed is known as acentrifugal process. This process led to better productivity, however, it has its setback; large kernel breakage.

Fig. 2. Palm kernel Processing Flowchart [9]
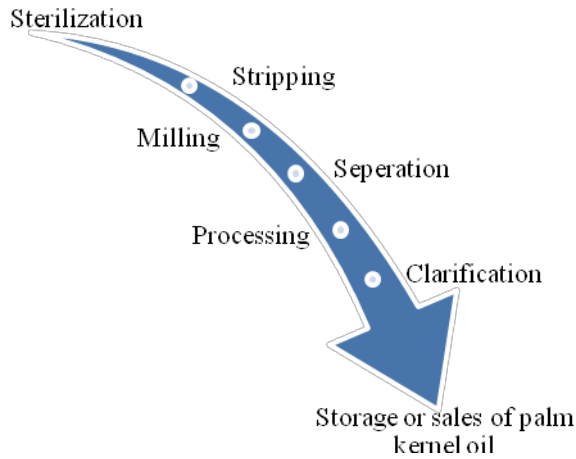
II   MATERIALS AND METHODS

A   The Hopper

The hopperis made of mild steel sheet metal of 1.4 mm gauge and constructed as a truncated square base pyramid. It is connected to the conveying channel that leads to the cracking chamber.

B   The Cracking Chamber

The cracking chamber is made up of a mild steel plate of 3 mm thickness. It is cylindrical in shape and of diameter 370 mm. The front and the rear ends of the rings are covered with circular plates of thesame material, thickness and diameter in order to form the cracking ring.

C   Power Transmission Shaft

The power transmission shaft is made of mild steel and one of its ends is step turned to Ø29 mm x 85 mm. It accommodates the two bearings. The shaft has a total length of 600 mm with a diameter of 35 mm.

D   Bearing and the Bearing Housing

The bearings are held firmly in place to theframe by the bearing housing.While the bearing itself holds the shaft into position in order to minimize friction during rotation, the specification of the bearing used is 34.9 mm and 97.5 mm internal and external diameters, respectively.

E   Pulley

This is the unit that transmits power from the electric motor shaft (prime mover) to the cracking mechanism shaft, via two V-belts. There is a smaller pulley of diameter 60 mm and a larger pulley of diameter 85 mm. The smaller pulley is attached to the shaft of the prime mover and the larger pulley is attached to the shaft of the cracking machine.

F   The Cracking Mechanism

These are the hammers (3 in number) which crack the kernel nuts by hurling it against the wall of the cracking chamber. They are placed at the angle of 120° to each other around the shaft.

III   DESIGN CONSIDERATION

In solving the challenge of a successful cracking of palm kernel nut without crushing the kernel itself, a lot of design considerations were put in place in order to ensure asignificant reduction in the production cost and reduction in drudgery. The followings were put into consideration:

- The physical and mechanical characteristics of the palm kernel
- Durability of the machine
- Energy conservation of the operator when nuts are cracked manually
- Ease of operation
- Ease of maintenance

IV   DESIGN ANALYSIS

A   Determination of Shaft diameter

The shaft design has to be determined for correct shaft diameter in order to ensure satisfactory strength and rigidity when power is transmitted by the shaft under the various loading conditions. There are either hollow or solid shafts. For the sake of this research, a solid shaft was used, see equation (1).

$$d^{3} = \frac{16}{\pi \tau_{s}} [(K_{b} M_{b})^{2} + (K_{t} T_{t})^{2}]^{\frac{1}{2}} \qquad (1)$$

Where, d is the diameter of the shaft (m), τ_{s} is the torsional shear stress (MPa), M_{b} is the bending moment (Nm), T_{t} is the torque, K_{b} is the combined shock and fatigue factors applied to bending moment and K_{t} is the combined shock and fatigue factors applied to torsional

moment [15].

B Determination of Speed of Shaft

$$\frac{N_m}{N_s} = \frac{D_s}{D_m} \qquad (2)$$

Where N_s is the speed of the larger pulley, connected to the machine shaft, D_s is the diameter of the larger pulley, connected to the machine shaft, N_m is the speed of the smaller pulley, connected to the prime mover and D_m is the diameter of the smaller pulley, connected to the prime mover. The above equation (2) is used to determine the shaft speed.

C Determination of Power Transmitted by the Shaft to the Cracking Mechanism and Efficiency of Drive

The power transmission by the shaft and the drive efficiency can be calculated using equations (3-4) and (5) respectively.

$$P_c = \frac{P \times N_s}{N_m} \qquad (3)$$

$$P_f = P - P_c \qquad (4)$$

$$\int = \frac{P_C}{P} \times 100 \qquad (5)$$

Where P is the power transmitted by the electric motor, P_c is the power transmitted by the shaft to the cracking mechanism; P_f is the power loss due to friction and $\int$ is the efficiency of the drive.

D Determination of Centre Distance between Pulleys

$$C = \frac{L}{4} - \frac{\pi(D+d)}{8} + \sqrt{\left[\frac{L}{4} - \frac{\pi(D+d)}{8}\right]^2 - \frac{(D-d)^2}{8}} \quad (6)$$

$$\beta = \sin^{-1}\left(\frac{R-r}{C}\right) \qquad (7)$$

$$\alpha_1 = 180 - 2\beta \qquad (8)$$

Where α is the angle of lap or wrap (rad), R is the radius of the larger pulley, r is the radius of the smaller pulley, L is the length of the belt (m) and C is the distance between the centres of the two pulleys. Fig. 3 shows the schematic diagram of a belt and two pulleys having different diameters.

E Determination of Belt Tensions

$$\frac{T_1 - T_c}{T_2 - T_c} = e^{\frac{\mu\alpha}{\sin\left(\frac{\theta}{2}\right)}} \qquad (9)$$

Where T_1 is the belt's tight side tension (N), T_2 is the belt's slack side tension (N), T_c is the centrifugal force due to the belt (N), θ is the groove angle for the V-belt and μ is the coefficient of friction between the belt and the pulley.
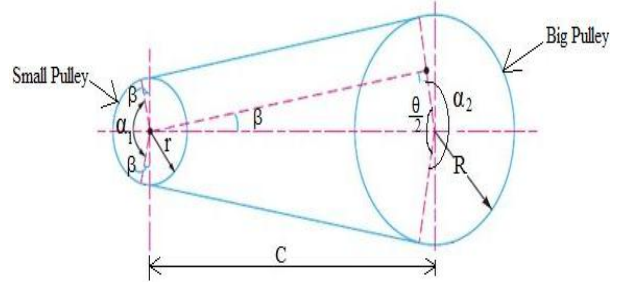
Fig. 3. Schematic diagram of the belt and the pulley[15]

F Determination of the Angle of Twist of Shaft

$$\theta t = \frac{32 T_t L}{\pi G d^4} \qquad (10)$$

Where, θt is the angle of twist of the shaft (rads), T_t is the torque (Nm), L is the length of the shaft (m), d is the diameter of the shaft and G is the modulus of rigidity of steel (GPa) = 84 GPa. Since the angle of twist derived (0.0072°) is considerably less than that of the allowable deflections of between 2.50 to 3° per metre length as quoted by Khurmi and Gupta [15], and then the selected shaft diameter is safe for the design.

G Determination of the Number of Belts

$$N_b = \frac{A_b}{A} \qquad (11)$$

$$A_b = T_1/\sigma_b \qquad (12)$$

Where N_b is the number of belts, A_b is the belt area, A is the area per belt and σ_b is the shear stress of the belt. From the calculations, the number of belts required by the machine is 2.

H Determination of the Dynamic Load Rating for the Bearing

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^P \qquad (13)$$

$$P = XVF_r + YF_a \qquad (14)$$

Where L_{10h} is the basic rating life in operating hours, n is the rotation speed (rev/min), P is the equivalent dynamic load rating, p is an exponent for the life equation (p = 3 for ball bearing and p = $\frac{10}{3}$ for roller bearing), X is the radial load factor for the bearing, Y is the axial load factor for the

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bearing, F_r is the actual radial bearing load, F_a is the actual axial bearing load, C is the dynamic load rating for the bearing and V is the rotation factor = 1.2.

I   Determination of Moisture Content

The moisture content of the palm kernel contributes the crack efficiency of the machine. If the moisture content is high, the amount of damaged kernel nut will be high. The moisture content can be calculated using equation (15)

$$W = \frac{W_i - W_f}{W_i} \text{ x } 100\% \qquad (15)$$

Where W is the moisture content (%), W_i is the initial weight before drying and W_f is the final weight after drying.

V   MACHINE TESTING AND PERFORMANCE EVALUATION

Having fabricated and assembled together all the parts of the machineas shown in Fig. 4, the machine was tested in order to determine the efficiency of the new machine. Three different tests were carried out with test samples of 100, 100 and 200 palm kernels. Each of the samples was fed into the hopper through the flow channel to the cracking chamber at a low and steady machine speed. The results were recorded and the machine performance efficiency, percentage cracked efficiency and mechanical damage kernel efficiency were calculated using equations (16 – 18) respectively.

$$E_m = \frac{W_U}{W_T} \text{ x } 100 \qquad (16)$$

$$E_c = \frac{W_C}{W_T} \text{ x } 100 \qquad (17)$$

$$M_d = \frac{W_C - W_U}{W_T} \text{ x } 100 \qquad (18)$$

Where E_m is the machine performance efficiency, E_c is the percentage cracked kernel, M_d is the mechanical damaged, W_U is the undamaged cracked kernel, W_C is the total cracked kernel (damaged and undamaged) and W_T is the total number of kernel fed into the hopper.

VI   RESULT AND DISCUSSION

The results of the performance test carried out are summarized and presented in Table 2. The overall performance of the palm kernel cracking machine was based on the percentage cracked palm kernel. The result was favourable due to the low moisture content of kernel.

TABLE II. Results from the test carried out

Input	Cracked kernel	Un-cracked kernel	Damaged kernel	Undamaged kernel	Percentage cracked (%)	Machine efficiency (%)	Machine damage (%)
100	76	24	1	75	76	75	1
100	79	21	2	77	79	77	2
200	143	57	3	140	71.5	70	3

Fig. 4.A pictorial view of the palm kernel cracking machine

VII CONCLUSION

The results show that palm kernel cracking machine can be designed and fabricated locally. The machine was designed and fabricated in order to minimize expending of human energy and time during the cracking of palm kernel nuts, using local and primitive methods. The machine has a mean efficiency, under good operating conditions of about 75.5%. The machine is easy to operate and it is cost-effective as all the materials were sourced locally. The total production cost is about one hundred and fifty-one dollar, forty-six cents (US$151.46), based on the exchange rate when it was manufactured. This can further be reduced if the machine is mass-produced. The machine is therefore recommended for small and medium scale producers. The government and financial institutions should make provision for loans to farmers in order to boost the production of the kernel and its byproducts.

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Wastewater Reuse: An Alternative for Sustainable Agriculture

Emenike PraiseGod Chidozie[*], Tenebe Imokhai Theophilus, Ben Ngene, Oniemayin Irewole Babatunde, Gideon Bamigboye, Ogundare Tosin, Busari Ayobami

Department of Civil Engineering
Covenant University
Ota, Ogun State, Nigeria
E-mail: praisegod.emenike@covenantuniversity.edu.ng[*]

Abstract— Africa is seen as one of the continent with the fastest population growth rate in the world. However, her landmass has seen 67% dryness, projecting that one of her problems could be water related. Similarly, maintaining agricultural produce seems to be the most exhaustive part of Africa's water with 85% being used for irrigation and agricultural activities. Target 2 of the Sustainable Development Goals (SDGs) is aimed at promoting sustainable agriculture, terminating hunger; achieving food security and improving the level of nutrition which makes Africa a probable zone. The study assessed different promotion practices in agricultural farmlands spread across Nigeria. In – depth interviews, farm investigations and group interactions amongst others were deployed in other to appraise farm size, water application frequency, and duration of application, water shortage experience, water usage and water saving measures. Quantitative data on water quantity used in farms were also captured. Results showed that water application within the farms relied on withdrawal from aquifers using tanker system. The shortage of water experienced within farms under study lasted for up to 3 hours. This will adversely pose underlying threats to the available water to be used for other purposes and also impede food production during water shortages. The study highlights that rain water harvesting (RWH) practices be carried out to reduce the pressure of agriculture on aquifer resources. The study proposed adequate management procedures that will help salvage the emanating challenges affecting food production.

Keywords—SDG; rainwater harvesting; agriculture; food security

I. Introduction

One of the difficulties faced around the world is water scarcity [1-2]. Since the post – 2015, Sustainable Development Goal (SDG) made sustainable and economical access to water a priority while the need for effective management of water resource increases when the growing water need becomes paramount [3-4]. In an estimate given by UN, it is expected that 1.8million people will be living in regions categorized as "Water – Stressed" zone by 2025 with the population increase and climate change having its own part on the stress [5-6]. In addition, population increase is a continuous trend that demands increase in alternative water sources. The population increase and changing diets tends to mount serious pressure on existing fresh water sources thereby increasing the need to explore non – conventional water sources. On the other hand, climate change has its own contribution to water security by affecting the availability of renewable water sources in different regions [7-8].

The impact of climate change will culminate in harsh weather events and subsequent instability in crop output and local food production [9], particularly in the third – world countries [10]. In a report released by Food and Agriculture Organisation (FAO) [11], it is estimated that a reduction of 9 – 20% of the entire agricultural productivity will be lost to global warming and this indicates that climate change will inflict negative impact on agriculture and food security. In order to meet the demand of the growing population that will exceed 9billion in 2050, FAO estimated that an increase of 70% of the global food production must be met in the first halve of the century [11].

Presently in developing countries, the strategy employed to carry out water savings focuses on evaluating the extent of water withdrawals thereby underestimating the full potential of wastewater reuse. Reference [12] made a remark that withdrawal of fresh water can be reduced when wastewater is reused since 80% of exhausted water is transformed to wastewater. Furthermore, [13] itemized that 30 – 50% of household water could be recovered when adequate treatment is administered. Reference [14] supported the statement, stating that treated municipal wastewater can be reused to propagate urban agriculture.

Three categories of wastewater reuse have been stated by the United States – Environmental Protection Agency; (i) Direct Use, in which the influent is a product of the effluent (With or without treatment); (ii) Planned indirect Use, where a return environment is constructed to receive the wastewater before it is collected for reuse (e.g. wetland); (iii) Unplanned indirect use, in which the wastewater receiving platform is a natural environment (rivers/lakes) with the collection source serving as a fresh source for other intended use in downstream location [15-16]. The unplanned indirect water reuse happens in all waterways, yet there is little report of its exploitation [17] despite the potentials and benefits of treated and reused water [18].

The overall motive of this research is to provide accurate assessment of water flow data from withdrawals as well as appraising the available methods for water collection and treatment which can be used for agriculture within some

selected farms in Nigeria. This will help in reducing over – exploitation of groundwater resources.

II.   METHOD OF DATA COLLECTION

Assessment of farmlands was carried out at random. The farmlands studied were located in the South – east and South – west zones of Nigeria. Quantitative data was collected in order to appraise the dependence on withdrawals to satisfy farm production needs. The farms considered includes; Ekwuribe livestock farm (located at Ajah, Lagos State), Ogundeji farm (located in Akure, Ondo State), Chekwube livestock farm (located in Enugu State), Ojemaie livestock farm (located in Port – Harcourt) and two Covenant University (CU) farm (located in Ota and Igbesa, Ogun State). The information gathered captured the farm size, water application frequency, duration of application, experiences relating to water shortages, water usage and available water saving measures. Physical observation and personal Interviews were also adopted.

III.   RESULTS AND DISCUSSION

A.   *Farm Size*
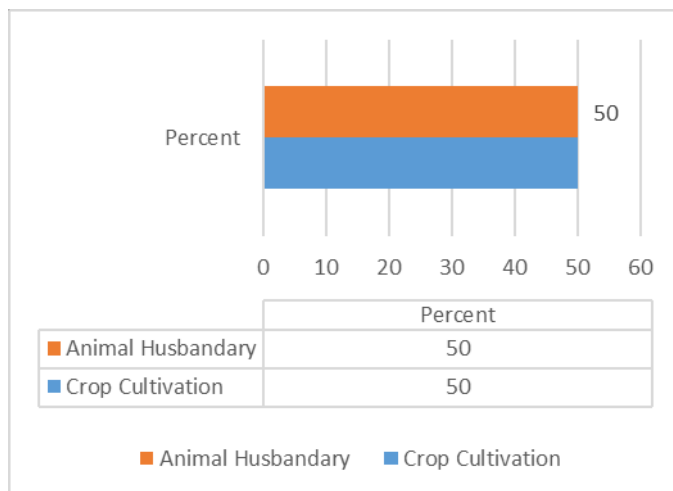
Fig 1: Percentage of Farm Activities

According to the findings (Fig 1), 50% of the farms assessed practice animal husbandry while 50% cultivate crops. The size of land used for farms that practice animal husbandry is 3 Acre, ½ Acre and 2 Acre for Ekweribe, Chekwube and Ojemaie livestock farms respectively and all the farms are located in south – eastern zone of Nigeria. Ogundeji farm and CU farms (Igbesa and Ota) had more than 3 Acres each used to cultivate arable crops. The size of agricultural area assessed in this study is a vital requirement because its operational capability depends on the amount of water required for its activities [19].

B.   *Water Application*

Chekwube farm, CU farm (Igbesa) and Ojemaie Farm had one borehole each located within the farm premises while CU farm (Ota) had 2 boreholes. The volume of water utilized within the agricultural area are 2000litres, 1000litres and 500litres per day for Chekwube farm, CU farm (Igbesa) and Ojemaie farm respectively. The farmlands enjoyed unimpeded access to water, using the tanker system for distribution (Fig

2). Reports showed that two – third of water used for farm activities were collected from groundwater resource while one – third were gotten from alternative sources such as streams, rivers, ponds and rainwater. The farms assessed made use of drip/localized system as the water application mechanism. On the long run, taking CU farm as a case study, about 60,000liters of water will be required majorly in dry seasons which may be prolonged as a result of climate change effect. However, this is not a sustainable approach as population within the community will surely increase. This increase is early anticipated as post graduate students are on board now and a new Faith theatre building with covenant estate is to be built in no time. The water required to cater for this population is quite high and complete dependence on ground water is a big risk. However, to cushion this effect, RWH could be used to supplement water redrawn for irrigation agriculture and proper personal water management practice.

Fig. 2 showing the extraction of groundwater for agricultural applications

C.   *Water application duration/frequency*

Findings showed that the efficiency of water supply service is high in all farms visited indicating that there is a continuous withdrawal from the underground resource available. Withdrawal is unimpeded and the withdrawal rate could last up to 3 hours per day, reason being that the source is easily accessible found at the point of use. These actions support wastage and depletion of the groundwater resource available. The adverse effect of wastage and depletion could lead to shortage which affects economic growth and food security in the long run.

D. *Experiences and Water saving measures*

Documented experiences within the farm showed that 25% of the farms assessed encountered water shortages for several hours while 50% of the farm operators mentioned that shortages have lasted up to several days. The remaining 25% explained that other measures are taken to avert water shortages within the farms. Even though water saving measures were not practiced in full, 50% of the farm operators encouraged the method, adopting rainwater harvesting as the option. Farm practitioners go as far as getting water from other sources that depend on groundwater resources when shortages are experienced. These water collection systems to satisfy farm needs are transported through tankers to farmlands where they are utilized. While some farmers practice rainwater harvesting in a small scale, the rainwater collected served several purposes; 33.33% of the operators use it for domestic purposes while 66.67% apply it on crops.

Reliability studies was conducted to evaluate the current water supply within the farms. The results obtained is represented in Table 1. Below. The data captured conditions that relates to the aspects of water supply that needs improvement in future and timely maintenance carried out when needed. The consideration requirement for future improvement outlined in the study were rated in three categories namely; Borehole Reliability, Routine Maintenance and Source of water supply.

TABLE 1: CROSSTABULATION OF RELIABILITY STUDIES

		Which of The Following Aspects of Your Water Supply Do You Need Improvement In The Future?			
		R(%)	M(%)	SS(%)	Total (%)
How is the current Water Supply Service?	Excellent	0	0	16.67	16.67
	Very Good	33.33	16.67	16.67	66.67
	Good	0	0	16.67	16.67

		Do You Have A Timely Maintenance Whenever it is Needed?		
		Yes(%)	No(%)	Total (%)
How is the current Water Supply Service?	Excellent	16.67	0	16.67
	Very Good	50.00	0	50.00
	Good	0	33.33	33.33

[Keys: R (Reliability), M (Maintenance), SS (Source of Supply)]

From Table 1. displayed above, Farmers clamor for improvement in their water facility constructed within the farms in order to boost production. 50% call for source improvement which stands as a pointer that water sources required for farming activities is limited. 16.67% want maintenance while 33.33% are of the opinion that the water available is not reliable. The obvious fact was stated when the farm operator in one of the location (Ogundeji Farm) explained that water scarcity occurs during the hours of 11am and 2pm daily. This timely scarcity has halted farm operations as well as food production.

For food production to correlate with water supply, adequate and timely maintenance of the water distribution system is required. The general inference obtain from the results espouses the fact that maintenance factor leaves a question mark within farmlands since no maintenance is carried out in 33.33% of the farms. With the rate at which climate change affects the environment, there is no doubt that it will take its toll on food production since increasing temperature within the environment gives rise to increase in evaporation of water molecules required for plant growth.

IV. CONCLUSION

This study has assessed the utilization of underground resources for irrigation agriculture in some selected farms in Nigeria. From this study, it is evidence that overburden of underground water is practiced in all the farms which makes both irrigation and food production not sustainable. With the challenge of global climate change and world increasing population, this is a major concern. Similarly, if this concern is not taking care of, it may result in over-dependence on food produced only during dry season as it may not require much watering. However, with our major study on CU farm, it is important to elaborate on the growing population which was about 10000 residents in 2013 [20]. The wastewater generated within the community amounts up to 1,000,000 litres daily. This could serve as a potential resource when harvested, treated and used for agricultural applications within the CU farm. This treatment, especially the grey water could be very useful as little treatment is required. From Figure. 3 below, the water used for watering of flowers were collected from the underground resource.

Fig. 2 showing water application on flowers

Treated water could be channeled to the watering of flowers thereby reducing the total reliance on groundwater. Adopting this mechanism will set the pace for farmers in the Sub – Saharan region which will in turn promote food production and also mitigate the impact of adverse climate change within the region. Also, personal discipline should be imbibed on the use of water resources, for it was noticed that when water is not readily available, the wastewater available (when treated) will be sufficient enough when properly managed during irrigation.

Of a truth, sustainable agriculture requires substantial investment for agricultural development to improve but water conservation structures seem to be key to restoring the natural capacity of our depleting water resources.

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Impact of Reliable Built Structures in Driving the Sustainable Development Goals: A look at Nigerian Building Structures

* Anthony Nkem Ede, Gideon Olukunle Bamigboye, Oluwarotimi Michael Olofinnade, David Olugbenga Omole, Gideon Adewale Adeyemi, Ben Uchechukwu Ngene

Department of Civil Engineering,

Covenant University,

Km 10, Idiroko Road, Canaan Land,

P.M.B. 1023 Ota, Ogun state, Nigeria.

*anthony.ede@covenantuniversity.edu.ng, gideon.bamigboye@covenantuniversity.edu.ng,
rotimi.olofinnade@covenantuniversity.edu.ng, david.omole@covenantuniversity.edu.ng, gideon.adewale@cu.edu.ng,
ben.ngene@cu.edu.ng

Abstract— **The bearing of lasting built structures in driving the Sustainable Development Goals (SDGs) cannot be overemphasized. The SDGs agenda is a plan of action for eradicating poverty among the people of the world, strengthening universal peace and laying the foundation for sustainable development and prosperity for all. The quality of built structures in an environment defines the level of advancement attained by the society, for which the quality of structures that will lay the base for sustainable development must be reliable. No meaningful development can be achieved without reliable built structures. In fact, all the 17 SDGs need consistent built structures to be achieved. This paper researches on the reliability of built structures as a base for sustainable development with particular emphasis on Nigerian building structures. Statistical method is used to analyze data on failed building structures. Results obtained point to the fact that the failure rate and the casualty rate of Nigerian building structures are very high. As safety of human lives is implicitly embedded in the SDGs, much have to be done to raise the standard of building that will contribute to the achievement of the SDGs.**

Keywords— Building Collapse, Building Structures, Casualty Rate, Failure Rate, SDGs.

I. INTRODUCTION

Sustainability could be defined as an ability or capacity of something to be maintained or to sustain itself. It's about taking what we need to live now, without jeopardizing the potential for people in the future to meet their needs [1]. The aspiration of the world for sustainable development have kept the United Nations busy for quite a lot of time now. The latest of the UN efforts gave rise to Sustainable Development Goals (SDGs) in 2015. According to [2], the Sustainable Development Goals (SDGs), officially known as "Transforming Our World: the 2030 Agenda for Sustainable Development", are an intergovernmental set of aspiration Goals with 169 targets. The story of the SDGs can be traced to 1972 when the United Nations Human and Environment Conference considered the rights of the human family to a healthy and productive environment [3]. That led to the creation of the World Commission on Environment and Development. In 1992 the first UN conference on Environment and Development held in Rio came up with the first agenda for Environment and Development known as Agenda 21. Agenda 21 is the forerunner to The Future We Want [4] which agreed on the key themes on poverty eradication, energy, water and sanitation, health, and human settlement. Agenda 21 and The Future We Want gave birth to the Millennium Development Goals (MDGs, 2000) which officially ended in 2015 before the takeoff of the SDGs.

The essential challenge of the post MDGs development agenda is to ensure that globalization remain a positive force for all the worlds' peoples of present and future generations. The enormous potentials of globalization are at presently very unevenly shared. The continuous striving for improvements in harnessing materials for human use is threatening the limits of the natural resource base unless there is a radical shift towards more sustainable patterns of consumption and production and resource use. Obstinate struggles for scarce resources have led to situations of conflict, hunger, insecurity and violence, which in turn hold back human development and efforts to achieve sustainable development [4]. The post MDGs agenda for sustainable development focuses on inclusive Social Development, Environmental Sustainability, Inclusive Economic Development, and Peace and Security.

As a successor to the Millennium Development Goals (MDGs), the SDGs builds upon the values agreed upon under the UN Resolution: The Future We Want [4] . The SDGs are

articulated in 17 goals with 169 targets entailing a wide range of sustainable development issues.

The goals are poverty, food, health, education, women, water, energy, economy, infrastructure, inequality, habitation, consumption, climate, marine-ecosystems, ecosystems, institutions and sustainability. Goal number 1 can be easily measured by the quality of built structures available in a society. Goals number 2, 3, 4, 6 and 7 need the reliable built structures to achieve. Sustainable economic growth, goal number 8 needs the activities of the built sector to achieve. Activities of the built sector have always propelled national economies and in most cases contributing to more than 20% of the GDP. Goals number 9 and 11, i.e. resilient infrastructure and resilient human settlements are fully built environment goals. Other goals on climate change, sustainable ecosystem for future development and sustainability will go on to affect how future structures are to be built. From this brief analysis, it is very evident that the contribution of the built environment in achieving the SDGs cannot be over-emphasized. Having established the relevance of built structures in achieving the SDGs, the paper now takes a look at Nigerian building structures to see if they are resilient enough to contribute to the achievement of the SDGs.

A look at Nigerian building structures

In Nigeria, the occurrence of Structural Failure has been problem of major concern in development of the nation as the rates of their incidence and the degree of the losses both in terms of death and properties are becoming disturbing [5]. Structural failure is the inability of a building to undertake its structural functions [6]. This may be in form of slackening, winding, crumpling, cracking, deformation or wearing of structural elements of a building.

The importance of buildings to man's survival and endurance both as a residence and for his activities is significant [7]. The conservation of the existing housing stock and those still to be constructed remains a great challenge to Nigeria. In spite of the numerous available Nigerian professionals of construction industry that the cases of building collapse have not abated in the recent years is very worrisome. The rising cases of building collapse in Lagos State, particularly around the Lagos Island axis and Lekki testifies to the sorrow state of buildings in Nigeria.

In one of the most recent cases, a five storey building under construction in Kushenla Road, Ikate Elegushi Lekki area of Lagos State collapsed on the 8 of March, 2016, killing more than 30 people. The collapsed building was served a contravention notice for exceeding approved floors and thereafter sealed by Lagos State Building Control Agency, but the owners unsealed and proceeded to build beyond the approved 3 storey, until the collapse occurred. In the collapsed scene, two floors sank into the ground. While investigations into the true causes of the collapse is ongoing, built environment professionals all point accusing fingers to the common causes of building collapse in Nigeria such as lack of due process, due diligence, poor foundation, as well as the use of substandard materials.

Among the principal causes of building collapse in Nigeria is the use of substandard materials, in particular poor quality concrete and reinforcing bars [8-9]. This particular problem of substandard materials is becoming very evident such that Nigerian Government agencies are bracing up to tackle the problem. According to the Standards Organization of Nigeria [10], most of the re-enforcement bars in the markets are deficient and do not comply with diameter, length and carbon contents standard, among others. The standard diameters for reinforcement bars of 25mm, 16mm and 12mm, are commonly substituted by 23.4mm, 14mm and 10mm respectively. The standard length of 12m is commonly substituted for 10m while the carbon contents exceed 0.37%.

II. METHODOLOGY

For the study of the state of Nigerian buildings, structured questionnaires were given to professionals and non-professionals that have experienced or witnessed building collapse in the past. Visual inspections of collapsed buildings and visitations to sites of building collapse cites were conducted to obtain firsthand information on the causes and effects of building collapse. Samples of available commercial steel reinforcement were collected and analyzed for conformity sizes with the standard diameters prescribed in design. Secondary data on building collapse in Nigeria were also collected from the professional bodies of the built environment. Analysis of the data collected were performed with MS Excel statistical tools.

III. RESULTS AND DISCUSSION

50 questionnaires were shared to the professionals in building industries and 41 of them were returned and were valid for analysis while 50 other questionnaires were given to non-professionals that have had firsthand experienced of building collapse in the past. The distribution of the questionnaires among the professionals can be seen from the pie chat in figure 1.

The professional respondents were mainly Architects and Structural Engineers. Over 50% of the professionals involved have been engaged in the construction industries for more than 10 years. From the analysis of the data collected, it emerged that the possible causes of building collapse in Nigeria are corruption, substandard materials, absence of site investigation

and faulty foundations, poor building plans approval procedure, poor supervision and construction procedures, environmental factors such as rain storm and flood, wrong usage of structures, Contractors' inefficiency in terms of poor methods of construction and technology, urban population surge which inspire greedy landlords to erect unhealthy structures that collapse, fire outbreak and unforeseen modes of failure. Figure 2 summarizes the common causes of building collapse in Nigeria.
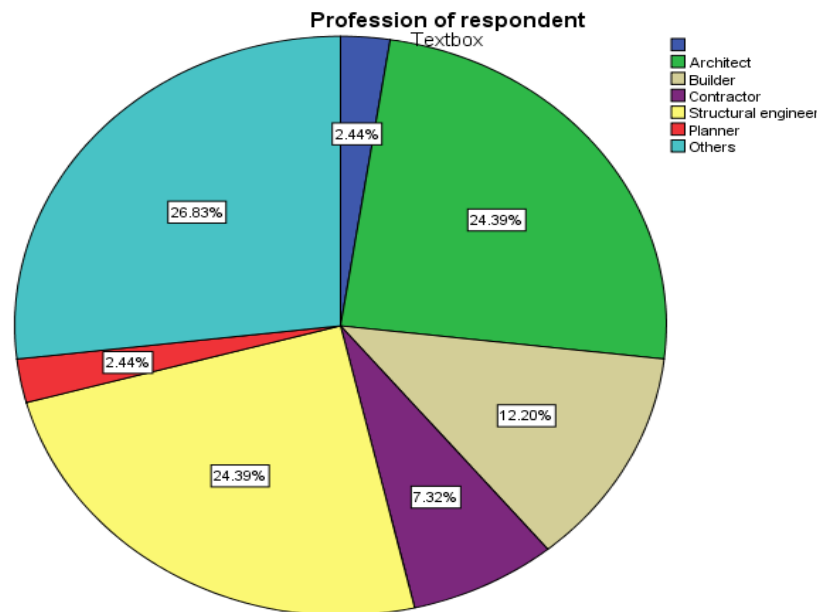
Fig. 1. Pie chart showing the profession of respondents
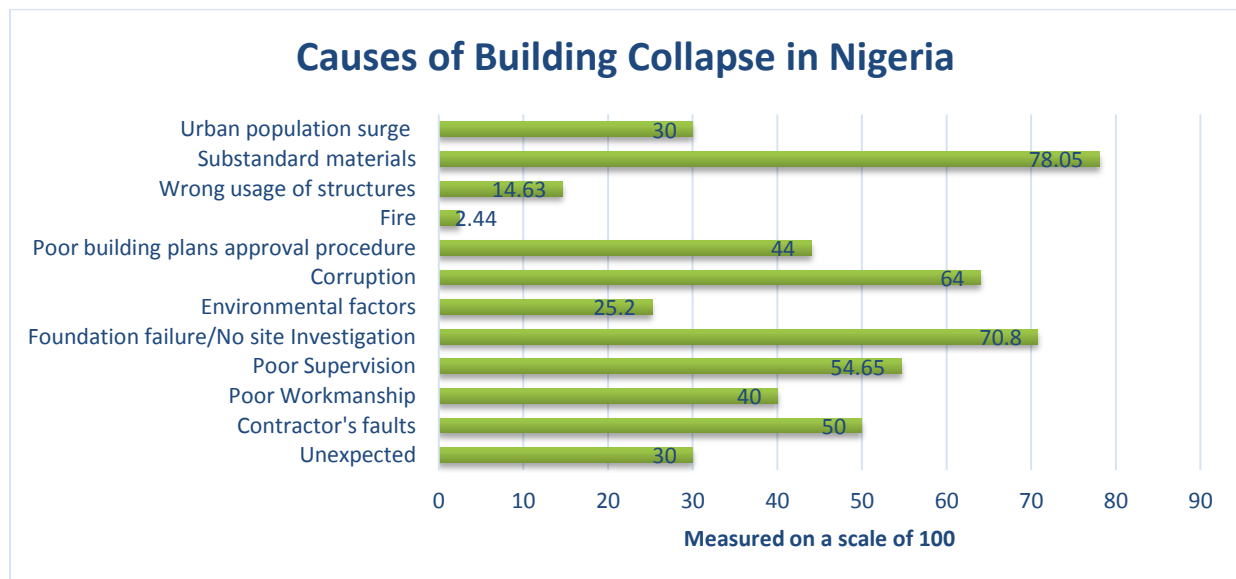

Fig. 2. Causes of Building Collapse in Nigeria

Common pre-collapse signs verified in this research include excessive cracks, deflection, settlement and vibrations. Among the effects of building collapse, ranked very high loss of human lives, human injuries, damage to properties, lost of economic resources and means of livelihood, emotional stress and poor national reputation.

Analysis of data on 18 collapse cases verified in Nigeria in the past 18 months (from September 2014 to March 2016) showed over 178 mortality rate. This is so high in terms of human loss and the grave repercussions that accompanied the gravely injured and the loss of properties and means of livelihood.

Scrutiny of variations of diameters for commercially available reinforcement bars from 25mm to 23.4mm, 16mm to 14mm and 12mm to 10mm translates to an average loss of reinforcement bar cross-section area of about 12.4%, 23.5% and 28% respectively with respect to the design prescriptions. This leads to gross under-reinforcement in conjunction with the low-strength reinforcement commonly available in the nation. This portend a great risk for the reinforced concrete structures as the possibility of achieving ductile structures is highly compromised.

IV. CONCLUSION

Results obtained from this research point to the fact that the casualty rate of Nigerian building structures is very high. The analysis of the variation of diameters of reinforcing bars reveals great danger to the structures where these reinforcements are used. This gross material defect and other ones which the SON is striving to achieve, like the improved calibration status of the weighing equipment in the steel factories, compulsory chemical analysis on all steel reinforcement batches and the replacement of all non- electric arc furnaces in Nigeria within the next 6 months will all help to shore up the danger of building collapse. Also, the move by the Lagos State Government in the recent time to vigorously enforce the building and construction regulations in the State is highly commendable and will go a long way to checkmate this gruesome incidence of building collapse. As the safety of human live and the wellbeing is implicitly embedded in the SDGs, much still need to be done to raise the standard of building structures that will contribute to the achievement of the SDGs.

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Promoting Gender Equality and Women's Empowerment for Sustainable Development in Africa

Lawal, Fatai Alani (Corresponding Author)
Department of Business Management,
Covenant University,
Ota, Nigeria
e-mails: fatai.lawal@stu.cu.edu.ng

Ayoade, Omisade Ezekiel
Department of Business Management,
Covenant University,
Ota Nigeria
e-mails: omisade.ayoade@stu.cu.edu.ng

Taiwo, Akeem A.
Department of Business Management,
Covenant University,
Ota, Nigeria
e-mails: akeem.taiwo@stu.cu.edu.ng

Abstract

Promoting gender equality is an essential component of the development strategy that seeks to enable people, both men and women, to reduce their poverty level and bring about improvement in the standard of living. An important element of sustainable development is to manage the natural resource base on which human activity depends. However, socially-constructed roles of men and women (which clearly manifest in lifestyles, consumption patterns, access to resources and power, decision-making and environmental effects) and deprivation of women due to discrimination, gender-segregated employment and traditional attitudes constitute source of concern in sustainable development initiatives. The study adopted the review of secondary data and information in exploring gender issues within and across the facets of sustainable development. Investing in girls and women (in all its ramifications), supporting their specific needs as entrepreneurs, workers, home-based consumers, producers, drivers of low-emission climate-resilient economies, and instituting sustainable development framework that confronts the discriminatory social norms and practices will promote gender equality and achieve development that is more sustainable. The study contributes to knowledge in the fields of gender studies, environment, and sustainable development where furtherance of gender-responsive policy focus, planning and implementation is the major thrust.

Key Words: *Sustainable development, gender equality, entrepreneur, natural resource, strategy.*

INTRODUCTION

Gender equality and women's empowerment is a fundamental development goal that is globally entrenched and envisioned for sustainable development. Women play significant and diverse roles from home, to workplace, to society, as a homemaker, societal well-being and job seeker, and job provider respectively. Promoting gender equality is an essential component of the development strategy that seeks to enable people, both men and women, to reduce their poverty and bring about improvement in the standard of living. The role of women is of paramount interest to the economy of nations in view of their constituting about 50 % of the world population (Sharma, 2016). Therefore, women inclusion in all facets of economic endeavour is fundamental to bring gender inequality to a decline and promoting overall economic growth. This is in view of the ripple effects that a woman's economic empowerment has on her children and family, society and the entire nation. The crucial task for the post-2015 sustainable development agenda is to migrate from unsustainable policy outlines, towards policies that foster sustainable production and consumption, protect the most susceptible and develop resilience of nations and communities to climate and other environmental and socio-economic risks. The promotion of gender equality has dual rationale vis-à-vis entrenching human rights and social justice (equal opportunities, rights and responsibilities), and ensuring that boundless equality between men and women is a pre-condition for sustainable people-centred development (OSAGI, 2001)

According to UNDP (2013), it is acknowledged that significant progress has been accomplished on many millennium development goals (MDGs) such as poverty reduction, decrease in infant and child mortality and on education but inequalities in varied dimensions including extensive environmental degradation, economic crises with gender-based inequalities being perceived as retarding progress on many development goals. A far-reaching development approach therefore involves gender-sensitive growth strategies that invest in women empowerment to effectively contribute to economic development. It is widely acknowledged that there is active participation of women as economic agents in Africa than anywhere in the word with their involvement in significant contribution to agriculture, with the ownership of one third of firms, and in some countries constituting up to 70% of employees (AGI, 2015). This is without prejudice to the fact that women often face a barrage of challenges ranging from restrictive practices, to discriminatory laws and extensively segmented labour markets. Consequently, getting rid of gender inequality and ensuring the empowerment of women has the potential to promote the productive capacity of over one billion Africans. It is apparent that in a number of African societies (as shown

in diverse production systems such as pastoral / agricultural), traditional roles imposed on men and women affect greatly the role of gender and gender equality (Ojalammi, 2010). To a large extent, the traditional roles and cultural beliefs that is socially constructed lead to the acceptance and practise of gender discrimination at an early stage.

Entrepreneurship is a vital avenue by which women could empower themselves towards partaking in economic development in the absence of other forms of employment. According to Blomquist, Chastain, Tickett, Unnikrishnan and Woods (2014), women own 40% of businesses less than men with a large number of men more likely starting, sustaining and growing their own businesses. The imbalance and perceived gap is attributed to differences in men and women access to human capital (skills, business knowledge and experience), financial capital (monetary resources), and social capital (access to networks, formal and informal mentor relationships). In the opinion of Blomquist et al (2014), women tends to have less access to the three types of capital and hence are less able to optimize opportunities that are available to them.

Statement of the Problem

Women often encounter an array of challenges (such as work hour restriction, and the type of job they are permitted to engage in), thus depriving them of the need to harness opportunities in being a completely productive members of the labour force. The often omission of women from the green economy as a result of decreasing access to green opportunities in primary, secondary and tertiary sectors owing to discrimination, gender-segregated employment, and traditional attitudes also constitute source of concern in sustainable development initiative. It has been reported that Africa is leading in the world averages in relation to women participation in politics with seventeen countries now having quotas for women at the national and sub-national levels. Records has it that amongst 30 countries in the world with at least 30% women representation in national parliaments, 10 are African countries with Rwanda breaking the records in 2013 with 63% of her parliamentarians being women (AfDB, 2014). Also many Africa countries have made giant effort in bridging gender gaps (especially in primary education), though still lagging behind other continents of the world. Despite these feats, the developments have not translated into improvement in women's decision-making capacity and economic empowerment.

Objective of the study

This strategic focus of the study is to explore the facets of gender inequality and over-arching consideration on sustainability with a view to establishing the extent to which women empowerment can complement sustainable development in Africa. Consequently, attempt will be made to proffer answers to the following research questions as offshoot of problems hitherto identified:

1. What is the relationship between gender equality and sustainable development?

2. How impactful are women towards sustainable development?
3. What strategies can be deployed towards bridging gender inequality and promoting women's empowerment for sustainable development?

Review of Related Literature

Concept of Gender and Gender equality

According to Oakley (1972, cited in Shava and Rungani, 2014), gender refers to involuntary grouping of humanity into "masculine and "feminine". This involuntary grouping often imbue multi-dimensional behavioural perceptions being ascribed to male and female with the masculine positioned to have domineering role over women. Gender is thus seen as a social construct that assigns diverse qualities and rights to women and men irrespective of individual capability or desires (Johnson-Latham, 2007). Ojalammi (2010) viewed gender as social attributes (learned through association), relationship, and opportunities associated with being male and female. OSAGI (2012) emphasised that the concept of gender refers to the consideration of both men and women, the relations existing between them and not a situation where gender is interchangeable with women. Hence promoting gender equality concerns and engages men as well as women.

It is a universal phenomenon to see women perform substantial work at home without pay while men obtain these services and are still ascribed the headship role and family providers. Consequently, understanding gender denotes proper dimensioning of opportunities, constraints and the effects of change as they impact on both men and women. Tchouassi (2012) sees systematic discrimination against women in social groups as a manifestation of power structure that causes some degree of imbalance, conflict, suffering, and marginalisation. He further stress that the concept of gender is not restricted to men and women only but the relationship of power between them and other groups that are marginalized such as the handicapped. Gender and gender power become manifested throughout the strata of society, with women shouldering responsibility for health and social care domestically and at the workplace, while men are at liberty to utilize a significant proportion of leisure time to chase careers / work and to partake in decision-making at all levels of public life.

Gender equality denotes a state of affairs in which men and women experience the same opportunities in all walks of life and similar consideration in terms of allocation of resources and rights. Johnsson-Latham (2007), in his study on gender equality as a prerequisite for sustainable development cited Sweden as a typical nation that has successfully incorporated gender equality in her sustainability programme, guaranteeing women the right to their own body, to own land, to sexual and reproductive health and rights, financial equality with men as well as the right to have equal say as men in decisions impacting any facet of sustainable development.

Gender Equality and Sustainable development

Sustainable development is often considered as varied interaction between social, economic and ecological dimensions of development. It is more importantly being perceived primarily as environmental sustainability with gender concerns often neglected. Achieving sustainability depends on paying equal attention to social, economic, and environmental factors and their harmonisation through sustainable development strategies. Green economy initiatives, a sustainable development strategy aimed at creating more environmentally-sound economies may not fully include basic and essential social requirements such as job quality, income equity, and gender equality. The Brundtland Report (1987) provides the most quoted definition of sustainable development as ''development that meets the needs of the present without compromising the ability of the future generations to meet their own need''. According to World Bank (2008, cited in Tchouassi, 2012), development is concerned with societal well-being (in terms of access to safe water, rate of poverty, access to health care services, access to sanitation, life expectancy at birth, infant and maternal mortality rate, population estimate, and the process of achieving transformation of the society, adult illiteracy, population estimates, and gross domestic product. More succinctly, sustainable development is conceptualised as lying on three inter-related pillars: social development, environmental protection, and social development, with a fourth pillar – the preservation of cultural diversity (UNECE, 2012). As further highlighted by UNECE, a key objective of sustainable development is the need to satisfy the present, while calling for impartial distribution of resources amongst those living today. This is without undermining the strategic perspective to give account for what men and women are bequeathing for the next generation.

Sharma (2016) opined that in many countries, the pillars of sustainable development are not sympathetic to the plight of the female party from the perspective of the society where an individual inhabits, propagates and practices culture on the following grounds, thus not projecting the tenets of sustainable development:

- Global data reveals that 35% per cent of women worldwide have experienced violence either physically and/or sexually more than once in their life.
- Women are far low in education, economic participation, physical safety and health.

The prevailing patterns and forms of production, consumption and distribution worldwide are heading towards unsustainable direction. The significant diminution of vital habitats and biodiversity occasioned by pollution of land, seas, and the atmosphere, floods, droughts and other forms of natural disasters add to poverty and inequality for people that depend on natural resources for their well-being and also a threat to future generations (UN-Women, 2014). Also human interaction with the agitated environment, producing extraordinary stresses and shocks (due to devastated rural and urban landscapes) creates unsustainable patterns of development with girls and women often affected disproportionately economically, socially and environmentally. Thus, the raving international debate now focuses on the need to move societies and economies by enabling prosperity through green economies or avert catastrophe and crisis.

Concept of Empowerment

The meaning of the term empowerment varies and it depends on the political, cultural and socio-economic context in which it is represented. Empowerment is a multi-faceted social process that assists people to have control over their own lives, communities, and societies (EP Report, 2016). World Bank (2001) defines empowerment as ''the expansion of freedom of choice and actions and increasing one's authority and control over the resources and decisions that affects one's life.'' Thus by extension, women's empowerment implies women gaining control and power over their own lives such that their rights, opportunities and responsibilities will be independent of whether they are born female or male. Women's empowerment is deemed important in achieving gender equality. According to OSAGI (2001), an empowered woman possess a sense of self-worth, has the capability to define her own choices, has access to resources and a wide array of opportunities she can pursue as well as being able to persuade the direction of social change to fashion a more just economic and social order locally and internationally. OSAGI further maintain that empowerment is not a zero-sum game where women's gain automatically translate to losses for men, but rather a phenomenon where men are brought alongside women in the change process. Thus, the empowerment of women is needed in so as to narrow the gender gap and establish a level playing field between men and women for gender equality to be reached and maintained (UNECE, 2012).

Issues in Gender inequality

Gender inequality has been the conception as far back as the era of Aristotle (Greece ancient philosopher) when women are being perceived as weak, cautious, and only good to be domesticated for home comfort, with men being considered as the strong, independent, adventurous, active, and rational. The practice is still the norm in some societies till today and the implication is the undermining of level of women participation in socio-economic activities which is considerable especially in entrepreneurship development. Women are adjudged to be the most underutilised resources in the world going by the lower level of participation in the labour force relative to men even when they constitute half of the word's human capital. According to OECD (2008), the employment gender gap is more prominent in OECD countries like Mexico, Italy and Greece with fewer than 50% women in paid employment, working part-time and earning less than men due to persistent gender wage disparity. Women undertake chunk of unpaid care work across all cultures and economies. More importantly, this is noticeable in many societies where existing norms command that women and girls shoulder the main

responsibility for caring for children, the sick, elderly, as well as household runs providing water, energy supplies and cooking (AfDB, 2014). This undercuts their possibilities of schooling or being able to harness and secure incomes and better working conditions on their own productive activities. The fact remains that there would be significant contribution to GDP if the bulk of household activities and childcare are valued to form part of national accounting.

According to AfDB (2014), gender equality is both a development goal on one side and a pre-condition for the attainment of other development outcomes on the other side. Equally, it is an issue of human rights and that of smart economies. Gender inequality remains an important hindrance towards achieving economic growth and poverty reduction as evidence in many societies where girls and women do not have equal rights, opportunities, responsibilities and access to services as boys and men. AfDB reports attest to the fact Africa trails other developing regions in poverty reduction with the poor constituting about 50% in Africa, whereas 15.8% worldwide in 2010. Growth within the African continent is significantly hindered as a result of alarming unemployment and the failure of GDP growth to reduce gender disparity. Women across Africa are at a disadvantage both in statutory and customary law. The issue of women's inheritance to land and other properties (as entrenched in the marriage law in Cote d'Ivoire) where the husband is the head of the household in charge of all assets including land is a clear manifestation of this development (BBC News 12 June 2013, cited in AfDB, 2014). Thus in the event of the demise of the husband, the male relatives take possession of the land leaving nothing behind for the woman to thrive on. Though government of Cote d'Ivoire have made attempts to change the law to reflect joint ownership between husband and wife, education and sensitisation is needed especially in the rural areas where social norms and custom still dictate that women are men's property.

In Sub-Saharan Africa, there are several issues which raise concern for women including exclusion of women from land ownership, polygamy, existence of patriarchal systems, female genital mutilation, and early marriages (World Vision, 2007). The pervasiveness of female genital mutilation in many African countries (especially among illiterates in rural areas) and HIV/AIDS pandemic affecting young women is a major issue of concern. AGI (2015) provides an elaborate perspective on phenomenon of gender inequality in Africa and reiterates the fact that though Agriculture is the backbone of Africa's economy, providing 70% employment (with women playing major role and constituting up to two-third of the work force), women farmers have less access to farm inputs such as land, credit, fertilizers, extension services and new technologies, thereby making their yields significantly lower than those of male farmers.

Women expend less hours in paid employment than men, working part-time in other to harmonise their family responsibilities and employment, and therefore accumulate less income than men in their lifetime. The discrepancies in earnings often increase women's vulnerability to poverty and economic dependence on the male breadwinner. In a related development, World Bank Study (2001) pointed out the following:

- Women utilises more of their time caring for others than men, thus suffering a greater deal of time poverty than men (i.e. men have more leisure time than me).
- Women give priority to others, while men invest more resources in them-selves.
- To enable women take on paid job, they often depend on external child care and men do not.
- Women give more priority than men to take care of interests and needs of the family, expending chunk purchasing convenience goods, while men's incomes are deployed for capital goods.

Contributions of governmental and non- governmental agencies towards promoting gender equality and women's empowerment.

The central role of gender equality, the realisation of women's rights and women's empowerment in attaining sustainable development has been consistently recognised judging from a number of international norms and agreements entered into by governmental and non-governmental organisations. Amongst the recent developments include:

- Principle 20 of the Rio Declaration on Environment and Development (adopted in 1992 by member states) which makes it clear in its statement and communiqué the full participation of women as being critical to actualising sustainable development (UN-Women, 2014).
- The 1995 Beijing Declaration and Platform for Action (BDfA) that launched the concept of gender mainstreaming with 12 key areas flagged, emphasising the need for urgent action to ensure greater opportunities and equality for women and men (EP report, 2016). The twelve critical area of concern highlighted are: women and poverty, education and training of women, women and health, violence against women, women and armed conflict, women and the economy, women in power and decision-making, institutional mechanisms for the advancement of women, human rights of women, women and the media, women and the environment, and the girl child.

Women's Concern towards sustainable development

Women entrepreneurship

Women play an important role in African economies with high presence in the micro and small business sub-sector with majority of them engaging in low income generating self-employment especially non-agricultural and agricultural activities with low growth prospect. The contribution of Women entrepreneurship to income generation and poverty

alleviation is quite significant in both least developed and most developed economies. According to OECD (2004), the number of businesses owned by women in developed economies of USA and Canada is over-shadowing those owned by men, notwithstanding the observed inadequacies inherent in the regulatory, legal and administrative context which engenders gender bias against women's involvement in economic activities. A handful of these biases are premised on tradition and socio-cultural frameworks vis-à-vis: rights to own land, rights to inheritance, and right to set up business in own name.

Women encounter different challenges at different stages in entrepreneurship process (*e.g.* opportunity identification, exploitation and fund-sourcing). OECD (2004) identifies such obstacles militating against greater entrepreneurship involvement by women to include unsuitable educational background, dearth of role models, the gendering of entrepreneurship, feeble social status, competing demands on time – particularly connected with family concerns, and inadequate access to finance. Consequently, the extent for women to realise their potential as entrepreneurs is a function of both the status and role of women in society, coupled with the forces operating within the society which influence entrepreneurship.

Individuals with significant prior managerial business ownership and industry experience can contribute remarkable proficiency in diverse business functional areas such as decision making. A number of evidences support the fact women who own businesses possess the capability to improve the economic fortune of the firm's performance with the tendency to adapt to continually changing marketing environment via excellent negotiating and superb team building skills. Studies conducted by Catalyst (2007) shows that Fortune 500 firms with board of directors consisting of more women posted improved financial performance including higher returns on capital invested (66%), equity (53%) and turnover (42%) respectively (66%). Likewise, large organisations with top management positions occupied by higher proportion of women validated outstanding performance within the parameters of innovation, accountability, work environment and profits (McKinsey and Company, 2007).

A number of factors identified by Das (2001) as having influence on entrepreneurship activities and success (which affects men and women differently) based on research from western nations includes the following:

- antecedent influences (i.e., background factors such as family influences and genetic factors that affect motivation, skills and knowledge),
- the "incubator organization" (i.e., the nature of the organization that the entrepreneur was employed in prior to starting a business, the skills learned there)
- environmental factors (e.g., economic conditions, access to venture capital and support services; role models).

Das further established that women entrepreneur in developing countries (like India) were able to achieve some level of success due to lower level of work-family conflicts (i.e., stronger family support system), access to paid household helps, and strong government funding programmes specially set up for women entrepreneurs which accounts for the reason why a number of women were able to have access to start-up capitals different from those from outside funding agencies.

Women and Agricultural activities

According to AGI (2015) report, it has been observed that women are more active as economic agents in Africa than anywhere across the world, performing significant proportion of agricultural activities, having ownership of one-third of firms and constituting about 70% of employees in some countries as well as playing central household economic roles and seeing to the welfare of their families. Women own up to 62% of businesses in Cote d'Ivoire even though they are micro-enterprises with low value added potentials of marginal returns. Their entrepreneurial pursuits are more of necessity than opportunity driven**.**

Women and Eco-Consciousness

Women have been shown to demonstrate the propensity to demonstrate eco-conscious attitude in their household purchases. Within the context of the environment, studies of household behaviour carried out by OECD (2008) revealed the more inclination of women to buy eco-labelled, recyclable and energy-efficient products than men with women now responsible for buying some 80% of household items in developed countries**.** According to Stevens (2010), quite a number of studies based on Sweden emphasise that women devote more time than men looking for information on sustainable consumption lifestyle options such as purchasing green, eating organic foods, and recycling at a higher rate than men. In the same vein, studies show that Japanese women are more eager to pay more for sustainable products, thus showing more concern than men on environmental issues.

Women and care

Women play a powerful role in educating and socialising their children in addition to teaching them responsibility and care with respect to the use and protection of natural resources. Thus adequate recognition must be accorded their contribution to sustainable development with the deployment of their skills and knowledge.

Strategies for promoting gender equality and women empowerment

The process of empowerment rest on women themselves and it encompasses raising consciousness, participation, and organizing themselves. It can also be facilitated through education, capacity building, training and other measures with change happening in the structures and legal frameworks (property rights, family laws etc.) so as to make the self-transformation process of empowerment sustainable (World Bank 2001).

Women's Education

Sustainable development is a far reaching dream in any nation or society where participation of women is not entrenched. If sustainable development is desired, the pillars (social, societal and environment) have to be channelled in preference for women, and women education is apposite. According to Sharma (2016), women education is the need of the hour that guarantees empowerment, improves economic position, gives income through employment prospects, and improves self–confidence etc. Thus, educating women is a foremost factor that brings about gender equality and women uplifting for sustainable development. The proportion of women in leadership position is quite low, thus limiting their influence and power to affect environmental policies. About 18% of legislative positions worldwide are held by women while in some countries, there are no female representations (Stevens, 2010). Steven further stressed that when there is representation of women on governing bodies, there is tendency for overall quality of governance to rise while levels of corruption decline. He reiterated the balance participation of women and men in public life as one of the basis of the 1979 United Nations Convention on the Elimination of all forms of Discrimination against women (CEDAW).

Bridging the gender entrepreneurship gap

Economic inclusion of women in all spheres of activities is fundamental to reducing gender inequality and promoting economic growth and sustainable development as women economic participation through empowerment have ripple effect on their entire constituency (children, family, society and nation). The underlying differences in the men's tendency to start, sustain and grow business reside principally in the men's access to human, financial and social capital. According to Blomquist et al (2014), bridging the entrepreneurship gap can be achieved by helping women develop Social Capital through Networks building and Mentoring so that their economic potentials could be optimised. This will enable women take advantage of benefits inherent in the power of network as follows:

- Acquiring better business ideas, developing new and improved business skills, sharing of experiences with entrepreneurs that can further lead to gaining valuable business insight, and receiving feedback on innovative business solutions, processes and ideas.
- Access to valuable business connections through collaborations that engenders credibility.
- Enhanced access to varied source of funding including micro-financing and loans from cooperative societies.
- Network provides women with emotional support in starting and sustaining their business especially that they need to maintain a balance between their ventures and family obligations.

Give women credit

To graduate and project women's income-earning activities from survival or subsistence level into strong and thriving businesses, women require access to complete range of credit, banking and financial facilities and services for full development of their productive assets (OECD, 2012). Conservative lending practices is the pre-occupation of banks in developing countries, with small women-owned businesses facing difficulties in accessing the credit needed to invest in business expansion. Microfinance (including micro-credits) is often considered to be an instrument that promotes empowerment, providing start-up funds for productive investment, helping poor people to even consumption flows.

Access to tools, innovations and agricultural extension services

Access to technology (such as fuel-efficient stoves, motorised scooters, and other time-conserving products) can promote women's productivity, entrepreneurial opportunities and economic decision-making (OECD, 2012). Across different countries and contexts, women have less access than men to a range of agricultural technologies such as machine and tools, pest control measures, improved plant varieties, and management techniques. Often times, tools and technologies have been adapted to men's task, thus women to use handheld tools while cultivating and harvesting

Building women's capacity

One dimension of women's empowerment is the removal of obstacles militating against complete women's participation and involvement in sustainable development, while the other dimension is to focus on women directly to enable them get more involved. The tools that can be deployed to meet the needs of women towards appropriate capacity building are training programmes that guarantees access to relevant knowledge and information (UNECE, 2012).

Conclusion, Recommendation and Policy implications

Sustainable development is more of a political concept because it essentially places emphasis on good governance which will be difficult to accomplish until there is closeness to gender parity. Thus, achieving sustainable development implies reconciling economic, environmental, and social concerns and objectives. All sustainable development policies and outlines at the local, national, regional and global levels must include an explicit obligation to gender equality and the realization of women's and girls' human rights and competences. This necessitates redressing gender inequalities, disadvantage and discrimination, and addressing their connection with other inequalities. The inclusion of women in more productive roles, women's collective action and equal participation in all aspects of decision-making related to policy development will be an assured way of moving faster towards sustainability in the social, economic and environmental sense.

Women's empowerment is a process that embraces the formation of an enabling environment for women devoid of discrimination, as well as reinforcing women's capability to assume control over their own lives and contribute fully

towards ushering the desired changes in the society. The empowerment process therefore needs to be pursued vigorously through concerted efforts and commitment of government, civil society and the corporate sector. Furthermore, equal participation of men and women in decision-making, an unbiased involvement of women and men in all policy sections and implementation levels will guarantee that men and women take equal responsibility for fair distribution of resources.

Governments should remove obstacles that make it hard for women with children to work and provide other incentives to increase the female presence in the labour force.

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The Study of Periwinkle Shells as Fine and Coarse Aggregate in Concrete Works

*Timothy Soneye, Anthony Nkem Ede, Gideon Olukunle Bamigboye, David Olatunde Olukanni
Department of Civil Engineering,
Covenant University, Cannanland, Ota, Nigeria.
*timan2005@yahoo.com, anthony.ede@covenantuniversity.edu.ng, gideon.bamigboye@covenantuniversity.edu.ng,
david.olukanni@covenantuniversity.edu.ng

Abstract— **For a country like Nigeria and indeed the third world countries at large, to be able to achieve a sustainable infrastructural development particularly in the area of housing in the nearest future, low cost building materials especially those readily available within each geo political areas must be exploited and used to make housing affordable for all and sundry. The inflationary trend in the Nigeria economy escalated the cost of building materials to the extent that many of the conventional building materials are no longer affordable for the construction of low cost housing. This research presents the study of the suitability of periwinkle shells as fine and coarse aggregate in construction works. Experimental and statistical approach was adopted in this project. Physical and mechanical properties of periwinkle shells and crushed granite were determined and compared. A total of sixty (60) concrete cubes of size 150 x 150 x 150 mm with different percentages by weight of crushed granite to periwinkle shells as fine and coarse aggregate in order of 0%, 10%, 30%, 50% and 100% inclusion of periwinkle shells were cast, tested and their physical and mechanical properties were determined. Compressive strength test showed that 30% replacement of granite by periwinkle shells and 30% replacement of sharp sand by periwinkle fine aggregate were satisfactory without compromise in compressive strength requirement for a mix ratio 1:2:4. Also, the cost analysis shows a 24% savings in cost when periwinkle shells are used holistically (100%) as coarse aggregate and 6.8% savings in cost when 30% are used to replace granite as coarse aggregate.**

Keywords— *periwinkle shells, mechanical properties, concrete, compressive strength, fine aggregate, coarse aggregates.*

I. INTRODUCTION

The inflationary trend in the Nigeria economy escalated the cost of building materials to the extent that many of the conventional building materials can no longer be used for construction of low cost housing. The need to produce durable and low cost building components using local building materials and simple technologies is of great importance. This will enhance employment opportunities and conserve foreign exchange. In order to cut down on cost of construction, researchers have concentrated on using natural occurring materials as substitutes to the conventional cost of building materials.

Concrete being the most popular material used for construction of buildings has cement, fine aggregates, coarse aggregates and water as its main components. The most expensive constituent

is cement and in terms of quantity, the most demanding are fine and coarse aggregate. Thus, it is necessary to look for locally available materials that would substitute for these aggregate in concrete wholly or partially without compromising strength. The choice of the locally available materials depends on three main factors of strength, economy, compatibility and availability [1]. For this reason a possible alternative is found in periwinkle shells.

Periwinkles are a group of marine snails. Their shells are typically mottled gray, white, and black and taper to a straight-sided or rounded cone with an obtuse point as shown in below. Periwinkles inhabit the littoral zone, the region between low and high tides. Although they must live near the ocean and spend part of their time underwater, they prefer to be partially exposed to air. In the riverine areas of Nigeria, periwinkles are extremely useful. Apart from the fact that the snails are been consumed as food, their shells are also useful for; soil stabilization, concrete production, beads production, poultry birds feeds, decorations etc. The reasons favoring the extensive usage of periwinkle shells as concrete materials are; the shells are hard, apart from being hard, they are generally light materials suitable for the riverine, they are readily available in sizeable quantity, they have good bonding properties with cement and sand and are less expensive when compared to crushed stones (granites). Efforts have been made and continue to be made within and outside Nigeria to investigate the suitability of these shells as coarse aggregates in concrete. [2-4] investigated the suitability of the shells as coarse aggregates using varying mix designs, design mixes and also varying the percentage of periwinkles shells in the concrete from 0% -100% periwinkle shells. From their findings the characteristics strength of the 28 days concrete produced at 100% periwinkle shells ranges from $11.77N/mm^2$ to $15.65N/mm^2$.

 So much efforts by researchers have been spent on the possible use of the shell as coarse aggregate but little or no effort has been made on the possibility of using the shell as fine aggregate either wholly or partially in structural concrete. Consequently, this work seeks to investigate the suitability of the shells as fine aggregates as well as coarse aggregate and in an attempt to do this, series of test such as; flakiness, Los Angeles   abrasion,

(PWCS) with granite concrete and periwinkle fine shell (PWFS) with granite concrete with varying percentage of periwinkle shell (coarse and fine) from 0 – 100% respectively.

specific gravity & absorption, impact value, elongation and grading will be carried out. Also two different types of fresh concrete will be made; periwinkle coarse aggregate shell

II.   MATERIALS AND METHODOLOGY

The materials required for this work are Periwinkle shells (coarse and fine), Aggregates (coarse and fine), Cement and Water. The periwinkle shells used in this work were the remains after the shells were cooked and the edible part removed. This periwinkle shells were obtained from oyingbo market in Ebute Metta, Lagos state. The (PWS) were thoroughly washed and sundried to remove impurities. Hand - picking of further impurities was done before the material was taken to the laboratory for tests. However, some of the shells meant for fine aggregates were grounded using los Anglos abrasion machine at the laboratory. Batching of the materials in this work was done by weight. The weighing scale was used in measuring out the weights of the constituents materials. Considering the quantity of work to be done, baromix machine was used. The mixing was done in such a way that the coarse aggregates were first introduced into the mixer followed by the fine aggregate; little water was added first before the cement was introduced into the mixer. This was then followed by a gentle introduction of more water into the mixer until a visible and consistent concrete was attained. The concrete was then discharged into a wheelbarrow in order to convey the concrete to a spot where the slump and the fresh density of the concrete was taken.

Casting Curing and Crushing
The standard mould by dimension (150 x 150 x 150) mm3 was used in the casting of cubes. For each percentage replacement of periwinkle shell either as fine aggregate or as coarse aggregate, six cubes were prepared. In order words, this means six cubes each of 0%, 10%, 30%, 50%, & 100% PWFS and 0%, 10%, 30%, 50%, & 100%, PWCS. Consequently, a total of 60 cubes were prepared. The cubes were allowed to set properly before the moulds were loose and the cubes transferred to a curing tank at an ambient temperature of 25% ± 2 degrees Celsius. Crushing was done concurrently with curing of cubes at age 3, 7, 28 and 56days respectively with their corresponding strength recorded.

III.   RESULTS AND DISCUSSIONS

Sieve Analysis Test Results
The results of the sieve analysis are presented in in figure 1 and 2. Aggregates from both PWFS and PWCS failed to satisfy the grading limits of BS 882: 1992 for aggregates. On one hand PWFS failed to enter the grading limits of BS sieve size 1.18mm and that of 600µm, lagging behind the lower boundary limits by 7.2% and 1.8% respectively. On the other hand PWCS also failed to satisfy the grading limits of sieve size 5mm shooting beyond the limits by 2.6%. On the contrary, the results of "3/4", "1/2" and Quarry Dust falls within the envelope adequately. However, the fact that PWFS and PWCS aggregates failed to satisfy the grading limits completely does not render the aggregates unfit for concrete production. This is so because there are no known grading limits for periwinkle aggregates and secondly, from experience, some aggregate failed to enter the grading envelope yet their 7 and 28 days cubes strength proves okay.
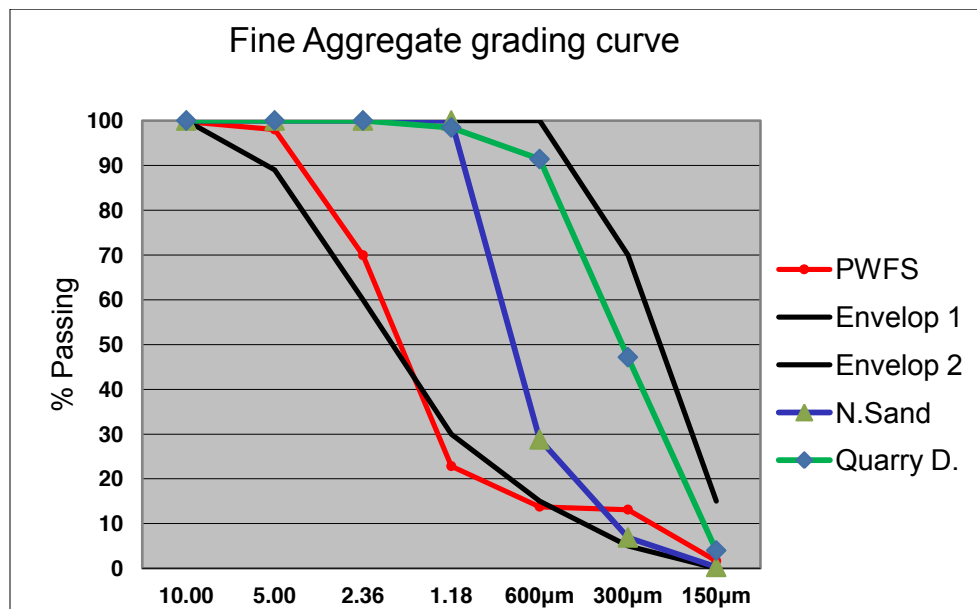
Fig. 1. Shows the Fine Aggregate grading curve
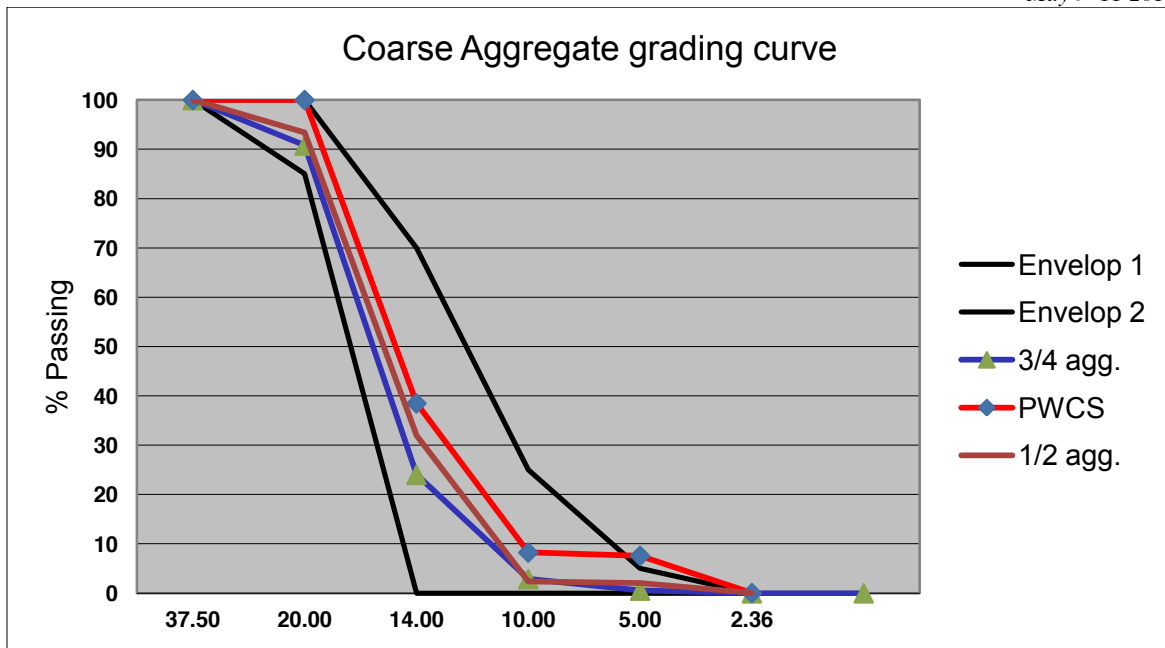
Fig. 2. Shows the Coarse Aggregate grading curve

Compressive Strength.

The slump, density and compressive strengths of PWCS and PWFS were obtained. For each percentage replacement i.e 100%, 50%, 30%, 10% and 0% six cubes each were prepared. The cubes were tested at age 3, 7, 28 and 56 days. For curing age 3 and 7, two cubes were crushed and the average strength taken. While for curing age 28 and 56 days one cube each was crushed. The slump increases with a reduction in the percentage replacement of PWCS and PWFS aggregates in concrete. Figure 3 compares the effects of PWCS with that of PWFS aggregates on the compressive strength of concrete. From the charts, similar compressive strengths were obtained at 100% PWCS and PWFS i.e between 2.67N/mm2 and 8.9N/mm2. These results are short of the expectation at 28 and 56 days. This implies that whenever the shell is used wholly either as PWFS and PWCS aggregates in concretes the strength at 28 days and 56 days is most likely going to be up to half of

designed strength. The low strength when the shells are used wholly could be linked to the high water absorption ability of the shells. Material that has high water absorption by implication encourages more water to be added to concrete during mix and the moment the designed water is exceeded by a certain percentage the proposed designed grade will fail. It is better for the water to be reduced slightly in as much as consistency and workability are enhanced in the course of production. The results at 10% replacement for PWCS aggregates and PWFS aggregates is close to that of 0% i.e control design mix, meaning that the results are good at this level of replacement. At 30% replacement, both PWCS & PWFS concrete passed but the coarse shell concrete showed a better characteristics strength property. However, at 50% replacement both PWFS and PWCS failed to attain the targeted strength of 20N/mm2, with the coarse shell showing a better result.
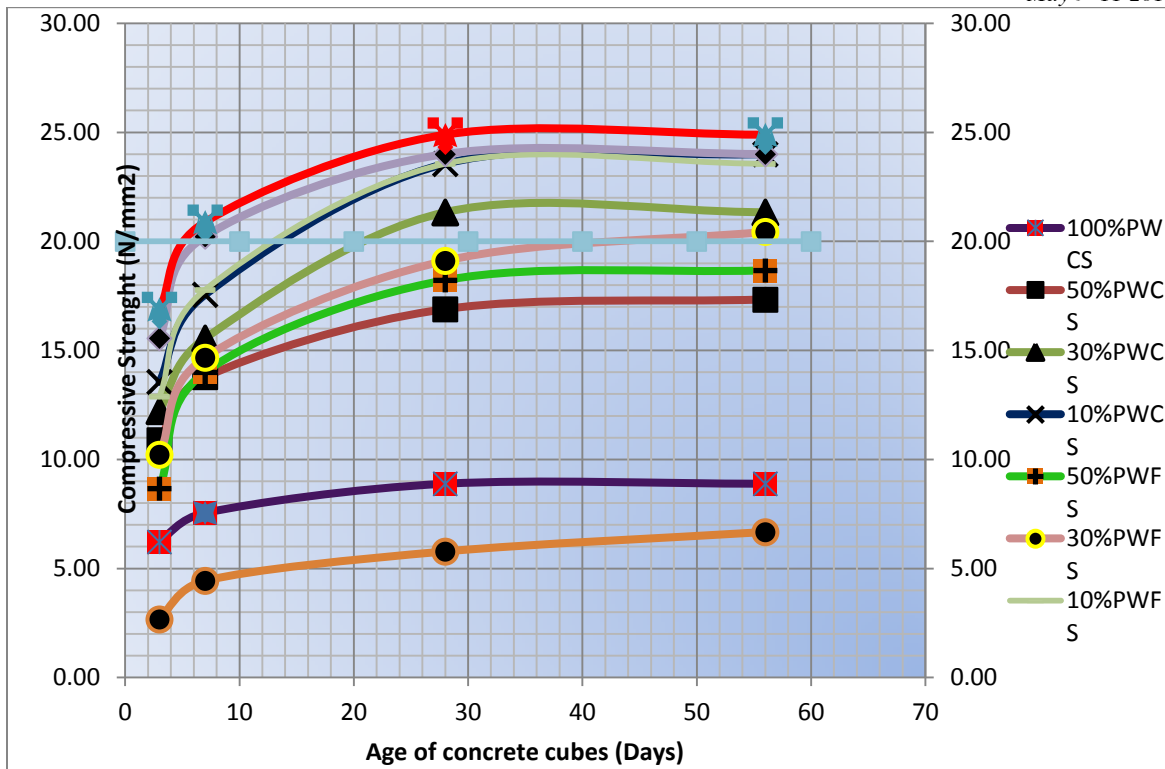
Fig. 3. Compressive Strength vs. age of concrete chart

IV. CONCLUSION

At the end of this research work, the following conclusions were arrived at:

- As the percentage replacement of PWCS and PWFS increases from 0% to 100% the slump decreases that is the workability decreases.
- Concrete made with 100% PWCS- aggregates are lighter than the normal granite chippings concrete, that is as percentage of granite chippings increases the density of concrete produced increases.
- PWCS and PWFS were able to attain the design compressive strength of 20N/mm^2 at 30% inclusion as aggregate in concrete works.
- The two specimens PWFS and PWCS concrete exhibited a low characteristics strength less than 10N/mm^2 when used holistically that is at 100 percentage replacement.
- There is a saving in cost of 6.8% when 30% of periwinkle shells are used with 70% of granite as coarse aggregate.

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Spectral Responses And Classification Of Earth's Features On Satellite Imagery

Oniemayin, Irewole Babatunde [1*], Tenebe Imokhai Theophilus [2], Emenike PraiseGod Chidozie [3] Busari Ayobami [4],
Bamigboye Gideon [5], Daramola Kofoworola [6]

Civil engineering department, Covenant University. Ota, Ogun state, Nigeria.
Irewole.oniemayin@cu.edu.ng

Abstract— **Remote sensing is fast becoming one of the most successful techniques in studying and classifying land-cover classes. Satellite remote sensing technology has provided environmental managers with a relatively cheap and accessible technique to accurately classify earth's features into common groups based on the similarities in behavior of their component structures. As the sun's electromagnetic light energy reaches earth surface, they are either absorbed and/or re-radiated into the atmosphere, depending on the component and structure of the receiving surface. The extent of absorption or radiation also depends on these components. Space satellite sensors are able to determine the wavelengths of light energy absorbed and reflected by the earth's surface. This paper assesses how three dominant land cover types (vegetation, water bodies and built-up areas which include buildings, pavements and tarmacs) usurp electromagnetic radiation, how satellite sensors are able to measure the radiation wavelengths and how RS technology uses data obtained by remote sensors which measure wavelengths of absorbed and reflected energy. The paper also presents the spectral response of these land cover types and their corresponding mathematical indices; *Normalized Difference Vegetation Index, Normalized Difference Water Index and Normalized Difference Built-up Index* (NDVI, NDWI and NDBI). The paper shows that vegetation absorbs most of the visible light in the electromagnetic spectrum (red and blue) but has a high reflectance in the near-infrared (NIR) band of the electromagnetic spectrum. This is because infrared light inhibits photosynthesis causes desiccation. Deep water bodies, on the other hand, quickly absorb NIR and red wavelengths, and reflects blue wavelength back into the atmosphere. These indices can be used to compute and determine specific land cover types from a constellation of several land cover categories on satellite imageries. LandSat-8 imagery of Nantucket Island, state of Massachusetts, USA was used for the computation.**

Keywords—Remote sensing, Spectral response, Electromagnetic radiation (EMR), Spectral indices, Satellite imagery

I. INTRODUCTION

The term remote sensing generally refers to the use of aerial sensor technologies to interact with and acquire information about earth's features, on the surface, in the atmosphere and oceans, by means of propagated signal waves e.g. electromagnetic radiation. In fact, electromagnetic radiation is the basis upon which remote sensing rests [1].

Naturally, a primary way for man to observe features is by looking at it. Light from the sun (Electromagnetic radiation) is reflected by these features, enters the eyes, interacts with sets of receptor cells in the retina and transmitted to the brain where the information is processed. The picture eventually seen and interpreted by the brain is the spectral distribution of the reflected light which arrives as visible light, a portion of the electromagnetic spectrum which the human eyes are sensitive to (Okin and Roberts, 2004). Remote sensors are however designed to detect various wavelengths of EMR, including those in the invisible spectrum. This is to say that while the human eyes are only sensitive to lights of wavelengths which occur in the visible part of the electromagnetic spectrum, remote sensors can detect both visible and invisible radiations. Visible radiant energy is attenuated in the colours of the rainbow, basically all the light the eyes can see, while invisible light include ultraviolet radiation (UV), infrared radiation, (IR), Near-infrared radiation (NIR) X-ray radiation, microwave radiation (MW) amongst others. Each one of these wavelengths has its unique characteristics and attributes, and transmit different information to sensors based upon their interaction with the target objects/materials or the intervening atmosphere [3][2]. A prior knowledge of the characteristics and spectral response of earth's elements (vegetation, water, bare soil, atmospheric particles) to EMR is the basis for classifying and identifying earth's features on satellite imageries.

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II. SATELLITE IMAGE DATA AND FOCUS AREA

Satellite imageries are imageries of the earth or portions of its surface captured by sensors which are mounted aboard earth observation satellites in space. One of the most prominent satellites is the U.S. government-owned LandSat program; a series of satellites launched between 1978 and 2013. The imagery used in this paper is a LandSat imagery of Nantucket Island, Massachusetts, USA.

Below is a true-colour satellite image of the study area developed for this paper using the image analysis software Imaje-J 1.50b.

Fig. 1. True-colour image of Nantucket Island in 2009.

The island basically consists of vegetal cover, built-up areas, water bodies and some bare ground surfaces. Much of the vegetation consists of field grass, shrubs and trees. Over the years these categories have remained unchanged; however the percentage covers have greatly changed due mainly to the impacts of urbanisation.

III. SPECTRAL INDICES, METHODOLOGY AND RESULTS

Spectral indices are mathematical combinations of surface reflectance at two or more wavelengths that indicate relative abundance of features of interest. The result of the combination is an image highlighting areas of interest, which share common attributes e.g. vegetal cover. Right from source, surface reflectance values are embedded in the different bandwidths of multispectral LandSat images in a process known as *radiometric correction* (this is done by the United States Geologic Society [USGS], the organisation responsible for maintenance of the LandSat data archive). A multispectral imagery refers to an imagery that comes in more than one spectral band, each band containing image data at specific frequencies across the electromagnetic spectrum [5]. LandSat has seven radiometers, which enables it capture an image (scene) at seven different bandwidths; red, green, blue (visible light ranging from 0.7 µm to 0.4 µm) and near-infrared (NIR), mid-infrared (MI), far-infrared (FI) and thermal (invisible light, from 0.7 µm to 10 µm or more).

Three spectral indices, *Normalized Difference Vegetation Index (NDVI)*, *Normalized Difference Water Index (NDWI)* and *Normalized Difference Built-Up Index (NDBI)*. Image analysis software *ImageJ1.50B* was used for computations.

A. Normalized Difference Vegetation Index (NDVI)

The NDVI is the most commonly used index for land cover and vegetation monitoring [4]. It is an indicator that describes the greenness or photosynthetic activity and relative density and health of vegetation — for each picture element, or pixel, in a satellite image.

The structural components of green plants have evolved to reflect longer wavelength (NIR) radiation (the water in their leaves scatters the wavelengths back into the sky) to protect plants from thermal stress and dehydration. Most of the other visible light (red and blue) are absorbed and used by chlorophyll to drive the chemical reaction ($6CO_2$ + $6H_2O$ + light energy = $C_6H_{12}O_6$ + $6O_2$) that converts carbon dioxide and water into sugar and oxygen. This is the photosynthetic process [4]. Vegetation reflects IR in its entirety; thus it is easily distinguished from other features by satellite sensors. **Band 5** in LandSat-8 imagery measures the reflected NIR. This band (band 5), thus, combines with the red band (band 4), in the computation of the NDVI. The equation is as follows.

$$NDVI = \frac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$$

Where NIR is the reflectance values of the Near-infrared band and Red is the reflectance values of the red band.

B. Modified Normalized Difference Water Index (NWDI)

The NDWI capitalizes on the generally high reflectance of water in the visible spectrum. In the Near IR and Mid-IR regions water absorbs much of the light, making it darker. NDWI is derived by the following formula;

$$NDWI = \frac{\text{Green} - \text{NIR}}{\text{Green} + \text{NIR}}$$

(Where Green is the reflectance values of the green band (LandSat-7 band 4 and NIR is the reflectance values of the red band (LandSat-7 band 3).

Enhanced water information using the NDWI is however, often mixed with the intervening or surrounding built-up area "noise" such that the area of extracted water is overestimated. This effect can be corrected by applying the modified normalized difference water index (MNDWI) proposed by [6]. The modified model replaces the NIR with shortwave infrared, creating clearer distinction between water and other surrounding surface feature pixels. Thus;

$$MNDWI = \frac{\text{Green} - \text{SWIR}}{\text{Green} + \text{SWIR}}$$

SWIR is the reflectance values of the shortwave infrared band (LandSat-7 band 6)

C. Normalized Difference Built-up Index (NDBI)

Man-made materials such as concrete and asphalt display spectral curves that generally increase from the visible through the near-infrared (NIR), mid-infrared (MI) and shortwave infrared (SWIR) regions. In other words, this index highlights urban areas where there is higher reflectance in the shortwave-infrared (SWIR) region, compared to the near-infrared (NIR) region [7]. The index is defined by the formula;

$$NDBI = \frac{\text{SWIR} - \text{NIR}}{\text{SWIR} + \text{NIR}}$$

It is worthy of note that as concrete gets older it turns darker and as asphalt becomes lighter with age. It is thus important to derive an index that will take into account the changes in properties for accurate classifications.

Below are the results of the various index operations based on the satellite image of Nantucket Island.
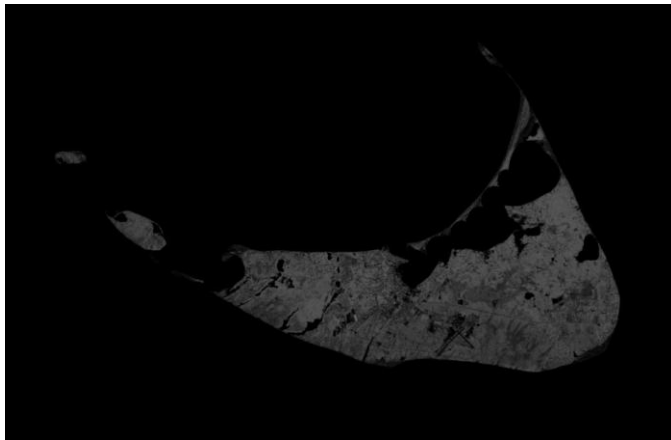
Fig2. *NDVI image depicting vegetation in light grey due to high NIR reflectance. Urban cover is shown in darker shade of grey while the water bodies (including the surrounding ocean is black.*

Fig3. *NDBI showing urban cover in black and other cover categories in different shades of grey.*
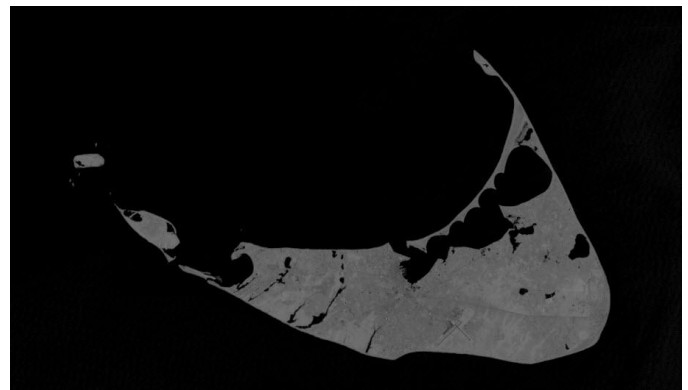
Fig4. NDBI imagery depicting water bodies in black.

These "normalized" indices generally have values ranging from -1 to 1. Values closer to 1 indicate higher intensity of the target surface feature. For instance healthy (green) vegetation ranges from 0.2 to 0.8 on the NDVI index, the smaller values indicating less complex vegetation such as grasses and shrubs while higher values indicate the presence of complex canopied vegetation like trees. Similarly in NDWI imagery, marshlands appear lighter in colour than whole water bodies like streams, ponds, rivers etc.

CONCLUSION

The advent of remote sensing technology as well as the relatively cheap accessibility to data and resources has greatly impacted the works of environmentalists across the globe. As against tradition methods of survey and data acquisition which would require researchers to have boots on the ground, researchers can now utilise this technology to gather and query loads of information, and accurately too. Asides the ability to identify and classify different land cover types, resources are also available to determine their extents; that is the areas of space they occupy. This is extremely useful in land use studies and management as shown in a study by Oniemayin *et al*., 2016.

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Transactional Leadership Style and Employee Job Satisfaction among Universities' Guest Houses in Southwest Nigeria

[1,*]Ohunakin, Folakemi, [1]Adeniji, A. Anthonia, [2]Akintayo, I. Dayo

[1]Department of Business Management, Covenant University
P. M. B. 1023,
Ota, Ogun State, Nigeria

[2]Faculty of Management Sciences, Osun State University,
Osun State, Nigeria

[1,*]Corresponding Author's E-mail:
folakemi.ohunakin@stu.cu.edu.ng

Abstract

This article seeks to establish the relationship that exists between the dimension of transactional leadership style and job satisfaction among employees in Universities' guesthouses in the hospitality sector of the economy. Quantitative cross sectional research design was adopted for the study. The correlation result reveals that contingent reward of transactional leadership style have weak positive relationship on the employee job satisfaction with 0.267 at P-value less than 0.05 level of significance, thus prompting the acceptance of alternative hypothesis.

Keywords: Transactional leadership, employee job satisfaction, University Guesthouses, Nigeria, Leadership style.

I.   INTRODUCTION

Retention of employee is one of the major issues in service producing industry, especially in hospitality sector. Literature has shown that employee job satisfaction relies largely on the leader's style of leadership which will reduce work load, employee turnover rate, over time and increased the productivity level of both the employee and the entire organisation [1]. Satisfaction of the employee with his or her job will lead to little or no intention to leave. Employee satisfaction, therefore, depends largely on the leadership of such an organisation [2].

Burns [3] argues that transactional leaders and transformational leaders understand employees' needs and help them to fulfil in their given tasks, thereby enabling them to perform extraordinarily in the face of challenges. Bass and Avolio [4] remark that transactional leader understand employee's needs and make provision to meet the needs through the reward given to such employee for his or her hard work and contributions towards the completion and success of the assigned duties.

Employees under transactional leadership believed that their relationship with their superior is based on the outcome of their performances [5]

With hospitality sector being one of the major employer of labour and contributor to national Gross Domestic Product (GDP), there is necessity to explore more about job satisfaction of the major players in this sector of the economy which are the employee. Since no previous studies examined transactional leadership styles and employee job satisfaction especially in southwest of Nigeria. Therefore, this study seeks to establish the relationship that exist between transactional leadership style and job satisfaction among the employees in the selected Universities guesthouses in southwest Nigeria.

The study aim to analyse the relationship between the contingent reward of transactional leadership on the employee job satisfaction in the selected Universities' guest houses in southwest, Nigeria. In order to achieve its stated objectives, the study is divided into the following sections:

II.   LITERATURE REVIEW

A. Job Satisfaction

In the work of Jorfi and Jorfi [6], job satisfaction was identified as employees' affective reactions towards their jobs as the outcome they desired are achieved, while Zhu [7] states that, job satisfaction is a product of non-regulatory mood tendency. Organisational outstanding performance depends largely on the employee satisfaction, it reveals how much an individual enjoys his or her job [8], individual emotional attachment to his or her job that could be viewed as global satisfaction (satisfaction with every aspect of the job) or facet satisfaction (satisfaction with a particular aspect(s) of the job) [9].

Combination of several factors creates job satisfaction and dissatisfaction among employee, which could be either motivators/intrinsic or hygiene/extrinsic factors [10]. Motivators (achievement, recognition, the work itself, responsibility and promotion/opportunity for promotion) promote job satisfaction. While hygiene factors (pay or salary, organizational policies, communication with colleagues/superiors, work conditions, supervision and leadership) absence could lead to employee dissatisfaction, but do not have direct effect on employee job satisfaction. Literature has shown that perception of equal opportunities in the place of work, level of training and development available, clear communication, teamwork and cooperation, feeling of personal accomplishment, work-life balance and receiving recognition for good performance are the major predictors of employee job satisfaction [11].

B. Transactional Leadership Style

This concept was introduced for the first time by Max Weber in his work on socio-economic considerations of the organization. Transactional leadership was defined by Weber as a leader who earns leadership through normative rules and regulations, strict discipline and systematic control. Burns, [3] describes transactional leadership style as more of "give and take" type of relationship at work, where exchange is a major form of interaction between superior and subordinate, such as a monetary rewards for achieving set objectives. Followers' obedience relied not only on rational values and rules, but also on laid down agreements. Followers are guided and at same time limited to the tasks assigned to them. Remuneration is fixed on hierarchical order and organization's bureaucracy. Clearly defined coercive measures are already established as it relates to different situations and conditions [12]. A transactional leader clarifies and lay much emphasis on goals and objectives, require tasks, performances, organisational rewards and consequence of laxities. Transactional leader overrides the personal interest of subordinates. It is a type of leadership style that is more of an exchange process such as "if you do this for me, this will be your reward."

Transactional leaders motivate subordinates by appealing to their personal desires. Burns [13] describes transactional leadership style as a "favour-for-favour" exchange. Transactional leader concentration is on performing the task in the right way. The followings are the three major dimensions of transactional form of leadership style: contingent rewards, management by exception (passive) and management by exception (active).

1) Contingent Reward: This depicts the exchange and transactional effectiveness between superior and subordinates. Transactional leaders that adopt this dimension will be ready to render any assistance in exchange for the subordinates' efforts and such leaders will only be satisfied when their expectations are met accordingly. Rewards or incentives are used for the achievement of desired outcomes.

C. Douglas McGregor Theory X and Theory Y

The theoretical review for the independent variable (transactional leadership style) of this study is based on Douglas McGregor Theory X. McGregor was the first full time professor of psychology at MIT University. In 1960, he identified and developed this renowned Theory X and Theory Y in his book Human Side of Enterprise. These theory Y and theory X are theories of human motivation that have been used for human resources management, they describe two very different attitudes toward workforce motivation and based upon Maslow's hierarchy of needs.

1) Theory X

McGregor's Theory X states that the workers should be constantly watched and directed on required task, that management needs to coerce and control employees, it assumes that an average worker does not like work, always wants to avoid responsibilities at all time, and work performance is motivated by either money, position or punishment. Theory X believes in adoption of regulations that are designed to enforce compliance, that average person have no ambition, dislikes responsibility, and prefer to be a follower rather than a leader, resist change, selfish and, therefore, does not have organizational commitment. Theory X could be likened to transactional leadership style which shows a pessimistic view of employee's nature in workplace.

III. METHODOLOGY

A. Research Design

This empirical research utilized cross-sectional research design to examine the influence of contingent reward of transactional leadership style on the employee job satisfaction. The population of this study consists of four hundred and ten (410) employees that are working in the six functioning Universities' guest houses within the south-west of Nigeria. Total enumeration method was used for determining the sample size, this is when the entire population is taken as the sample.

Probability random sampling technique has been chosen for this study because of their accessibility

and proximity to the researcher and at the same time to enable the researcher to achieve the sample size needed for the study. Also these samples are within the geographical location, open door administration of these organisations, extremely fast, easy, readily available and cost effective. The Cronbach's Alpha for all the variables is shown in Table 1.

TABLE I: CRONBACH'S ALPHA FOR ALL VARIABLES

1	Transactional Leadership Style	Contingent Reward	0.842
2	Job Satisfaction		0.832

B. Method of Data Analysis

The study adopted SPSS software version 21 to analyse the data gathered which will enable the study to summarize and synthesize the data collected quantitatively using pearson product moment correlation. Six points likert scale questionnaire was used as a measuring instrument, with 6 Strongly Agree (SA), 5 representing Agree (A), 4 representing Partially Agree (PA), 3 representing Partially Disagree (PD), 2 representing Disagree (D) and 1 representing Strongly Disagree (SD). The pearson Product-moment Correlation Coefficient was used to measure the strength and intensity (dependence) between two variables X and Y giving a value between +1 and -1 inclusive, where 1 is total positive correlation, 0 is no correlation and -1 is negative correlation. Three hundred and twenty four (324) questionnaires were correctly filled and returned which represent 79% response rate.

C. Research Question

This study research question indicates: in what way is contingent reward of transactional leadership influence job satisfaction of employee in selected guest houses in southwest of Nigeria?

D. Research Hypothesis

The following hypothesis stated in a null form was established in order to be able to provide solution to the above research question.

Hypothesis I

H_1: Contingent reward of transactional leadership style has no significant relationship with employee job satisfaction in selected Universities' guest houses in southwest of Nigeria.

TABLE II: CORRELATION SHOWING RELATIONSHIP BETWEEN CONTINGENT REWARD AND JOB SATISFACTION

		CR	JS
CR	Pearson Correlation	1	.267**
	Sig. (2-tailed)		.000
	N	324	324
JS	Pearson Correlation	.267**	1
	Sig. (2-tailed)	.000	
	N	324	324

**. Correlation is significant at the 0.01 level (2-tailed). *Source: Field Survey, March 2016*

Table 2 showed the relationship between the contingent reward (independent variable) and job satisfaction (dependent variable. The results show a positive correlation between contingent reward and job satisfaction. The relationship is significant at 0.05 or 5% level of significance, we therefore accept the alternative hypothesis and reject the null hypothesis and conclude that contingent reward will significantly improve the employee job satisfaction in the Universities' guest houses studied. The extent to which contingent reward influences job satisfaction is to the degree of 0.267 which is 26.7%.

Literature has shown that contingent reward of transactional leadership style have positive effect on subordinates' satisfaction and performance [14, 15]. Transactional leadership style is task-oriented, give reward based on performances and has positive relationship with subordinates' job satisfaction [16, 17]. Transactional leadership style had been identified with little influence on the employee job satisfaction in the study conducted on the international companies in (UAE) according to [18].

According to [19] contingent reward significantly enhances employee satisfaction within the Nigeria work environment and the banking sector specifically.

In the study conducted by Javed, Jaffari, and Rahim, [20] on selected private banks in Pakistan, they hypothesised transformational and transactional leadership styles on the satisfaction of the employees with their jobs, and the outcome revealed that branch managers in Pakistan banks embraced transactional leadership style as the major leadership style that boost the satisfaction of the employees with their job.

CONCLUSION

The result from the correlation table showed that, transactional leadership style dimension (contingent reward) have positive but weak relationship with the satisfaction of the employee with their job. This suggests that transactional leadership style dimension (contingent reward) although, the relationship is weak, but at the same time could be used alongside with other forms of leadership styles in order to make it suitable for the service producing firms especially in the Universities' guest houses that had been used as case study for this research work, and to get the best out of the subordinates. This is consistent with the study carried out in Pakistan [21].

Transactional leadership style could be perceived as style of leadership management strategy that will enable employees to have clear understanding of their given task and the objectives associated with such task as established by the leader. It is expected of a leader to be professionally skilful in his or her field of expertise. Therefore, for performance improvement, it is imperative for firms with leadership capabilities to enhance their management style using this skill, which will reduce the labour turnover, workload, job stress, over time and uncertainties and improved the employee job satisfaction in this sector of the economy.

RECOMMENDATIONS

For the leadership in the Universities' guest houses, the study recommends that they should be leaders by example, motivate their subordinates through their style of leading and work towards becoming their role model. Also, the leadership in the Universities' guest houses studied, should encourage their subordinates by giving recognition to their achievement, reward accordingly, embrace their strength and assist them to overcome their weaknesses by so doing these problems confronting this sector will be overcome.

The leadership should do away with old style of totalitarianism and give considerations to workforce concerns, feelings and thoughts by embracing leadership style that will suite the situation which will bring about positive influence on the employee job satisfaction and thereby result in increase in revenue earning in this sector of the economy. For further research, the study suggests the inclusion of other dimensions of transactional leadership style such as management by exception (passive) and management by exception (active).

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FOOD SECURITY AND TECHNOLOGY DEVELOPMENT IN AFRICA

Steve-Essi, Onyinyechi F
EIE Department
Covenant University
Ota, Nigeria
Onyii.essi@gmail.com

Dr. Idachaba Francis
EIE Department
Covenant University
Ota, Nigeria
idachabafe@yahoo.com

ABSTRACT

The numerous positive changes that will evolve in the area of food security in Nigeria, Africa and the world at large when there is a proper synergy between Technology development and Human Empowerment are properly highlighted in this article. Technology Entrepreneurial development with regards to Food security is a vast and new field of study with quite a large number of untapped resources yet to be identified. This article defines and describes the application of this field and also shows how its application can lead to improvement in Food Security.
Keywords: Food Security, Technology, Entrepreneurship, Human Development

I INTRODUCTION

When you think of Food Security, a few other terms quickly come to mind. These are terms that are closely related to the word in focus. Agriculture is one of such terms as well as Human, Technological and Entrepreneurial Developments. We will critically but briefly look at these concepts in order to heighten our understanding of these concepts.

Agriculture is known to have become one of the major sources of funds as well as employment for a very large number of the African populace. Quite an appreciable number of this teeming population is sustained by Agricultural products while a few others go into it for commercialization. The larger part of agricultural practices in African continent is majorly local and depends solely on the rainy season for planting. This method is easily exposed to unpredictable Climate induced hardship in form of extreme dry season, lack of rain in its season and other extreme weather events that may likely occur.

This particular situation is more common in the dry parts of the African continent. This area in question is inhabited by not less than 250 million people. Agriculture in the African continent in this present age is being faced with quite a significant number of challenges which includes partly on the need for improvement in the quantity of food produced and how to effectively distribute same while trying so hard to adapt to changing climatic conditions and ensuring a lasting sustainable environment. In a bid to tackle these Agricultural challenges in Africa, there is need to mechanize, innovate and take advantage of existing technological advancements in this field.

A. FOOD SECURITY

Food security is generally defined as the ability to have access to quality and healthy food. In clearer details, it has been defined by the World Food Summit of 1996 as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". The Food Security Network (FSN) also has it that Food Security occurs when all people at all times have physical and economic access to adequate amounts of nutritious, safe and culturally appropriate foods**,** which are produced in an environmentally sustainable and socially just manner, and that people are able to make informed decisions about their food choices.

B. TECHNOLOGY ENTREPRENEURSHIP

This terminology was derived from a combining two words from two varying academic fields; Technology was gotten from the field of innovation while the term Entrepreneurship was gotten from the field of business. This term as defined by Prof Tony Bailet (2012) is an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm. It is an integration of technological and entrepreneurial realms.

C. HUMAN DEVELOPMENT AND EMPOWERMENT

This is ultimately defined as an individual condition of gaining the power to control and modulate changes in one's own life, if not in a complete sense, at least, in a significant and focal manner in areas that are considered important to

one's identity and adjustment in life. This is majorly concerned with the development and empowerment of oneself with regards to the group which the individual belongs to in the society. Human development as well as his/her empowerment comes through providing opportunity structures for people to achieve, through education, entrepreneurship and employment gain access to greater social control over resources, along with increased responsibility in the utilization of those resources [1].

RESOURCES USED

This article made extensive use of secondary data emanating from the Internet, journals and such other related literatures on food security, Technology Entrepreneurship and Human Empowerment. Having acquired an in-depth understanding of the various terms that were used in this paper in the previous section, we will at this point review different literatures consulted and similar work already done in this area.

According to the World Health Organization report in 2015 on food security, several health challenges in most countries are dietary excess related and therefore, constitute an ever increasing threat to such countries' population. Malnutrition, water and food borne diseases have become huge unbearable burden to several African countries as well as other developing countries. In order for a country to have food security, certain factors must be duly considered. These include;

- Food availability: The quantity of the food available for consumption on a consistent basis must be sufficient enough.
- Food access: This factor has to do with having sufficient resources so as to enable a country or individuals acquire sufficient appropriate foods for a healthy meal.
- Food use: This considers the usage of food based on the understanding of basic nutrition and care, as well as adequate water and sanitation.

Presently, Agriculture is amongst the largest employment sector in Africa and also in most developing countries. Agricultural agreements between countries help the food security level of any country. Quite a number of criticisms have been made in this regard arguing that trade liberalization may possibly reduce or hinder a country's food security by subsequently reducing the level of agricultural employments. Concern about this has led a group of World Trade Organization (WTO) member states to recommend that current negotiations on agricultural agreements allow developing countries to re-evaluate and raise tariffs on key products to protect national food security and employment. They argue that WTO agreements, by pushing for the liberalization of crucial markets, are threatening the food security of whole communities.

This is an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm.

This proposed definition of technology entrepreneurship is based on some elements:

1. Ultimate outcomes. Value creation and capture are identified as two outcomes of technology entrepreneurship because the sources that create value and the sources that capture value may not be the same over the long run.

2. Target of the ultimate outcomes. The firm is identified as the target organization for which value is created and captured.

3. Mechanism used to deliver the ultimate outcomes. Investment in a project is the mechanism mobilized to create and capture value. A project is a stock of resources (i.e. specialized individuals and heterogeneous assets) committed to deliver the two ultimate outcome types for a period of time.

According to Hugh M. Lewis in [2], it is majorly a case of offering individuals the means to empower themselves, or to realize a form of self-empowerment that is largely independent of any external structures that are coercive or obligatory in some manner that enforces conformity. This is as true on an individual level, as it is true on a collective or even a global level of articulation. It makes sense therefore than any program promoting human empowerment that is consonant with larger meta-systemic frameworks, will work positively toward the promotion of human and systems development in the larger meaning of the term, and that human empowerment therefore is one of the principle objectives of any proposed human development program.

Technological development in Agriculture tends to discuss the various approaches adopted by individuals or a group of individuals in order to improve the yield or result of Africa's and global Food Security. This could be in form of Machineries or GMO (Genetically Modified Organisms)

DISCUSSION

In this section, considerations will be on the different approaches that can be employed in order to achieve Food Security with major interest on Technology entrepreneurship and Human Empowerment.

In the first place, a closer look will be on revisiting the keywords; Food Security, Technology Entrepreneurship and Human Entrepreneurship. The Food Security Network (FSN) defined Food Security as a situation whereby those that are responsible for the production of these consumables are capable of also living decently while carrying out the various processes associated with the production, distribution and subsequent consumption of food. Most importantly, food security is also responsible for the availability of healthy and

nutritious food for the teeming (African) populace. Accessibility to food as well as the availability of food is said to be at par with the provision of such, therefore, the topic under discuss (food security and technology development in Africa) is solely a product of a healthy and a sustainable system of supplying food.

According to [2], there are about five factors that make up the food system. These factors are; acquisition, production, processing, distribution, marketing, and consumption of food. When technology (innovation) entrepreneurship (business) and human empowerment synergizes with the above processes of food system components, the challenge of food security will almost if not be a completely forgotten issue. It is worthy of note, the fact that every healthy as well as sustainable food system must have its full attention the following factors enumerated below;

- **Healthy** Environment: This aims at ensuring that the process of producing and/ or acquiring food for human consumption does not hamper or compromise any part of the environment such as the trees and lands or bring about the pollution of the air or water. This problem should be completely avoided both presently and in the near future.
- **Vitality in the Economy**: This particular factor ensures that whereby those that are responsible for the production of these consumables are capable of also living decently while carrying out the various processes associated with the production, distribution and subsequent consumption of food. This ensures the continuity of the food production process.
- **Health And Social Equity:** This factor makes community development and good health disposition of the members of the community of utmost importance. It also ensures that foods that are healthy are available both physically and economically to the members of the community. These foods should as well be accessible.
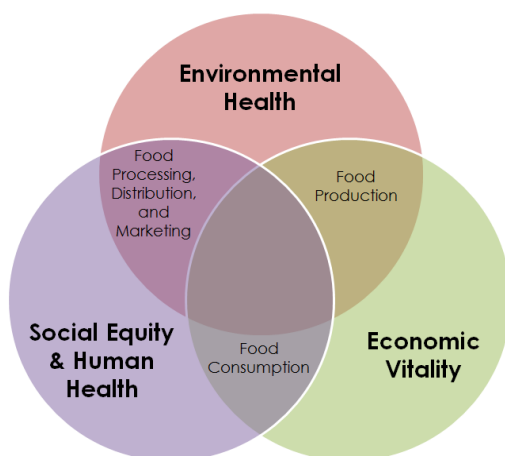
Fig 4.1 Food System Diagram

The level of food in any given environment can be measured according to household and individual level consumption. Regularly-used indicators include;

- The number of meals per day,
- Diversity of diet (the number of different food items per day), and
- The frequency of consumption of the most common foods.

4.1 TECHNOLOGICAL DEVELOPMENT AND FOOD SUSTAINABILITY

It is pertinent; the need for technological development in agriculture in order to achieve sustainable and positive strides on the agenda of governments and international bodies as regards Food Security. At the center of the European Union (EU) 2020 strategy is innovation and diverse levels of technological improvements in order to yield better agro products. New technologies and their adoption by farmers are key drivers in maintaining agriculturally competitive atmosphere in a global world. While the potential of technological development for sustainability of agriculture is acknowledged, it is equally worthy of note, the fact that there is a global trend towards increased regulation of new technologies in agriculture, particularly bio-technologies that result in genetically modified organisms (GMOs), be it for concerns about their safety or ethical and societal concerns. Applying new and innovative ideas as well as advanced technologies and machineries in Agriculture is occurring at a very fast pace. However, with the various level of advancement in the world, particularly in the area of innovative breeding (new plant breeding techniques) and also other new technologies such as nanotechnologies and improved machineries. Some machineries are shown below;

Agricultural Machines for improving Production

With necessary actions in the area of capacity building as well as developing the required (human and capital) resources, some other factors like human empowerment, infrastructural development, determination and ultimately, self-motivation can help in cultivating and developing an achievement oriented mindset in food production processes.. This will as well lead to improved quantity and quality of food produced. Certain environmentally induced situations can either make or mar a person's worth and achieved goals. On the other hand, the absence of the factors mentioned earlier, there is no level of innovation or resource development or any other external facility will produce the required result. For instance, younger minds when given the necessary required support and guidance alongside an enabling environment will mostly try very hard in order to produce the expected innovative results. The major reason behind this is not that of independence, it is rather due to their dependence on certain models, goals, response patterns and motivations of their significant care-takers as well as their immediate environment. Recent giant strides recorded so far in this field with the sole aim of improving product yields and to provide better working conditions were results of inquisitive minds aiming at solving disturbing global challenges.

Another important technological development factor with respect to food security is the modification of seedlings for improved yield. Certain breeds of some crops, tubers and plants have been recently genetically modified in order to produce better results than the original one.

Genetically modified and unmodified foods

THE ROLE OF TECHNOLOGY ENTREPRENEURSHIP FOR IMPROVING FOOD SECURITY

It is increasingly being recognized by development organizations, the masses and government agencies that entrepreneurial skills are necessary in order to achieve an acceptable and appropriate level of food security in Africa and the world at large. Technology Entrepreneurship can be understood as a key mechanism for improving the level of productivity of agricultural products and to also develop the market at both the domestic and international levels. According to Eenhoorn (2007), "it has now been established that in the short run, sustainable food security for the poor can be best enhanced by, in the first instance, concentrating on the subsistence smallholder because they form the majority of the rural poor and their development is the fastest route to food security for the rural masses'.

A report published in 2008 by the World Development Report team completely recognizes the fact that African smallholder (agricultural) development (which is Human Empowerment) is the quickest and most efficient way out of poverty." The result of this will be improved employment opportunities for the teeming African youths, Research opportunities for

Researchers and other accompanying benefits that this will bring as well as the ultimately desired food security.

CONCLUSION AND RECOMMENDATION

In conclusion, I strongly agree that Technological, Human and Entrepreneurship Developments are key factors towards attaining Food Security in Africa. These afore mentioned factors are necessary tools required driving the nation's economy and improving job creation. It also helps in reducing the high rate of rural-urban migration in such affected countries hence, tackling the challenge of overpopulation and subsequent pollution in urban areas. From the discussions in the previous section, it is also obvious that the role of Human Empowerment in enhancing Food security cannot be over emphasized.

Having made the above conclusion, I hereby recommend that agriculturally minded individuals and organizations to work with the government to ensure the aim of Food security is achieved.

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Electric Tricycle for Commercial Transportation

ARINZE DAVID, ADISA ADELAKUN, ETUKUDOR CHRISTIE, AJAYI FEMI

Electrical and Information Engineering Department

Covenant University

Ota, Ogun State, Nigeria.

david.arinze@covenantuniversity.edu.ng

Abstract-The paper analyses the design of an electric solar-powered tricycle for use as a commercial means of transportation. The tricycle uses an electric brushless direct current motor connected to the rear wheels of the tricycle using the chain and sprocket mechanism. This motor is powered by direct current from the battery bank. The battery bank is charged via a solar PV system directly installed on the roof of the tricycle. This enables the panel to charge the battery bank while the tricycle is in motion. The tricycle also employs the regenerative braking system which also charges the battery every time the brake is initiated. If effectively deployed, an estimated 32tonnes of CO_2 emissions is calculated to be the CO_2 savings effected by this energy system annually. Conclusively, this paper addresses the need to provide a sustainable and affordable solution to commercial passenger transportation in developing countries of the world.

Keywords: solar powered; tricycle; electric tricycle; research paper; direct current motor.

I. INTRODUCTION

The electric hybrid tricycle is an electrically powered device that has zero carbon emission that can be used for commerci*al* transportation. The tricycle uses an electric brushless direct current motor connected to the rear wheels of the tricycle using the chain and sprocket mechanism. This motor is powered by direct current from the battery bank. The bank is charged by direct connection to the mains and also by a solar panel that sits on the roof of the tricycle, so even when the tricycle is in motion, the panel charges the battery to replenish some power that has already been used. The tricycle also employs the regenerative braking system which also charges the battery every time the brake is initiated.

Electric vehicles tend to cost more than their gasoline counterparts. This is because gasoline vehicles have benefited from a century of intensive development; electric cars have been virtually ignored for several years. Gasoline vehicles still profit from billions of dollars of research conducted in its favour every year while researches conducted in electric vehicles haven't been beneficiaries of this resources.

THE PROBLEM DEFINITION

The alarming reality in our world today is that automobile usage is beginning to grow at a much faster than the human population, with saturation nowhere in sight. If present trends continue, overtime 3 billion vehicles could be in operation by the year 2050, exceeding 20 cars per 100 people. With challenges like fuel scarcity, pipe line vandalism, sabotage etc. This initiates a concern our hearts that vehicles powered by other sources of energy is not a nice to have but absolutely a necessity. Hence a solution is being proffered in the electric hybrid tricycle. Knowing that the gasoline powered tricycle is a major means of transportation in this part of Africa. An efficient replacement such as this will definitely reduce the dependency on automobiles.

REVIEW WITH RESPECT TO EXISTING WORKS

The following papers are being studied and are referred for the project. These papers belong to various authors, having various papers related to the research work.

1. The aim of this project is to add an electric power train and control system to the current hand-powered tricycle to provide tricycle users with improved levels of mobility. [1] The design objectives required a simple and affordable design for the power train and controls, a design that needed to be reliable, sustainable, and functional the design of the Electric Tricycle is adaptable to the current hand-powered tricycles with little modification. The design consists of an electric motor, a drive system, motor and steering controls, and a power supply.

2. The solar assisted bicycle developed is driven by DC motor fitted in front or rear axle housing & operated by solar energy. The solar panels mounted on the carriage will charge the battery & which in turn drive the hub motor [2]. When the bicycle is idle, the solar panel will charge the battery. This arrangement will replace the petrol engine, the gear box & the fuel tank in case of a two wheeler or a chain sprocket, chain & gear shifting arrangement of a conventional bicycle being used by most common man. As a part of dissertation work, the solar assisted bicycle is fitted with a dc hub motor on front axle of a bicycle with power rating of 250W and with a travelling speed of around 25-30 kmph. It is provided with a pair of lead acid batteries of 35 Ah each, a photovoltaic solar panel with capacity of 20 watt, a voltage regulator of 24v

10 Amp, accelerator and motor controller of 24v 25Amp. There is also a provision for charging of the battery with 220-240V, AC wall outlet supply, in case of poor solar supply due to cloudy weather. [3]

METHODOLOGY

In actualizing the objectives of this project above, the electric tricycle will be segmented into two (2) stages. These are

1. The electrical system design stage

2. The mechanical coupling stage

The electrical system design stage would include wiring the battery, solar panel, motor and constructing a speed controlling circuitry to ensure proper travel speed control during the operation of the tricycle.

The mechanical coupling includes the proper welding, creating of frames and arrangements of all these components especially the motor and batteries on the frame work of the tricycle. This would ensure that it retains a steady standing frame and maintain its balance when in motion.[4]
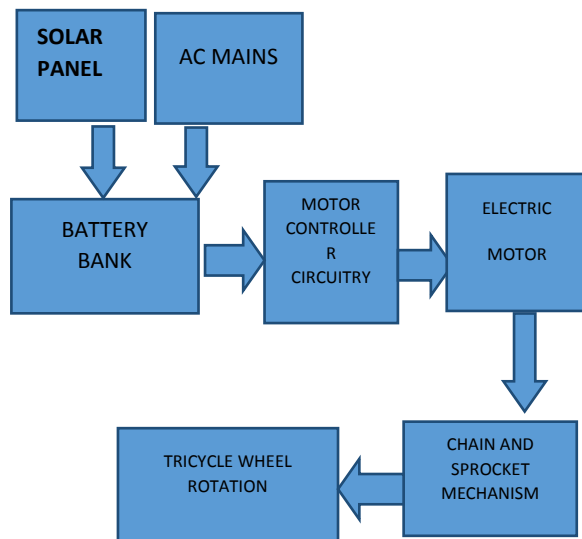
FIGURE 1: BLOCK DIAGRAM OF THE SYSTEM

SYSTEM DESIGN

230-V AC from a 13A socket is supplied to the charging circuit which steps down and rectifies the voltage to 24V DC which is then supplied to the 24V 200AH battery bank. The charging circuit contains first the step-down transformer which steps 230V AC to 24V AC then a bridge rectifier diode is used to convert the 24V AC to DC. At this stage a filter capacitor is employed for the filtration of AC ripples to ensure we have a pure direct current output supplied to the motor. The motor with a power rating of 1200watt with an average speed of 20-30kmph is connected to the rear wheels for the movement the tricycle undergoes. [5] That produces pulse width modulation pulses. The solar panel rated at 300watts also feeds the battery bank to ensure that while the tricycle is in motion, the bank is being charged. Other devices include, 24v solar charge controller, Speed Control circuitry etc.
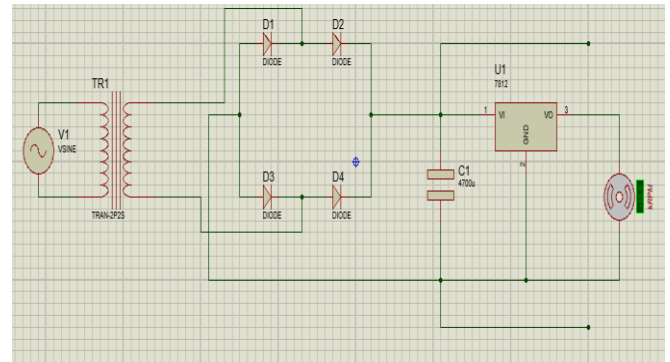
FIGURE 2: Charging Circuit

THE POWER SUPPLY UNIT.

Power supply is one of the basic requirement for all electronics appliances. Most electronics devices require dc power sources to be able to function. Batteries are one form of dc sources; they are not large are free of ripples. However their voltage output is low, frequent replacements are require due to discharge and they are more expensive than conventional dc power supplies. Most importantly, alternating voltage conversion to dc voltage is possible and very advantageous since ac power supplies is economical to produce.

For the execution of this project a 230V AC supple from the mains was utilized to provide a 25V DC output. The 25-V DC output was regulated to 24V by current limiting resistors, this was in turn used to power the control circuit which required only 5V as its inputs to control the electric motor rated at 1.5hp.
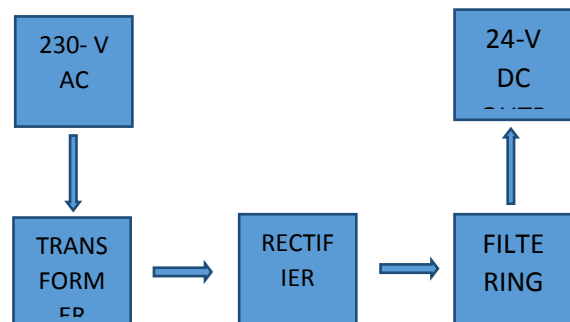
FIGURE 3

Block diagram of the power supply unit

TRANSFORMATION:

A transformer is a device that transfers electrical energy from one circuit to another by the use of electromagnetic induction. It is a static (or stationary) electro-magnetic passive electrical device that works on the principle of "Faradays law of electromagnetic induction" by converting electrical energy from one form to another. Transformers are capable of either increasing or decreasing the voltage and current levels of their supply without modifying its frequency, or the amount of electrical power being transferred from one winding to another via the magnetic circuit.

There are two types of transformers namely:

Step-Up Transformer: provides an output voltage that is higher than the input voltage

Step-Down Transformer: Provides an output voltage that is lower than the input voltage.

For the execution of this project a step down transformer was used to step down a 230V to a 28V supply which is unregulated and is alternating voltage.

RECTIFICATION:

Rectification is the process of converting an alternating ac voltage to a pulsating dc voltage. In this application of rectification a full wave bridge of four diodes incorporated into a single electronic was used. During the positive half cycle of the input voltage, D1 and D4 are forward biased; D3 and D4 are reverse biased. During the negative half cycle; D2 and D3 are reverse biased.
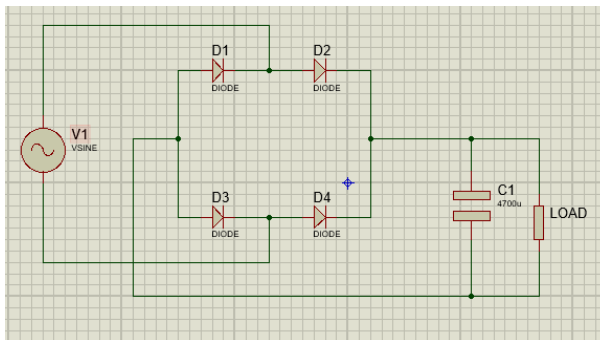
FIGURE 4: Full wave bridge rectifier

In the full wave rectifier, there is a voltage drop of 1.4V which is as a result of the 2 diodes which are always present in the conduction path of each cycle. When a voltage greater than 1.4V is across the rectifier cuirtcui.t D1 and D4 are forward biased and current starts to flow through D1 to the load and to the ground, then up from the ground through D4 to the lower part of the transformer.

At this stage, D2 and D3 are reverse biased and thus only negligible leakage current will flow through. This implies D2 and D3 do not allow current to pass through in the opposite direction and thus the diodes behave like a switch

At the opposite half cycle D2 and D4 are now forward biased, thus current flows out of the lower part of the transformer through D2 to the load and then to the ground and also up from the ground to the upper part of the transformer through D4 and D1 and D3 are now reverse biased.

FILTERING

This is also known as smoothening and can be defined as the removal of pulsations found in the output voltage. Smoothening is performed by an electrolytic capacitor which has a larger value connected across the supply to act as a reservoir, sending current to the output when changing DC (dotted line) and the smoothed Dc (Solid line). The capacitors charges rapidly near the peak of the changing of the changing DC and then discharges as it supplies current to the output.
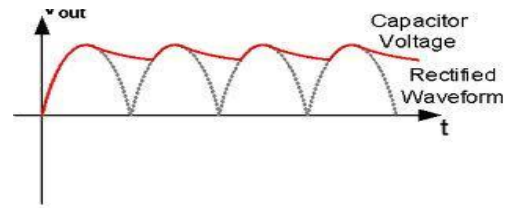
FIGURE 5: RECTIFIED WAVEFORM

Smoothening Process

Filtering increases extensively the average value of Dc voltage to almost the peak value (1.4 x RMS value). Smoothening is not perfect due to the capacitor voltage reducing a little as it discharges, providing a small ripple voltage.

Voltage Regulation

A voltage regulator is designed to automatically maintain a constant voltage level. It provides the function of pass element. Voltage reference and protection from over current in one package. It may use an electromechanical mechanism or electronic components, depending on the design; it may be used to regulate one or more AC or DC voltages. The voltage regulator has the primary function of keeping the terminal voltage of the Dc supply constant when the ac input voltage to the transformer changes or the load varies.

BATTERY UNIT

A battery is a device that converts chemical energy directly into electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half-cells connected in series by a conductive electrolyte containing cations and anions.

FIGURE 6: BATTERY COMPARTMENT

Two 12 V rechargeable batteries were selected for the actualization of this project due to its following advantages.

- Improved energy density (up to 40% greater than nickel-cadmium cells) which can be translated into either longer run times from existing batteries or reductions in the space necessary for the battery.
- Elimination of the constrains on cell manufacture, usage and disposal imposed because of concerns over cadmium toxicity
- Simplified incorporation into products currently using nickel cadmium cells because of the many design similarities between the two chemistry.

SOLAR PANEL

Solar or Photo Voltaic (PV), cells are electronic devices that essentially convert the solar, energy of sunlight into electric energy or electricity. The physics of solar cells is based on the same semiconductors principles are diodes and transistors, which form the building blocks of the entire world of electronics. Solar cells convert energy as long as there is sunlight. In the evenings and during cloudy condition, the conversion process diminishes. It stops completely at dusk and resumes at dawn. Solar cells do not store electricity but batteries can be used to store the energy. One of the most fascinating aspects of the solar cells is their ability to convert the most abundant and free form of energy into electricity, without moving parts or components and without producing any adverse forms of pollution that affect the ecology as is associated with most known forms of non-renewable energy production methods, such as fossil fuel, hydroelectric or nuclear energy plants. [6]

FIGURE 7: SOLAR PANEL

SOLAR CHARGE CONTROLLER

A solar regulator (also known as a charge controller) is used in conjunction with a standalone (off grid) system, or a grid connect solar power system that incorporates a backup battery bank. For a grid connect solar power system that doesn't use batteries, a solar regulator is not needed. [7]

FIGURE 8: SOLAR CHARGE CONTROLLER
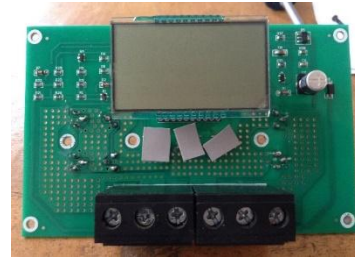
A solar regulator is a small box consisting of solid state circuitry that is placed between a solar panel and a battery. Its function is to regulate the amount of charge coming from the panel that flows into the *deep cycle battery bank* in order to avoid the batteries being overcharged. A regulator can also provide a direct connection to appliances, while continuing to recharge the battery; i.e. you can run appliances directly from it, bypassing the battery bank; but the batteries will continue to be charged.

Modern solar regulators are very efficient.

RESISTORS:

Resistors is a two terminal electronic component that produces a voltage across its terminals that is proportional to the electric current passing through it in accordance with ohms law.

$$V = I \times R \tag{1}$$

The formula for calculating resistance is given by.

$$R = V/I \tag{2}$$

The function of the resistor in both the charging and control / switching circuits is for current limiting.

CAPACITORS

A capacitor, which is a passive electronic component, consist of a pair of conductors which are separated by a di-electric. A capacitor has good similarities with a battery but charges and discharges more efficiently. An ideal capacity is characterized by a constant capacitance C, defined as the ratio of charge +/- Q on each conductor to the voltage V between then i.e. $C = Q/V$

Large capacitors are used in the battery charging unit for filtering and elimination of pulses while they are used in the micro-controller unit for the oscillator.

DC COOLING FAN

Cooling fans provide cooling solutions to your system thermal problems. The need for forced-air cooling by using an AC or DC axial fan or blower should be determined at an early stage in the system design. It is important that the design plans for good airflow to heat-generating components and allows adequate space and power for the cooling fan or blower. [8] Cooling fans and blowers are essential to systems that produce a significant amount of heat like computers and other electronic components. Different systems are engineered to work with specific types of fans. Cooling fans come in all shapes and sizes as well as voltage, airflow and case size, some are even weather resistant and can stand up against the elements. It's important to know the specific type

of fan your electronic component requires as fans are not universal. (NMBTC, 2016)

GEAR

A gear is a rotating machine part having cut teeth or cogs which mesh with another toothed part to transmit torque, in most cases with teeth on the one gear being of identical shape and often also with that shape on the other gear. When two gears mesh, and one gear is bigger than the other (even though the size of the teeth must match), a mechanical advantage is produced, with the rotational speeds and the torques of the two gears differing in an inverse relationship, when two gears mesh, the smaller gear usually rotates faster than the larger gear though the larger torques gear is still proportionally greater [9]

In transmissions with multiple gear ratios such as bicycles, motorcycles and cars, the term gear refers to a gear ration rather than an actual physical gear.

Gear Ratio

The gear ratio of a gear train, also known as its speed ration is the ratio of the angular velocity of the input gear to the angular velocity of the output gear. The gear ration can be calculated directly from the numbers of teeth on the gears in the gear train. The torque ration of the gear train, also known as its mechanical advantage, is determined by the gear ratio. [10] The speed ratio and mechanical advantage are defined so they yield the same number in an ideal linkage.

The number of teeth on a gear is proportional to the radius of its pitch circle, which means that the ratios of the gears' angular velocities, radii, and number of teeth are equal. NA is the number of teeth on the input gear and NB is the number of teeth on the output gear. The following equation is formed:

$$\frac{wA}{wB} = \frac{rB}{rA} = \frac{NB}{NA} \qquad (4)$$

This shows that a simple gear train with two gears has the ratio R given by

$$R = \frac{wA}{wB} = \frac{NB}{NA} \qquad (5)$$

This equation shows that if the number of teeth on the output gear GB, is larger than the number teeth on the input gear GA, then the input gear GA must rotate faster than the output gear GB.

For the implementation of this project, a 38 teeth gear was used as the drive and a 14 teeth gear as the driven; hence the ratio would be

1:2.7, therefore from equation (5) above, we have

$$Ratio = \frac{38}{14} = 2.714$$

COST ANALYSIS

After a survey carried out on commercial tricycle transporters that ply (Bells Bustop – Tollgate aixs) in ota, ogun state Nigeria. It was discovered that a full fuel tank would give two trips to and fro the

Gear Trains with two gears

The simple's example of a gear train has two gears and that is type used for the implementation of this project. The input gear (also known as drive gear) transmits power the output gear (also known as the driven gear). The input gear will typically be connected to a power source such as a motor or engine. In such an example, the power output of the output gear (driven gear) depends on the ratio of the dimension of the two gears.
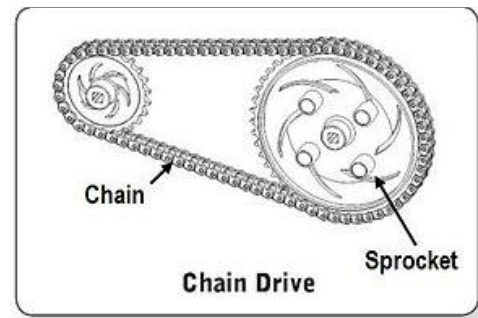
FIGURE 9: CHAIN AND SPROCKET MECHANISM

Mathematically if the input gear Ga has the radius Ra and angular velocity Wa and meshes with the output gear GB or radius Rb and angular velocity Wb then.

$$v = r_A w_A = r_B w_B \qquad (3)$$

axis. On a Regular days' work, they refill their tank three to four times.

The Comparison between the Gasoline and Electric Tricycle in the aspect of cost in naira implication is as follows;

	INITIAL PURCHASE	RUNNING COST /DAILY	RUNNING COST /YEARLY	INITIAL+RUNNING COST
GASOLINE TRICYCLE	505,000	1800	657,000	1,162,0
ELECTRIC TRICYCLE	337,500	1307.14	477105	814605
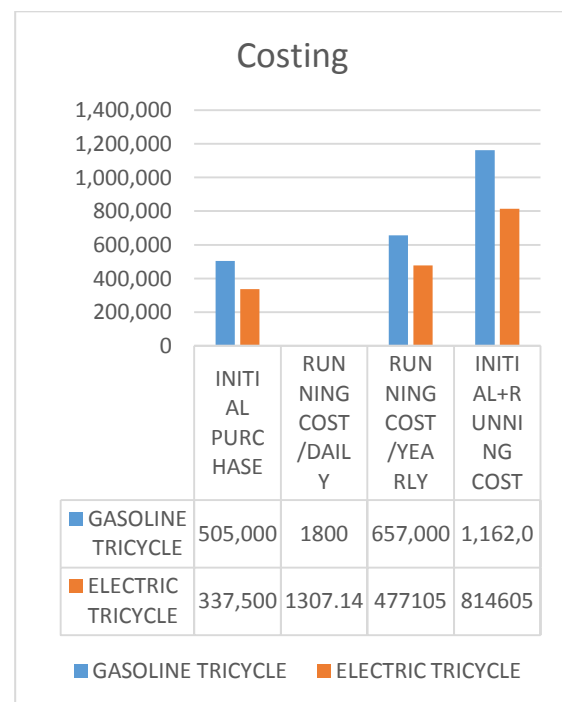
The electric tricycle would not use fuel but it would require electricity to recharge the bank @ a rate of #17.02 per Kwh. The bank charges for 8 hours to be full.

BENEFITS

❖ Job Creation
❖ Lower running cost for commercial transportation
❖ More accessible commercial transportation
❖ Better customer satisfaction
❖ Reduced noise pollution.

EXPORT VIABIITY/HISTORY OF COMMERCIAL EXPORTS IN NIGERIA.

The opportunities and benefits are endless commercializing this product. This would give to the rise to job opportunities that will come to the forbear when we have the right investment in the tricycle. [11]

CONCLUSION

The electric tricycle as compared the conventional petrol powered tricycles gives you a cost savings of over three hundred thousand naira on running cost as against the petrol powered which is almost enough to purchase another electric tricycle which means good business for the entrepreneur. It also has a carbon savings of 32 tonnes against the conventional tricycle which makes it absolutely a better option if intelligent steps are to be taken to combat global warming.

Safety in automobiles is a very integral part, so the Design was done in such a way the driver does not speed beyond the set limits of 30Km/hr and this helps minimize the hazards that accompany over speeding and it's also helps the brake to be fully initiated at any instance in time.

In conclusion, this project seeks to provide an alternative source of power for vehicles; [12] thereby ensuring that regardless of the various challenges that may affect the petroleum sector in Nigeria, commercial transportation will still be a vibrant sector in the country as total dependence on petrol or diesel will be avoided.

LIST OF FIGURES

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Assessment of Sustainability Reporting In Nigerian Industrial Goods Sector

Owolabi, Folashade
Department of Accounting,
College of Business and Social Sciences, Covenant University, Ota, Ogun State
folashade.owolabi@covenantuniversity.edu.ng

Adetula, Dorcas
Department of Accounting,
College of Business & Social Science, Covenant University,
Ota, Ogun State.
dorcas.adetula@covenantuniversity.edu.ng

Taleatu, Akinwumi
Department of Accounting & Finance,
Mountain Top University,
Ibafo, Ogun State
owolabitt@yahoo.com

Uwuigbe, Uwalomwa
Department of Accounting,
College of Business and Social Sciences, Covenant University, Ota, Ogun State.
uwuigbe.uwalomwa@covenantuniversity.edu.ng

Abstract- **Sustainability reporting has gained recognition as an improvement to traditional reporting. Whereas there is mandatory requirement for sustainability reporting in some countries, it is implemented in some other countries as a voluntary practice. This study examined the extent of sustainability reporting practiced by Lafarge Africa Plc. Content analysis was used to analyse the data extracted from their annual reports and the Global Reporting Initiative (GRI) G4 sustainability reporting guideline was used as a basis of assessment. The study found no disclosures on human rights issues, 3% environmental disclosures and an aggregate of 30% disclosure based on one hundred and sixty-nine indicators used. Consequently, this study recommends the regulation of sustainability reporting in Nigeria so as to enforce compliance on corporate entities because this will improve sustainability reporting among corporate entities in the nation and thus bring about more transparency and accountability which will enhance development in the nation.**

Keywords: *Sustainability reporting, Global reporting initiative, assessment, regulation*

I. INTRODUCTION

Environmental catastrophes brought environmental issues to the forefront since the late 1960s, and such events stimulated a flow of concern which has led to sustainability reporting [1]. Sustainability reporting is a practice that enhances goal-setting, performance measurement and change management of organizations towards a sustainable global economy and it uses the medium of sustainability report [2]. In addition, [3] posits that "Sustainability reporting is considered as a wider level of transparency and accountability to stakeholders for social activities of firms" because according to [4], the traditional financial statements can no longer provide a complete assessment of corporate performance and shareholder value creation.

Reference [5] asserts that as an organization expands, its effects (positive and negative) through its business activities also increases and the more it becomes visible to the public. Thus, an organization becomes responsible to the society in explaining its actions and their consequences in details to its society, hence the justification for sustainability reporting. Reference [6] argues that sustainability reporting has made enormous progress over the last two decades. Furthermore, [7] argues that increasing demands from stakeholders for more all-encompassing information about the operations and financial standing of businesses is influencing some companies to incorporate information on sustainability in their reports. Consequently, sustainability reporting has become an increasingly popular practice among global companies and financial regulators. But how has Nigeria fared so far?

Reference [8] observed that corporate social responsibilities (CSR) disclosures in building and materials industries was just emerging. Nonetheless, the financial reports of Nigerian companies have not been adequate overtime. Reference [9] asserts that generally, corporate entities don't fully comply to mandatory disclosure requirements of regulatory bodies and hence on the average, disclose only 44% of information required. Reference [10] expressed concern that while IFRS adoption in Nigeria was targeted at improving the level of accounting information disclosure, it seems that the level of CSR disclosure, which is just a fraction of sustainability, is low and it was attributed to the fact that the practice is not regulated. This brings some concern to the fore that even when there are mandatory disclosure requirements, accounting reports of corporate entities are lacking in some form. Therefore, having to comply with mere voluntary disclosure requirements will exacerbate the position.

Notwithstanding, corporate entities in Nigeria, especially listed companies have been winning awards which include that of sustainability reporting. Nevertheless, how well are these entities reporting their sustainability engagements

especially in line with available sustainability indicators such as GRI guidelines?

Reference [4] posits that sustainability reporting has emerged as a response to interdisciplinary reporting. This practice keeps the society abreast of what is happening in organizations in an holistic manner. Nonetheless, environmental sustainability is still voluntary in Nigeria. From the position of [9] how well do organizations in Nigeria practice sustainability reporting? Are these organizations driven by their own policies to become transparent or they have to be coerced by regulatory institutions? To this end therefore, this study seeks to assess the extent of sustainability reporting in the Industrial goods sector in Nigeria using Lafarge Africa Plc as a basis of investigation.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Stakeholder theory explains that if organizations understand their purpose of existence, it would help them to maintain good relationships with their stakeholders such that the stakeholders will cooperate with them to enhance performance. Also, the theory argues that organizations are responsible to numerous stakeholders and this shapes how organizations do business in order to ensure survival [11]. Sustainability reporting is a new trend in modern day business and organizations are incorporating it into their businesses gradually because the larger society is clamoring for sustainable practices.

Reference [3] assessed sustainable reporting among food and beverage firms in Nigeria which were randomly selected from the list on the Nigerian Stock Exchange. The study found that the firms exhibited some level of sustainability reporting though not significant because it only comprised of approximately two percent of the total disclosures of the annual reports. The results revealed that environmental activities represent 20.40% of the total disclosures, followed by product disclosures represented by 19.75% while human rights disclosures were the least representing 12.84%. The study further indicated that inverse relationship exists between the disclosures and the size of the firms.

Reference [12] assessed triple bottom line reporting in the banking industry in Nigeria through a survey study. The study opined that emphasis is still on financial profitability of the banking industry in Nigeria. However, in another study, [13] examined the annual reports of some banks in Nigeria for the presence or absence of sustainability reporting. The study found that sustainability reporting has received substantial attention over the past four (4) years in the Nigerian banking sector and that small positive correlation exists between sustainability reporting index and Profit After Tax (PAT)/shareholders fund. Reference [14] carried out an exploratory study on the benefits of triple bottom line disclosures on corporate performance. The study showed a positive correlation between sustainability reporting and corporate performance.

Reference [15] carried out a survey of sustainability reporting integrated into annual reports of Estonian companies for the years 2007-2010 based on companies listed on Tallinn Stock Exchange as at October 2011. The study revealed a continuous upward trend in the number of social and environmental accounting disclosures by the companies but a fairly low number of issued standalone corporate social responsibility reports. However, in an earlier study [16] assessed the impact of environmental accounting and reporting on sustainability development in Nigeria. The study posited that there is a significant relationship between environmental reporting and sustainable development and that environmental reporting encourages organizations to track their GHG emissions and other environmental data against reduction targets.

Reference [4] assessed sustainability reporting in the Nigerian oil and gas sector in order to ascertain the level of reporting with global best practices. The GRI G3 reporting guidelines were used and all the sampled Nigerian companies were benchmarked against their international counterparts. However, the study only used limited criteria deemed fit to be "relevant within the Nigerian context". This assertion was not scientifically justified. Nonetheless, the study found incompatible difference in sustainable reporting indicators of all companies studied when compared with their counterparts. Reference [17] carried out a study on why New Zealand firms initiate sustainable development reporting. Organizational narratives were constructed from semi-structured in-depth interviews with reporting winners who participated in a sustainability reporting workshop sessions. The narratives were analyzed using the theory of institutional isomorphism to search how regulatory, normative and cognitive institutions combine with organizational dynamics to influence sustainability reporting activity. The study found that reporting is initiated by these firms because it forms a strategy that differentiates an organization and corporate entities appreciate the benefits derivable from it.

III. METHODOLOGY

The method adopted in this study is the content analysis using the GRI G4 sustainability reporting guidelines and standard disclosures. The GRI Standards for Sustainability Reporting are now the most trusted and widely used in the world [2],[3] and GRI G4 is the latest version. The content analysis technique was employed because "it uses a set of procedures to make valid inferences from texts" [18]. The content of the annual report of Lafarge Africa Plc for 2014 was evaluated vis-à-vis the GRI G4 sustainability reporting guidelines and standard disclosures to know the extent of sustainability reporting in the company.

The reason for choosing Lafarge Africa Plc is because it won the best company award in both Environmental sustainability and Stakeholder Engagement in the Social Enterprise Report Awards (SERAs) competition award for 2015. Also, it is in the building material and quarrying sector and classified as a high environmental-impact sector. The rating for assessing the extent of sustainability reporting in Lafarge Africa Plc. is as follows:

Rating

Index not included in the report at all   0
Index included in the segment report but in general terms 1
Index included in the segment report and in specific terms 2

IV. ANALYSIS OF RESULTS AND DISCUSSION OF FINDINGS

There are seven general and two specific standard disclosures included in the GRI G4 reporting guidelines. The general disclosures are strategy & analysis, organizational profile, identified material aspects, Identified Material Aspects and Boundaries, stakeholder engagement, report profile, governance and ethics and integrity. The specific disclosures include disclosures on Management Approach, and indicators.

However, the focus of this paper is on environmental disclosures.

The Environmental category consists of twelve (12) aspects which include materials, energy, water, biodiversity, emissions, effluents and waste, products and services, compliance, transport, overall, supplier environmental assessment, and environmental grievance mechanisms.

Out of the thirty-three (33) disclosures required by the GRI-G4 index on environmental impacts, Lafarge Africa Plc disclosed only 5 which represented a mere 15%. The result further corroborates the findings of [8] that this practice is still at the developing stage. This suggest that organizations embrace reporting standards when they perceive incentives, otherwise, they dump them especially where it is not mandatory. It could also be that the technicalities involved in the reporting guidelines are not properly understood by Lafarge Africa Plc and may require more time to grasp the details. This is probable considering a 60% disclosure achieved in the economic indicator which is not a new aspect.

The results of the other disclosures based on the GRI G4 Reporting Guidelines are summarized in the table below-

Table 1: Data Analysis

RATING	0	1	2	Total	% of disclosure
Strategy and Analysis	7	1	6	14	50
Organizational profile	3	-	11	14	79
Identified Material Aspect	3	-	4	7	57
Stakeholder Engagement	4	-	0	4	0
Report profile	3	-	3	6	50
Governance	23	-	7	30	23
Ethics and Integrity	1	-	2	3	67
Disclosure on	1	-	0	1	0
Management Approach					
Economic	4	-	6	10	60
Environmental	**28**	**-**	**5**	**33**	**15**
Labour Practices and decent work	14	-	2	16	12.5
Human Rights	11	-	0	11	0
Society	9	-	2	11	18
Product Responsibility	8	-	1	9	11

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study examined the extent of sustainability reporting in Lafarge Africa Plc by analysis of documents through content analysis using the GRI-G4 reporting guidelines. Findings from the analysis show that the company scored 15% disclosure on Environmental issues.

Therefore, the study concludes that Lafarge Africa Plc exhibit some level of sustainability reporting, however, the extent of reporting is still below average which suggests there is much work to be done to improve this practice in order to become more transparent and accountable to its stakeholders.

VI. RECOMMENDATION

There have been testimonies of sustainability reporting contributing to accountability and transparency to wider group of stakeholders hence, it should become regulatory rather voluntary in Nigeria in order to make corporate entities operating in the country more committed to the protection of environmental virtues and society at large.

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The Changing Face of Education and the Dilemma Of Massive Open Online Courses (Moocs) in Nigeria's Tertiary Institutions: Implications for Development

I.A.P. Wogu[1], A. A. A. Atayero[2], F. E. Olu-Owolabu[1], M. A. Sholarin[3] P.C. Ugbogu[4]

[1]Department of Political Science & International Relations, [2]Department of Electrical Engineering, [3]Department of Psychology, [4]Center for Systems & Information Services, Covenant University, Ota:
Ogun State, NIGERIA
ike.wogu@covenantuniversity.edu.ng,
atayero@covenantuniversity.edu.ng,
fadeke.owolabi@covenantuniversity.edu.ng
solarinadeniyi@gmail.com
paul.ubogu@covenantuniversity.edu.ng

U. K. Ogbuehi
Federal College of Education (Technical)
Bichi, Kano State (NIGERIA)
uckings1@gmail.com

V.O. Akoleowo
Dominican Institute of Philosophy and Theology,
Ibadan, Oyo State (NIGERIA)
opeakoleowo@gmail.com

Abstract—**On-going studies indicates that the changing face of education via online instruction has drastically turned the tables on the essence of the flipped classroom where usually class work goes home and home work comes to class, a scenario referred to as '*education tsunami*'. Aside the psychological and ethical problems arising from this scenario, preliminary studies carried out among Nigerian tertiary institutions revealed that most students tend to feel their fingers burnt out when they fail to get expected results from the exercise (enrolling in a Massive Open Online Course 'MOOC' programme). While employing the traditional methods of rational critical analysis in philosophy to interrogate, and analyze the major contending arguments on the place and relevance of MOOCs in Nigeria's 21st century educational development, preliminary investigations show an increasing number of students dropping out of MOOCs programmes as a result of problems ranging from distancing phobia and unnecessary anxiety. The flipped classroom model is however recommended as a method which institutions and educators need to embracing since it offers a win-win situation for both students and facilitators.**

Keywords— *Development; Flipped Classroom; MOOC Programmes; Online Education; Tertiary Institutions; Rational Critical Analysis insert.*

I. INTRODUCTION

One of the most outstanding developments in the turn of this century is the idea and a quest to attain the highest global education rate for the world in the nearest future. This development has jumpstarted a revolution in global online higher education. The thought of this idea excites and leaves one extremely hopeful about the future of every individual in the world. Think about what a world full of educated people would be like. Indeed, the idea of a global education will liberate more people out of poverty since this development will provide affordable and in most cases free education which increases an individual's chance of getting a job or improving on the job they already have. Contemporary researchers [1,2,3,4,5] have among other things, argued that "nothing has more potential to unlock a billion more brains to solve the world's biggest problems." Majority of these researchers are in agreement on the vehicle through which this feat can be achieved (the platform which will act as the spring-board from which accessible higher education can reach interested individuals. Of the various platforms suggested, the Massive Open Online Course, or MOOC for short, is most preferred and is currently undergoing further developments by the likes of Stanford University and Massachusetts Institute of Technology and companies such as Udacity, Coursera, Wiz IQ, edX, UPEx, iversity, Stanford Online, and Etcetera[6]. In a report by Daphne Koller, Ng, Doand Chen[7]. on Coursera, it was stated that:

> In 2012, the typical Coursera massive open online course (MOOC) enrolled between 40,000 and 60,000 students, of whom 50 to 60% returned for the first lecture. In classes with required programming or peer-graded assignments, around 15 to 20 % of lecture-watchers submitted an assignment for grading. Of this group, approximately 45 % successfully completed the course and

earned a Statement of Accomplishment. In total, roughly 5 % of students who signed up for a Coursera MOOC earned a credential signifying official completion of the course [7].

In another report by Friedman [8] a study conducted at Stanford, it was noted that:

> … about 300,000 people were taking 38 courses taught by Stanford professors and a few other elite Universities. Today (Jan, 2013), they have 2.4 million students, taking 214 courses from 33 Universities, including eight international ones [8].

In a similar study carried out on edX , [9]. It was noted that:

> "edXa non-profit MOOC which Massachusetts Institute of Technology (M.I.T) and Harvard are jointly building, has since the month of May, 2013, had 155,000 students from around the world who have taken edX's first course: an M.I.T. intro class on circuits. "That is greater than the total number of M.I.T. alumni in its 150-year history..." [9].

From the trends recorded in the above behavioural pattern and the availability, affordability and accessibility of MOOCs which are made available via the global online education network and powered by the internet, researchers believe that this platforms will in no distant time, reach a much broader demographic range with all the privileges, advantages and opportunities that go with an educated community. In all, online studies are being projected to be able to give millions of students' access to the best lectures and teachers in specialized fields of profession and endeavour. It is already on record that hundreds of thousands of interested learners have been privileged to take classes in physics, Robotics and in accounting by Walter Lewin of M.I.T, Sebastian Thrun of Stanford University and Norman Nemrow of Brigham Young University respectively. Classes with this world acclaimed specialized professors - for most students – will be an experience, which may linger with them for a life-time.

While not undermining the huge advantage which this modern and global technological advancement is poised to bring on humanity and to the greater populace desiring to advance their knowledge, this study is focused on identifying and assessing the degree of harm which global online education is beginning to have on the product of education and the education process. There is also the adverse psychological and sociological implication which has gone unnoticed among subscribers and facilitators of this innovative platform (MOOC), all these are critically analysed in this paper.

In considering the dilemmas associated with this new platform of acquiring fresh knowledge for empowerment (MOOC), this study pays closer attention to what the state of online education in named institutions of learning is like. An analysis of some of the adverse implications and effects of adopting MOOC as a platform for administering and disseminating knowledge in named institutions shall be carried out.

II.   CONCEPTUAL CLARIFICATIONS

Some of the concepts considered for this study include: Education, MOOCs Tertiary Institution and Dilemma.

A. Education

This study perceived education as the major drive for any kind of professed empowerment; as in political power, financial power and intellectual power. The direct or indirect access to capital makes all the above mentioned avenues to empowerment possible. By the use of the term "*capital*" in this study, we refer to the *Latin* root word *Capitas* or *'*Knowledge in the head'… when someone is *de-capitated* it means that their head had been cut off. Well from the word *'capitas'* you get "capital" which is rooted in what you have in your head [10]. This is why education is perceived as the right knowledge you have in your head which gives you the capacity to display wisdom.

On the meaning of education, it has been inferred that the word "Education" is derived from the Latin term "*Educatum*" which when translated means 'the act of teaching or training'. Another set of intellectuals suggest that education comes from the Latin word "*Educare*" which means "to bring up" or "to raise". The same Latin word has also been translated to mean "to come out" or to lead forth". From these inferences, it can be deduced that education seeks to nourish the good qualities in man and draw out the best in every individual. Education therefore seeks to ignite innate capacities. This study argues that any method of education which does not succeed to "bring up" or "to raise" the right kind of knowledge, intention, motivation, boldness, and or ignite the quest to know more, will fall short of qualifying as *education*.

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B. MOOC

> "In 50 years… there will be only 10 institutions in the world delivering higher education and Udacity has a shot at being one of them." – Sebastian Thrun, Udacity CEO, March 2012 [11].

The acronym 'MOOC' stands for Massive Open Online Course. It simply refers to "online courses designed for hundreds or thousands of learners as the courses are open for everybody" [12]. In a study conducted by MaAuley, Stewart, Siemens, Cormire [13], they noted that MOOC is:

> An online phenomenon gathering momentum over the past two years or so, a MOOC integrates the connectivity of social networking, the facilitation of an acknowledged expert in a field of study, and a collection of freely accessible online resources. Perhaps most importantly, however, a MOOC builds on the active

engagement of several hundred to several thousand "students" who self-organize their participation according to learning goals, prior knowledge and skills, and common interests. Although it may share in some of the conventions of an ordinary course, such as a predefined timeline and weekly topics for consideration, a MOOC generally carries no fees, no prerequisites other than Internet access and interest, no predefined expectations for participation, and no formal accreditation [14].

Courses taken on this platform usually come with the option of free and open registration. They also come with a publicly shared curriculum with open-ended outcomes. MOOC sort of integrates a kind of social network scenario with accessible online resources, which are more often than not, facilitated by professionals and leading practitioners in various fields of study. One of the most significant features of MOOC is that it is built or designed to allow learners build and structure their own schedules and learning goals, common interests, prior knowledge and skills. Our discussion of MOOC's will focus mainly on assessing how this platform has lived up to the purpose for which it emerged in the field of 21st century education.

C. Dilemma

The word *Dilemma* when interpreted from the Greek meaning (*Di-Lemma*) could be construed as "double problem" a situation where a problem is said to offer more than one favourable solution [15]. There are various kinds of dilemmas: *Ethical*, *Double blind*, *Extortion* and *Fairness* dilemmas. The dilemma that we shall focus on is the *ethical dilemma* which basically bothers on the complex situation that often involves an apparent mental conflict between moral imperatives in which accepting a state of affairs ethically will be tantamount to transgressing the other [16]. This study generally argues that the advantages which MOOC proclaim to offer is indeed a curse in disguise due to the commensurate harm - studies have shown - it has the capacity to cause, a fact which most researchers have failed to take notice of while in their euphoric celebration of a new instructional paradigm.

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III.   MOOC & MODERN EDUCATIONAL TRENDS IN NIGERIA

It is on record that Nigeria is taking steps and procedures to make the value and quality of education better than what it was some decades ago. In the light of the initiatives taken towards implementing innovative and technological changes in the field of education, the nation had taken giant strides to correct and improve the flaws which had for long weighed the education sector down. The poor structure, which had burdened the brick and mortar educational system, was beginning to experience a boost by virtue of new technologies injected into the existing system of education. The introduction of online education in so many of its sectors no doubt, has further consolidated the efforts the government is making towards drastically reducing mass illiteracy and to increase in strength, the number of persons who can have access to education designed to improve their quality of living and /or wellbeing at any point in time.

Numerous initiatives have been taken to promote online education in the country. One of such recently lunched initiative in Nigeria is the platform put in place by *Exolve Technologies*. Their platform, at little or no cost, sets out to provide up-to-date online learning tools such as the virtual class room, which makes it possible to interact and learn from foreign experts in whatever field of their choice. Other tools that have been integrated in most schools already include: Personalized Content Creator, Real Time Virtual Classrooms, Webinars, Live Videos, Electronic White Boards, etc.

The innovation in education has transformed the formally called sandwich programmes to what is now preferably called Distant Learning Education (DLE). Ivory Universities in Nigeria such as The University of Nigeria Nsukka, Obafemi Awolowo University, University of Ibadan, The National Open University of Nigeria, *etcetera* are some of the Universities that have taken serious measures to start their online distant learning programmes. Reports generally indicate [17] that the work force (working professionals), senior citizens, home makers and even young students seeking to acquire fresh degrees or certificate to enhance or improve their job positions, promotions and a better life for the future, have all taken advantage of these innovations in the Nigerian education sector. The troubling question however is. Are the online platforms boosting the quality and efficiency of development in education among Nigerian institutions or are the platforms facilitating the service of other institutions abroad?

A. Distant Learning Activities in Selected Nigerian Universities

The preliminary survey carried out for this study revealed that while online platforms are fully and well established in the Eastern and Western world: USA, UK, Asia, Europe and North America, the distant learning programme in tertiary institutions of Nigeria, areas till at the ground breaking stage. The entire educational system recently suffered some setbacks when the NUC ordered and suspended all part-time institutions of learning in Nigeria who had before the time of suspension in 2012, had directly or indirectly involved themselves in the business of conducting distant learning programs via various platforms, one of which is the online distant learning platform. This hitch and many more like it seem to constitute the story and history of online distant learning programmes in Nigerian tertiary institution.

A close study undertaken in the University of Ibadan revealed that online activities at the Diploma and the Degree levels has spanned over 2 decades with a total turnover of

about 6,000 students graduating in different fields of human endeavour [18]. Special organisations such as *Socketworks* Nigeria and a few others are examples of organizations that have been contracted to provide the technology and the platform for running online programmes. A close study of other institutions: The University of Nigeria Nsukka, Obafemi Awolowo University, University of Ibadan, The National Open University of Nigeria, indicates that they all seem to have the same excuse for not having a global online platform for administering their courses and programmes in their various Universities. Interviews conducted and data collected seem to corroborate reports provided by the National Centre for Education Statistics. The results of the survey gathered offered the following reasons: (1) Inappropriateness and the issue of quality, (2) reasons of cost and technological incapability's and (3) Reasons of necessity as some of the reasons offered as explanation to why online education in Nigeria had not taken roots. A few of these reasons are further explained below:

1. 44% of respondents (Institutions) who in 2001 had not offered online education, and was not also planning to offer such service in the next 6 years, claimed their reason had to do with conflicting issues arising from their original vision and mission on which their institutions were founded upon.
2. 22% of schools officials displayed a substantial degree of lack for instituting distant learning educations courses in their institutions.
3. The same report noted that about 26% respondents up held concerns about the need to sustain the quality of the knowledge transferred via these platforms as major factors influencing their decisions not to float distant learning / online schools/programmes.
4. Most of the institutions interview noted that one of the major reasons for their setback is their inability to appropriate the enormous cost implications of developing a functional online and distant learning programme.
5. The fact that the online formant isn't just ideal for all learners was also emphasized by some institutions. Person who know they have problems with motivation, procrastination and others, who cannot do without always needing supervision, will certainly not be able to cope with the online platform for studying [19].

Other reasons such as: employers lack of value for (or acceptance of) online degree; inability of the persons concerned to getting accustomed to new technologies, are some of the other reasons that have been adduced for the poor outing with the global online initiatives by these great institutions of learning in Nigeria. However, the other part of the survey reveal that a commensurate number of Nigerians; both the young and the advanced professional seeking to expand his/her horizon and marketability in the labour market, have all had to take advantage of the more established global online platforms for distant learning educations in the 'none-profit' and in the 'for profit category abroad to meet their career and educational development needs.

The place of instituting successful MOOC platforms in the Nigerian educational system, from the forgoing arguments, has therefore been perceived to be untenable in the nearest feature, since her economy for instance is not as advanced as that of the United states of America where Universities like Harvard and MIT are self-sustaining enough to the extent that they could afford to jointly committee Sixty Million US Dollars ($60,000,000.00) to a cause which is directed at offering free online courses [20] to desiring students all over the world. One of the few Universities investigated for this study- such as the University of Ibadan – is known to charge a reasonable fee for the online distant learning Degree and Diploma programmes which she offers students who are willing to pay the price. The authors believe that only when Nigeria's economy improves and the standard and quality of education improves, before one can begin to conceive of the idea of implementing any form of MOOCs as an ideal educational platform for successfully bringing to bear the goals and aspirations of education in the country.

IV.   THE DILEMMA OF MOOCS ON EDUCATION

"We were on the front pages of newspapers and magazines, and at the same time, I was realizing, we don't educate people as others wished, or as I wished. We have a lousy product…. It was a painful moment."
Sebastian Thrun, Nov. 2013, [21].

Online education today is not new. Records show [22] that online degree programme started in the University of Phoenix in 1989, by 2007, it was recorded that four million students had taken at least one online class during the fall of that year. However, the most interesting thing now is that there seems to be a craze among the elite, pace-setting Universities to embrace and embark on the use the internet for administering full scale online courses, which used to be only interesting experiments a while ago [23]. It is obvious that for these elite Universities: University of Phoenix, Harvard, Massachusetts Institute of Technology, Stanford University, Michigan, Penn, Yale and Princeton, etc., are some of the few Universities that have now embraced online activity as a core aspect of their future academic pursuit, one they are willing to invest huge sums of money in. In May 2012 for instance,   Harvard and the Massachusetts Institute of Technology committed $60,000,000.00 to offer free online courses from both Universities [24]. The seeming craze at which these elite Universities made serious commitments towards online education was what caused the President of Stanford; Johns Hennessy to express shock at the emerging trend of events. His exclamation was captured in an article by Ken Autltta in *The New Yorker* as:

There is a Tsunami coming… What happened to the Newspaper and magazine business is about to happen to higher education. [25].

Several other writers: [26, 27, 28] have viewed the coming change with trepidation.

Will online learning diminish the face-to-face community that is at the heart of the college experience? Will it elevate functional courses in business and marginalize subjects that are harder to digest in an online format, like philosophy? Will fast online browsing replace deep reading? [29].

Where it is established that a few professors can make lecture presentations to millions at the same time, what now happens to the remaining members of faculty? Will one professor be able to sustain and maintain the academic standards and rigorous nature of studies anticipated at this level? What happens to the students who do not have enough enthusiasm to stay glued to his computer for hours on end? What degree of communication is captured, established or lost during these sessions- eye contacts moods and gestures – especially when you are not actually in a room with a fervent tutor and learners?

Some of the above reasons perhaps explains why Cary Nelson, the past President of the American Association of University Professors (AAUP) appealed that MOOCs are not a dependable platform for providing identifiable knowledge, affirming that "It's fine to put lectures online, but this plan only degrades degree programs if it plans to substitute for them" [30]. In the same vein, Sandra Schroeder, the chairperson of the Higher Education Program and Policy Council for the American Federation of Teachers (AFT), conveyed her apprehension when she said that: "These students are not likely to succeed without the structure of a strong and sequenced academic program" [31].

Following the fears and apprehension arising from the astronomic adoption and implementation of MOOC' as the platform and future path way for advancing education, institutions and Universities such as Amherst College, Duke University, and San Jose State University, all expressed dissatisfaction on issues varying from incompatibility of courses issues, issues surrounding different models of teaching, the issues surrounding a Westernized curriculum, issues surrounding the quality and standards of courses, the issues of failing to reach the very audience MOOC were designed for and issues surrounding maintaining standards of examinations administered and on issues of inequality in quality of education [32, 33, 34, 35]. These fears and criticism notwithstanding, there still seem to be a massive surge and a scrambling among most Universities and institutions to be one of the first to join in the next big thing that is happening in the world of education industry [36]. It has been reported that dozens of institutions in Asia, Europe, Mexico and Canada have been listed among those that have formed partnerships with some of the biggest names in the business of providing MOOC services in America [37]. This unbecoming behaviour has caused some researcher to wonder whether the academia was going to be muzzled out by MOOC [38, 39]. These

scenario has resulted in the publishing of articles with titles such as: "*A Future With Only 10 Universities*" – by Audrey Watters; "*What's Right and What's Wrong About Coursera-style MOOCs*," "*MIT and Magic*" – by Tony Bates; "*MOOCs: Not There Yet*" and "*MOOCs are a Fundamental Misperception of How Teaching Works*" – both by Mark Guzdial.

A. The Problem of Learning or Cheating with MOOCs

Cases of plagiarized papers are one of the problems which online educators must grapple with. The social sciences and some of the science disciplines have been known to record cases of ambitious students who stop at nothing to make high grades. They are often known to start a class with fictitious names in other to get familiar with the questions. The exams are later repeated with their real names, this time with a better chance of making higher grades in the test or examination. Sebastian Thrun, founder of *Udacity*, observed that they have not been able to find ways of knowing with certainty, whether assignments submitted by registered students in an online class, match their actual capabilities. He therefore concludes that "providers of massive open online courses (MOOCs) who desire to offer formal credentials to graduates, must first come to terms with the kind of strategies they 'll need to put in place to verify students submitted work online*"* [40].

B. The Problem of Concentrationwith MOOCs

The alarming movement from the normal classroom learning activity and methods of teaching to online education now constitutes a dilemma for educators in the educations industry. A study from communication research and philosophy tends to highlight the existence of the *distancing effect*, a problem which affects students who are separated in time and place by the use of MOOCs. This separation, studies show [41, 42, 43, 44], often has adverse effects which include: a reduced understanding for the wellbeing of the human person among others. Consequently, researchers such as Russell [45] has identified and examined the psychological implications of the use of MOOCs for online students. Russell argues that "when computers or other forms of electronic media mediates human experiences during the process of learning, they tend to produces related tendencies such as moral distancing, psychological distancing, media richness, and psychological propinquity" [46]. Rubin similarly argued that:

> …technology increases the propensity for unethical conduct by creating a moral distance between an act and the moral responsibility for it. This position, known as the *Moral Distancing Hypothesis*, draws on earlier pre-Internet theories [47].

From an ethical perspective, the implementation of online pedagogy usually causes harm by reducing the empathy that one person should feel for another in a civilized community. It is against this background that Palmer, from the light of the above studies, observed that learning experiences done in the traditional classroom setting seem to be the best and ideal way learning and education. In his words:

> Face-to-face communication would appear to remain the idealized form of interpersonal communication, embodying all the features which humans developed to facilitate the rapid, explicit, and implicit negotiation of relational information [48].

Another dilemma considered worthy of note in this study is that which concerns the achievement of cognitive objectives and learner satisfaction. In a study by Inglis, [49] it was argued that "while online teaching is suitable for transmitting knowledge, it struggles to address the Affective Domain". Evidence in support of this view is vividly stated in the choices made with regards the subject matters reported in some comparative studies made in the previous pages [50]. This study observed that projects done in the traditional brick wall class room were not seen as significantly different in quality when assessed.

Another dilemma considered here is that which concerns the 'the quality of education'. Most distant education learning outfits exist for the sole purpose of making profit rather than pedagogy. The main subject of discussion in such organisation is 'increased market share profits' rather than to increase teaching quality. Technology therefore is more of an instrument for control and domination [51]. To support his claims, the authors cite Lewis Mumford, who wrote as early as 1936 in *Technics and Civilization* that: "the aim of many of the primary inventions was not technical efficiency, but business, or power over other men".

C. Two Way Communication in MOOC

One of the major problems which providers of MOOCs tend to overlook is the problem of how to blend online information with face-to-face discussion, tutoring, debate, coaching, writing and projects. In the section where we clarified the terms used in this paper, we noted that the term 'education' refers to those actions which are directed towards *"bring up"* or *"to raise"* (i.e. elicit) the right kind of knowledge, intention, motivation, boldness which ultimately ignites the quest to know more in an individual. That stated, this study notes that the kind of pleasure received from seeing and hearing a live orchestra play in a music theatre, is often quite different from the kind of pleasure that could be communicated to (and consummated by) the same or another individual who only listens or sees the same kind of music via a recorded music or audio device. The same differences apply when one is engaged in a live and immediate teaching in a conventional classroom; compared to when teaching or learning is administered via an online platform. All over the world, the science of *communicology* is one discipline questioning these problematics. Studies on MOOC's indicate that it is another area where the USA has fallen way behind in the last decades [52]. Online educations and activities tend to fail a lot in its effort to fulfill the basic objectives which the art of educating prescribes. Where and when the desired knowledge is not communicated after an exercise, then the exercise, in this case, the activities of MOOC has failed in its bid to satisfy the requirements for basic education. A onetime software teacher for a big software corporation, who taught classes in brick-wall settings but now also teaches students online recalls his experience with the communication problem as stated below:

> I can say that the biggest difference for me has nothing to do with nonverbal communication from me to the student. It's the lack of nonverbal communication from the student to me that has always worried me the most. Rare is the student that is psychologically capable of raising his hand and "interrupting" the lesson in progress to say, "I don't understand." Instead what happens so much more often is a furrowing of eyebrows, a tilt of the head, or a hesitantly half-raised hand. This is the moment for an instructor to know that you have to pause and explicitly create space for a question. But online, you are asking remote students to take action that says, even if silently, "I don't understand." In the classes that I teach online now, most often that moment does not come until days later [53].

The argument here is not that the problem posed in unsolvable, but the point being made is that, it is a problem that nothing serious is being done about it right now. We cannot also say for sure how providers of MOOCs tends to foster and replicate the kind of communication that goes on in a college community through on-line teaching by distinguished professors. The truth is that trying to teach a course on-line is at best only half the picture. The real question is, "can on-line learning also connect the students as efficiently as it is done in a physical community? Software engineers have confirmed that the technology is now in place to do it....but will it work"? [54].

V. FURTHER DISCUSSIONS AND CONCLUSION

As the study begins to wind down, the authors wish to note that on-line studies basically reduces the standards and the quality of education given, due to the massive number of participants that are engaged in these programmes per time.

Testimony of students taking on-line courses will perhaps further buttress this point;

> I have tried a lot of these new online courses that have been created but I still think they have missed the point, the point that Khan academy got right. I don't want to plan my life around weekly assignments. I keep getting emails about assignment deadlines, causing unneeded anxiety which puts off the whole learning experience [55].

There is largely an enormous difference between teaching/studying on-line and teaching/studying in a brick wall environment. The issue we think rather boils down to *the naïve notion that more is necessarily better*. The ease at which mediocrity is rewarded from this platform is rather alarming and frightening. A face-to-face social learning setting has the capacity to inform the mind. The mind here is uncovered, identified and enhanced by close and real time interactions with competent and experienced faculty; online learning on the other hand is efficient at aiding the already formed mind fill up on realities essential to deal reasonably and ethically with the self and others. If you try to fill up an unformed mind with facts, what conclusions will that mind draw? What moral standards will that mind apply to those facts? What will be the resulting behaviour? Exposing minds not ready to grapple with realities of life only leads to the scenario which this study has tried to establish in the arguments so far.

On-line learning no doubt will bring about a return to what Jim Muller calls "an insular, provincial, tribe-oriented perspectives" [56] which is precisely what is not need in this expanding and emerging global community. In trying to acquire a knowledge that is foreign to you, it helps if you can write the words and say the words, it helps if you can also hear the word and see the word. This is because it has been proven that the mind works better when all the senses are collectively engaged together. The community where this socialization takes place can therefore not be over emphasized. How the community aspect of the learning environment in a University for instance, intends to replicate in an on-line platform, is what the authors in this study cannot really phantom. However, one known fact is that an online learning experience cannot successfully and effectively connect students the way a physical community engages students. This study therefore earnestly upholds the need for the continued adoption of the *face-to-face contact* methods with caring and knowledgeable faculty carrying out the duties of teaching and educating students if the dilapidating state of education all over the world will be addressed.

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Development of a Smart, Low-cost IoT-enabled System for Energy Management

Omole Olayinka Success, Akpobasah David, Atayero Aderemi

Electrical and Information Engineering
Covenant University, Ota
Ogun State, Nigeria
olayinka.omole@gmail.com, atayero@covenantuniversity.edu.ng

Abstract—**With the advent of the Internet comes not only the opportunity to send and receive data from our peers or fellow humans, but also the opportunity to send and receive data from our devices. This concept is known as the concept of Internet of things (IoT), and it proposes immense opportunities, part of which can be applied to solving the growing issue of power/energy management. The consumption of electricity has skyrocketed in recent years, and methods which are costly and of harm to the environment are also mostly used in electricity generation. Therefore, energy monitoring, management and efficiency is of utmost importance to improve the power sector of any economy. A solution to the growing issue of energy monitoring and management is a cheap and smart electricity socket that could show the users the amount of energy they spend at every point in time for each of their devices (in monetary terms). The socket allows users to set limits to their power usage by switching their devices on and off remotely. A database of home appliances is also set up to enable awareness on the various energy profiles for different devices and appliances and proffer energy efficient alternatives to such devices based on usage and region, using intelligent web systems. The Smart Socket makes use of the IoT concept of Smart Metering to measure key energy consumption data and will send instantaneous data to a web server to be saved to a database and accessed by permitted users. This project primarily addresses the need for access to data and proper information in making informed decisions concerning energy management and usage.**

Keywords—Energy management, Internet of Things, Intelligent Systems, Smart Homes, Home Automation, Smart Sockets.

I. INTRODUCTION

The pursuit of energy efficiency as part of everyday life is a necessary objective, both from an economic and ecological point of view. Our standard of living is based on the consumption of electricity, a limited and costly to generate resource whose consumption has skyrocketed in recent decades. Energy management is one of the major issues affecting the power sector of any economy. Many individuals are ignorant about how much power their devices consume and hence use these devices indiscriminately. A system that could show the users the amount of energy they expend at every point in time (in monetary terms), and also allow them set limits to their power use by switching their devices on and off remotely would be a good solution to the energy management issue. This solution is the use of Smart Metering technology in

Smart Sockets, which would monitor important power and energy readings, store the gathered information and send such information via a network to an Internet server to be accessed by Smartphones, Tablets and Personal Computers. The sockets are also capable of switching the devices connected to them on and off remotely. A database of home appliances and devices is also developed to be used by every stakeholder in the power industry and the general public to enable awareness on the various energy profiles for different devices and also proffer energy efficient alternatives to such devices.

A. Significance/Motivation

The problem of energy management is especially a huge one in developing economies like Nigeria, as the generation and distribution companies are not able to attend fully to the needs of the nation in terms of power generation and distribution. The aim of the proposed metering and database solution would be to ensure that every citizen is aware of their power usage and are empowered to take steps to reduce their energy consumption, hence also reducing the amount of money they spend buying electricity. The sockets can also be used for home automation by enabling it to switch connected devices on and off remotely, and also enabling it to switch off automatically when above a particular energy spend. This will further drive energy conservation.

B. Aim/Objectives

The aim of this project is to apply the concept of **Internet of Things** to solve an age- old problem of energy management using a developed IoT (Internet of Things) Metering and Automation device and a Cloud based Open Access Home Appliances Database.

The developed smart metering device will accomplish the following major objectives:

- To design and develop a cheap and functional alternative to existing expensive smart meters, which are about $150 (~N45,000 as at this writing).

- The developed metering device will have a simple connection, which can be used to measure total energy use at connection points.

- Accurate energy consumption data will be measured as the sockets will measure real power and cost of power.

- The device will store energy consumption data to a web database to be used by individuals or organizations.

- A Simple Graphical User Interface (GUI) will be developed by which data from the Smart Meter can be accessed by personal computers, tablets and smartphones over an Internet connection.

- The socket will be able to be switched ON/OFF remotely.

The developed database will achieve the following objectives:

- It will be a web database of domestic appliances and their ratings and it will be accessible by all stakeholders in the power industry.

- It will have an Application Programming Interface (API) on which other rich applications can be built.

- It will have a minimalistic and easily accessible GUI, so as to enable ease of use to all key stakeholders.

- It will be open access and will be able to be contributed to by any stakeholder in the power system.

C. Energy Management

Energy management involves the planning and operation of energy production and consumption units. Energy management is necessary for resource conservation, cost savings and climate protection. Energy efficiency is an energy reduction technique that encourages energy customers to use less energy and still enjoy the same services. For example, using LED (Light Emitting Diode) lights in place of the more common incandescent bulbs to provide the same amount of illumination is an example of practicing Energy Efficiency. Energy efficiency results in reduced energy cost, and also reduces greenhouse gas emissions. Energy efficiency is said to be one of the pillars of sustainable energy, along with renewable energy [2]. According to the International Energy Agency, improved energy efficiency in various sectors could reduce the world's energy needs in 2050 by a third, and help control global emissions of greenhouse gases [1]. In some countries energy efficiency is also seen to have a national security benefit because it can be used to reduce the level of energy imports from foreign countries and may slow down the rate at which domestic energy resources are depleted. Energy conservation is also a management scheme that involves reducing or going without an energy service to reduce consumption. An example of energy conservation is switching off of light bulbs and using day lighting instead during the day in homes and companies. The proposed energy management

solution utilizes both techniques of energy reduction discussed above in its operations to ensure quality energy control and cost savings.

D. Energy Usage in Nigeria

Even though, Nigeria is an energy-rich country, we have acted more as an energy store rather than an energy utilizing country over the years, up until now. The only major sources of energy utilized for generation are coal, crude oil, natural gas and hydro [3]. This, among other reasons has caused power supply to the citizen to be epileptic and inconsistent. Over the years, energy consumption in Nigeria has been on the rise. Figure 1 shows the Electricity consumption (in kilowatt-hours per capita) in Nigeria from the 1970s up till 2011 as obtained from data from the World Bank.
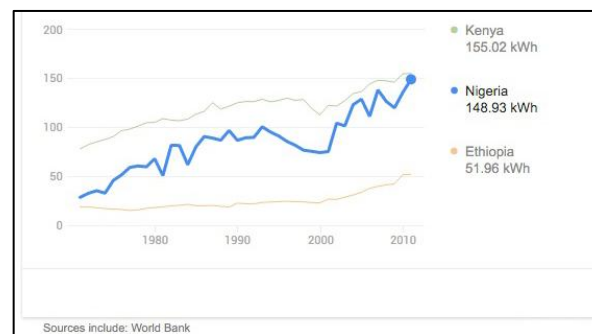
Fig. 1.   Energy consumption per capita in Nigeria

Our current consumption, while seeming normal when compared to some other developing African nations, is far less than our counterparts in developed economies, as seen in Figure 2.
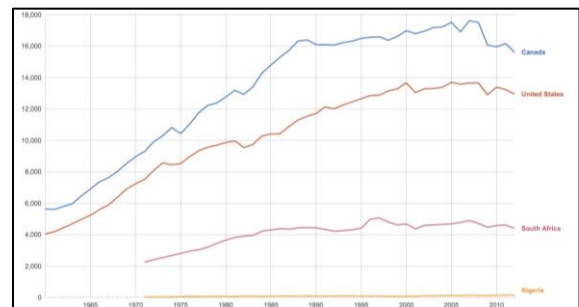
Fig 2. Energy consumption in Nigeria per capita compared to developed economies [Source: World Bank]

A report showed that the global average electricity consumption for households with electricity was roughly 3,500 kWh in 2010 [4], while in Nigeria, it was about 570 kWh. This emphasizes that there is a huge energy gap that needs to be filled if Nigeria is to claim its position as the giants of Africa. One way to improve on the power network and provide better

quality of service in the energy sector is to implement energy reduction, conservation and efficiency programs. The low energy per capita also affords the citizens with no option but to employ energy efficiency and conservation programs so as to maximize the little amount of energy available to them.

II. Literature Review

A. Smart Sockets and Meters

AC (Alternating Current) sockets are devices that allow electrically operated equipment to be connected to the primary alternating current (AC) power supply in a building. A smart socket is a power socket that communicates with the user via a network or communication interface such as the internet, or via SMS. It works like a smart meter and communicates energy consumption details to the user to see real time and also stores these consumption details in a database.

A smart meter is an electrical meter that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility or user for monitoring, billing and informational purposes. Smart meters enable twoway communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting. Smart Meters differs from traditional automatic meter reading (AMR) in that it enables two-way communications with the meter.

Various research and design work has been done on Smart metering. van Gerwen et al [5] in their research work on Smart Metering highlighted that countries like the USA and other countries in Europe have implemented Smart Meters to improve energy efficiency and management, which shows that the concept is feasible. They explain that Smart Metering technology (also referred to as Automated Meter Reading) is mature and can be implemented. Their paper shows that the basic functions of Smart Meters are to: measure electricity, remotely switch customers (devices) on or off and to remotely control the maximum electricity consumption. According to them, the communication infrastructure for Smart Meters may include: Power Line Carrier (PLC), A wireless modem (GSM or GPRS), An existing permanent internet connection (ADSL).

Others have also investigated ways in which a single metering connection can be used to monitor and control various load sources from a single connection point. For example, Barsocchi et al [6] in their work; 'Smart Meter Led Probe for Real-Time Appliance Load Monitoring' experimented on a concept known as Non-Intrusive Appliance Load Monitoring (NIALM) to obtain appliance specific time and power draw characteristics of devices by disaggregating the information collected at the main break level. They were of the opinion that Home Automation networks may become the primary tools for smart energy management in the near future.

They stated that an extension of the original MIT (Massachusetts Institute of Technology) NIALM method can be used to recognize signatures in devices such as spikes in power draw and types of devices. Their solution is based on the use of optical sensors of the modern smart meters. It infers the domestic electric consumption from the readings of the smart meter's LED flashes, and using a Finite State Machine (FSM), it recognizes the most common appliances used in domestic activities. They focused on the non-intrusiveness of their system and developed a simple single device to get real time information about the energy consumption and usage of domestic appliances. As a proof of concept, they tested the proposed power monitoring solution to infer when the Electrical Microwave Oven in a home was on/off for a period of 6 (six) months, and recorded closely-accurate results. In conclusion, they were able to present a NIALM system that monitors the usage of a domestic appliance in order to recognize the associated activity of the user.

B. Web Applications

A web application is a Software Application that is stored on a remote server and is delivered to the final user through a Web Browser.

A comprehensive database application of Home Appliances and their energy ratings is not currently available on the internet. Even though some energy and utility companies have tried at various times to post information about home appliances and their energy ratings, such as Wholesale Solar [7], there is no consolidated collection showing the cost implications of usage and energy ratings of the different home appliances.

III. System Design

The design of the complete Energy Management System has been broken down into two (2) functional parts which would incorporate the metering, control and database aspects. The system design architecture is shown in Figure 3.
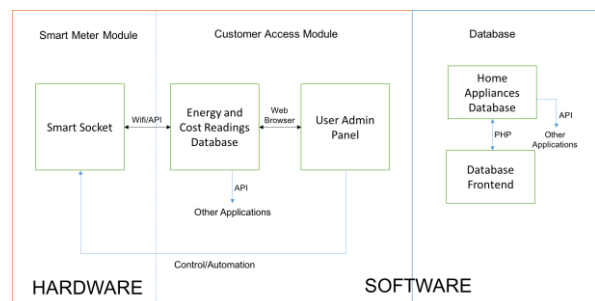

Fig. 3. System Architecture for Energy Management System

The design of the socket is based on the use of an open source Microcontroller board, the Arduino Uno R3, which is based on the ATmega328 MCU. It possesses an ESP8266 Wi-Fi module for communication, ACS 712 current sensing module and a voltage sensing unit for measuring consumption data.

A. Hardware Design

The hardware design involves all the components and tools used to design the Wi-Fi Based Smart Metering/Sockets System. There are four Units/Interface involved in the hardware design stage; Metering Unit, Control Unit, Processing Unit and Communication Interface. The block diagram in Figure 4 gives an overview of this stage and the flow of metering information.
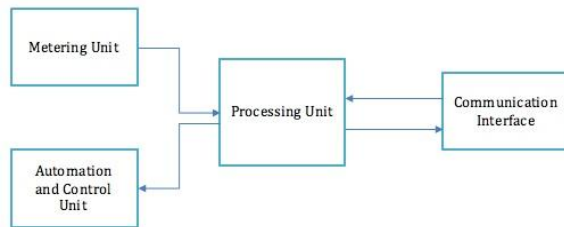

Fig. 4.   Hardware Sub-System Block Diagram

The metering unit is responsible for measuring the amount of load connected to the meter and forwarding it to the processing system for the necessary computation to be done with it. The metering system uses a Voltage and Current Sensor connected to the Arduino to measure average active real power. A current sensor is a sensor that detects electric current in a wire, and generates a signal proportional to it.

The Automation and Control Unit coordinates the automatic switching of load connected to the smart socket. This is achieved by the use of a relay module. The Arduino Uno coordinates the switching of the relay hence switching whatever device is connected to the socket ON/OFF. A relay is an electrically operated switch.

The processing unit takes the values of quantities generated from the metering system and performs computation on them. The CM (Central Microcontroller) Block serves as the core of this system. The Arduino Uno was chosen as the Microcontroller as it is open source, affordable and can be easily adopted to interface with other components. Microcontrollers are electronic circuits that can be programmed to carry out a vast range of tasks. The Arduino Uno can be programmed using the Arduino IDE (Integrated development environment) and using the Arduino language, which is a variant of the C Programming language.

The communication interface is the main point of interaction between the Smart Meter and the Online Database. Communication is achieved by the use of a Wi-Fi module with a Microcontroller to send and receive information to and from the Server. The major component of the communication system is the Wi-Fi Module. The Microcontroller is responsible for sending the appropriate Attention Commands (AT) to the WiFi Module.

B. Software Design

This comprises of all the elements and technologies used in the development of the server side and frontend of the Energy management solution. It mainly comprises of the development involved in the creation of the following:

- Database to save customer energy usage

- API (Application programming interface) to enable the meter to save readings to a database and enable the Admin interface pull data from the database.

- Customer Access Module or Admin Interface for users to view meter readings

- Home Appliances Database (HADB) comprising of various Home Appliances and their energy profiling and costs based on customer usage.

A database management system (DBMS) is a computer software application that interacts with the user, other applications, and the database itself to capture and analyze data. A general-purpose DBMS is designed to allow the definition, creation, querying, update, and administration of databases. The database contains information sent by the meter and required by the user to understand how much energy they use and how much it costs. An online service called Thingspeak© was used to create a database to store the values of current, voltage and time and then serve that data to the user admin panel via it's API.

An API (application program interface) is a set of routines, protocols, and tools for building software applications. The API specifies how software components should interact and APIs are used when programming graphical user interface (GUI) components. The API used was built on the Thingspeak© service and was used to build other components of the system including the Graphical User Interface (GUI) for the user to view energy usage readings and to program the Microcontroller.

The Customer Access Module is responsible for interpreting results from the database which contains information from the Smart Socket to the user in a Graphical User Interface. It is built using web technologies: HTML, CSS, PHP and Javascript.

The Home Appliances Database Module involves the construction of a web application which would hold information about various home appliances and their energy profiles. It is built using web technologies such as HTML, PHP, Javascript, CSS and Laravel. An Admin backend is developed which aids to serve a supervisory role for adding, editing and removing appliances from the database using a GUI.
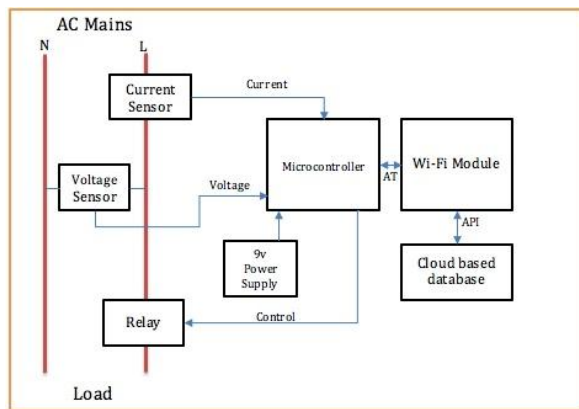
IV. CONSTRUCTION AND TESTING

Fig. 5.   Block diagram of Smart Socket

Figure 5 shows how the various components in the Smart Socket system interact with each other.

A. Phase 1

The Smart Socket system was first constructed and tested on a breadboard using a 9v battery as the power source and a DC motor as the load on which energy usage readings were gotten from. The ACS 712 current sensor was connected in series with the DC Motor load and was connected to the Arduino to collect current readings. The readings gotten were displayed on the Arduino IDE (Integrated Development Environment) serial monitor.

The voltage sensor unit consisting of a voltage transformer and 2 resistors of 10k Ohms and 100k Ohms was also tested.

B. Phase 2

At this phase, the relay was tested separately and was used to switch a 5v Relay ON and OFF via the serial monitor.

C. Phase 3

After the current reading connections were confirmed, the ESP8266 connection to the Arduino was implemented. The ESP 8266 enabled the system for communication over the internet via WiFi. The Customer Access module was also developed in this phase to grant users access to the reading via the Admin User Interface as a replacement to viewing via the Serial Monitor as in Phase 1.

The readings from the constructed system are monitored via the Customer Access Module as shown in Figure 6.

An export of the database showing some values gotten from the smart socket during testing are shown in Table 1.

D. Authors and Affiliations
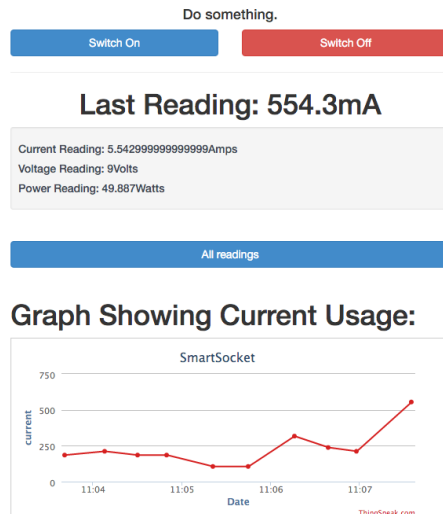
Fig 6. Example of a figure caption. (*figure caption*)

TABLE I.   DATABASE ENTRIES OF SMART SOCKET

	Created At	Entry ID	Current Value	Voltage Value	Time
1	Created At	Entry ID	Current Value	Voltage Value	Time
2	2016-03-14 16:03:39 UTC	9	527.9		
3	2016-03-14 16:03:57 UTC	10	290.3		
4	2016-03-14 16:05:34 UTC	11	1055.7		
5	2016-03-14 16:05:52 UTC	12	1187.7		
6	2016-03-14 16:06:30 UTC	13	844.6		
7	2016-03-14 16:06:49 UTC	14	897.4		
8	2016-03-14 16:07:27 UTC	15	607.1		
9	2016-03-14 16:09:47 UTC	16	475.1		

V. HOME APPLIANCES DATABASE DEVELOPMENT

A. Phase 1

This involved setting up the MySQL relational database which had the various tables required for the Home Appliances Database system. A web application called Phpmyadmin was used to set up the MySQL database.

B. Phase 2

At this phase, the frontend (which is what the users sees) is developed using HTML, CSS and Javascript. The Admin frontend is first developed for admins to upload and edit appliances and their alternatives. After the admin frontend development, the user end was developed for users to view appliances, their energy ratings and alternatives.

C. Phase 3

This involved using PHP to do the server-side programming and add the functionality for the various parts of the software. The Laravel framework for PHP was installed and set up to enable faster prototyping. Controllers, Models and Views were then created for the various aspects of the application.

VI. CONCLUSION

The system developed allows monitoring of power consumption, with the aim of providing intelligent energy consumption information. In the domestic environment, the use of Smart Metering provides more information and control over the electricity consumed, to the user. By means of the Smart Metering prototype developed, users are able to discover their consumption habits. With this information, users can develop strategies to make their consumption more efficient and thus, most environmentally-friendly.

The project is able to accomplish the objectives defined in the 'Aim and Objectives' section as shown below:

- The total cost of the project is about $28 as compared to the price of $99 of the average Smart sockets, which enables it to accomplish purchase cost reduction.

- It can be connected to devices via a common socket, which enables it have a simple connection.

- It makes use of voltage and current sensors and a timer, which enables it capture key energy consumption data.

- It possesses a WiFi shield and a data logger on a web database which enables it store energy consumption data to be used by various persons.

- It possesses a simple GUI on a web server by which consumers can access their energy consumption data.

- It possesses a Relay for automatic switching of the devices connected to it.

ACKNOWLEDGMENT

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Biodegradation of Crude Oil, Refinery Effluent and Some Petroleum Components by Penicillium Sp. and Mortierella Sp. Isolated From Oil Contaminated Soil in Auto Mechanic Workshops

A.E. Okougbo

Department of Biological Sciences
Covenant University
Ota, Ogun State, Nigeria
okougboakhere@gmail.com

N. De*

Department of Biological Sciences
Covenant University
Ota, Ogun State, Nigeria
manadina93@gmail.com

Y.M. Bello

Department of Microbiology

Federal University of Technology, Yola

Abstract—Ten isolates of five different types of fungi identified as Penicillium sp. (B101F, B202F and B302F), Aspergillus sp. (B102F, B104F and B304F), Fusarium sp. (B501F), Trichoderma sp. (K602F and K561F) and Mortierella sp. (B1002F) were isolated from contaminated soil samples obtained from auto mechanic workshops in Minna, Nigeria. Mycelial extension rate measurement method was used for the isolation of the best crude oil, refinery effluent and some other petroleum hydrocarbons degraders. Two fungal strains B101F and B1002F were selected based on their ability to degrade (Lagoma light) crude oil and some other petroleum components as both carbon and nitrogen sources in mineral salt medium (MSM). The biodegradation study showed Penicillium strain B101F and Mortierella strain B1002F performed degradation at an optimum pH and temperature of 5.0 and 280C respectively. The optimum concentration of (Lagoma light) crude oil, refinery effluent and other hydrocarbons in mineral salt medium (MSM) for fungal growth was 0.5% within an incubation period of 21 days. When complex medium such as maize bran was utilized as nitrogen source with crude oil in mineral salt medium (MSM) omitting NaNO3, the optimum growth was attained on the 14th day of fermentation for both the isolates. With respect to the selected strains ability to degrade crude oil, these organisms have shown significance in reducing pollution that arise from oil spills in our environments.

Keywords—Biodegradation, Mycelial extension rate, Lagoma light, Mineral Salt Medium (MSM).

I.   INTRODUCTION

Bioremediation, microbial decomposition of petroleum and petroleum products, is of considerable economic and environmental importance. Because petroleum is a rich source of organic matter and the hydrocarbons within it are readily attacked aerobically by a variety of microorganisms, bioremediation employs microorganisms capable of degrading toxic contaminants [1]. By augmenting the contaminated site with an appropriate inoculum of microorganisms is a promising technique to enhance the biodegradation of hydrocarbons. It is known that petroleum hydrocarbons can be removed by microorganisms such as fungi belonging to the genera *Aspergillus*, *Penicillium*, *Fusarium*, *Amorphotheca*, *Neosartorya*, *Paecilomyces*, *Talaromyces*, *Graphium*, yeasts which includes *Candida*, *Yarrowia* and *Pichia* and microalgae [2]. Filamentous fungi play an important role in degrading diesel and kerosene by producing capable enzymes, because of their aggressive growth, greater biomass production and extensive hyphal growth in soil, fungi offer potential for biodegradation technology [3].

Reference [4] have reported that single cultures of fungi have been found to be better than mixed cultures of fungi and bacteria and more recently, fungi have been found to be better degraders of petroleum than traditional bioremediation techniques including bacteria [5]. Forty five isolates belonging to 12 genera were purified and five isolates namely *Alternariaalternata*, *Aspergillusterreus*, *Cladosporiumsphaerospermum*, *Eupenicilliumhirayamae* and *Paecilomycesvariotii*as well as their consortium were found to be able to grow in association with petroleum oil as sole carbon source under *in vitro* conditions [6]. *Aspergillusniger* and *Rhizopusstolinifer* were capable of consuming kerosene as a sole carbon source [7]. The white rot fungus Polyporus sp. S133 collected from petroleum contaminated soil was tested for its ability to grow and degrade crude oil obtained from petroleum industry. Degradation at 93% was observed at crude oil concentration of 1000 rpm for 60 days [8].

In this study, an investigation was made on the biodegrading capability of crude oil and other petroleum components by fungal species isolated from oil-contaminated soil of mechanic workshop dumps and the effects of some

environmental parameters on the biodegrading capability of these fungal isolates.

II. MATERIALS AND METHODS

A. Collection of Samples

Soil samples were collected from three auto mechanic workshops located in three areas namely Bosso, KeteranGwari and Northern bye-pass, Minna, Nigeria where the mechanics generally dump lubricating oil, gasoline and diesel. Three samples were collected at each site for microbiological and biochemical purposes.

The crude oil (Lagoma light) was collected from Chemical Refining Laboratory, NNPC, Kaduna.Refinery effluent was collected at a discharge point where the effluent runs off pavement freely in Kaduna Refinery, Nigeria. Gasoline and diesel were collected from a filling station whereas engine oil was collected from a lubricating shop, all in Nigeria.

B. Isolation and Identification of Microorganisms

One (1) g of soil from each sample was transferred into 9 ml of sterile distilled water, and aseptically, serial dilution as described by [9] was performed to obtain soil suspension up to 10^{-9}. 1ml of each dilution (10^{-1} -10^{-9}) was inoculated on potato dextrose agar medium using a duplicate method: spread plate method and pour plate method. The plates were incubated at 28^{0}C for 48 hours. Distinct colonies were selected to re inoculate into PDA slants for identification purpose. Pure culture of fungal isolateswere examined under the microscope. The microscope study of each colony was carried out by wet-mount method [9]. The somatic and reproductive structures were observed. The relationship of the hyphae, size and shape of the reproductive structures were also noted.

C. Selection of Crude Oil, Refinery Effluent and Other Petroleum Hydrocarbon (Diesel) Degraders

Sterile PDA plates were inoculated with 2mm of the mycelium of each of the isolated fungus and cultures were incubated for 4 days at 28^{0}C. Mycelial plugs measuring 5 mm in diameter were cut with a sterile cork borer from the margin of the fungal colonies on PDA and placed at the center of Modified Czapek (MSA) plates containing the crude oil at different concentrations [10]. About 18 - 20ml of the solid medium was poured unto sterile plates and dried at room temperature for 3 - 4 hours before the plates were coated with crude oil. Crude oil at concentrations of 0.1, 0.5, 1.0, 2.5 and 5.0% were used. Plates with MSA medium without incorporation of crude oil were served as controls. The plates were incubated at 28^{0}C and mycelium extension were recorded for seven days.

The same experiment was repeated for refinery effluent and diesel samples.

D. Determination of Optimum Cultural Conditions for the Biodegradation of Crude Oil, Refinery Effluent and Other Hydrocarbons by Strains B101F and B1002F.

From previous experiments, it has been shown that B101F and B1002F were best degraders compared to others with the optimum concentration of the hydrocarbons being 0.5%. So these were selected for further work. For the development of inoculum, each of the isolates was grown for 7 days in 50ml Potato Dextrose medium. After 7 days of fermentation, the cells were harvested and washed twice thoroughly with distilled water and then 30ml of sterile water was added to the cells to make a cell suspension. The optimum pH (initial) of fermentation medium was determined by carrying out the fermentation at different pH values (3.0, 5.0, 7.0 and 9.0) of the medium. For this purpose, 5ml of inoculum was added to 50ml of Modified Czapek Liquid Medium (MSLM) at different pH with 0.5% crude oil in each of the 250ml Erlenmeyer flasks. The flasks were incubated at 28^{0}C for 28 days and the dry cell weight (wt.) was determined at definite time intervals. For determination of dry wt., the cells were harvested and washed twice thoroughly with distilled water and then transferred to a constant weight aluminum cup, dried at 60 - 70^{0}C for 24 hours. For determination of optimum temperature, fermentation was carried out at 28°C and 37°C. Dry cell wt. was determined on different days of fermentation. Then the optimum incubation period was determined by carrying out the fermentation for 28 days using 0.5% crude oil incorporated in 50ml MSLM in 250ml Erlenmeyer flask and the dry wt. was determined at definite interval.

E. Effect of Complex Nutrients on Biodegradation of Crude Oil

The materials used were beans husk extract (BN) and rice (RN) and maize bran (MN) extracts. Twenty grams of each of the materials was suspended in 200ml hot water in a 500ml flask. The suspensions were kept at 90^{0}C for 24 hours. The hot extracts were filtered through Whatman no. 1 filter paper. The solid content (%) of rice, maize, corn and beans were determined to be 3.43, 4.12, 3.91 and 0.98 respectively [11, 12].

To first set, each of the complex nutrients at 0.1% level was added in the crude oil incorporated MSLM (omitting $NaNO_3$) as nitrogen source. To second set, only crude oil at 0.5% level was incorporated into $NaNO_3$ containing MSLM medium. In each case, 5ml inoculum was added for 50ml fermentation medium in 250ml Erlenmeyer flask. Dry cell wt. was calculated as described before.

Same thing was repeated with refinery effluent and diesel samples.

F. Utilization of Gasoline, Kerosene, Diesel, Engine Oil and Refinery Effluent

For refinery effluent, 0.5% of the hydrocarbon was incorporated into Minimal Salt Liquid Medium. 50ml of the medium was dispensed into 100 ml conical flask and inoculated with B101F. The experiment was also done using B1002F. For each isolate, the experiment was done in triplicate.

For other hydrocarbons, the same experiment was done while in case of refinery effluent, other hydrocarbons were used. Crude oil was used as control. All the flasks were incubated at 28 ± 1⁰C for 4 weeks. At the end of the incubation period, the cell mass of the fungal degraders were calculated and expressed as g/l.

III. RESULTS

A. Characteristics of Soil Samples

The values of pH of collected soil samples in three sites were in the ranges of 4.8 - 6.4 and the moisture content (%) of the samples were in the ranges of 8 - 14.

B. Isolation and Identification of Microorganisms

Ten isolates belonging to five different types of organisms namely *Penicillium sp.*, *Aspergillus sp.*, *Fusarium sp.*, *Trichoderma sp.* and *Mortierella sp.* were identified.

C. Selection of Crude oil Degraders

All the isolated fungi were capable of utilizing crude oil, refinery effluent and other hydrocarbons at 0.5% concentration but B101F and B1002F (Fig. 1, Fig. 2 and Fig. 3) were capable of utilizing the hydrocarbons more efficiently than the other isolates. So these two isolates were selected for further studies.
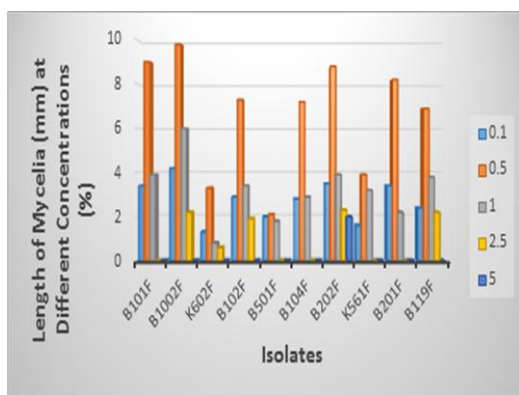
Fig. 1: Biodegradation of Crude Oil by the Isolates
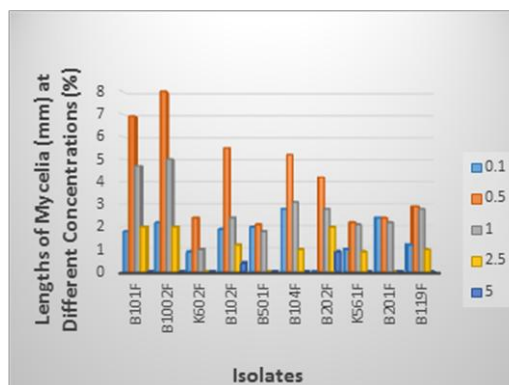
Fig. 2: Biodegradation of Refinery Effluent by the Isolates
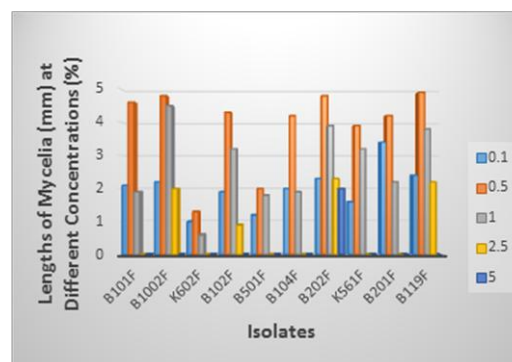
Fig. 3: Biodegradation of Diesel Oil by the Isolates

D. Determination of Optimum Cultural Conditions

The optimum pH and the optimum temperature for the degradation of crude oil by B101F and B1002F were 5.0 and 2.8⁰C (Fig. 4 and Fig. 5). The optimum incubation period was the 21st day of fermentation. The results are shown in Table 1.
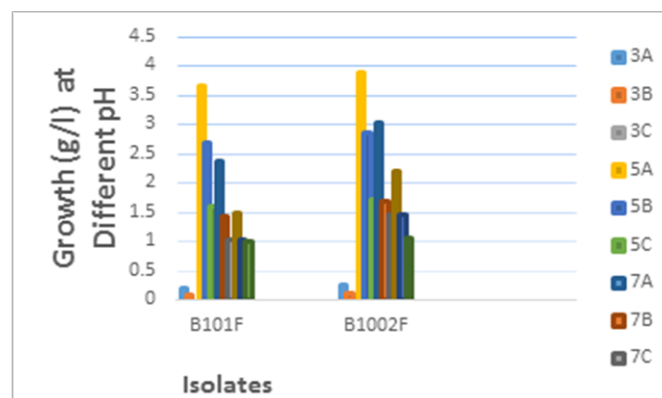
Fig. 4: Effect of pH and Temperature on Utilization of Crude Oil by B101F and B1002F (28ºC)
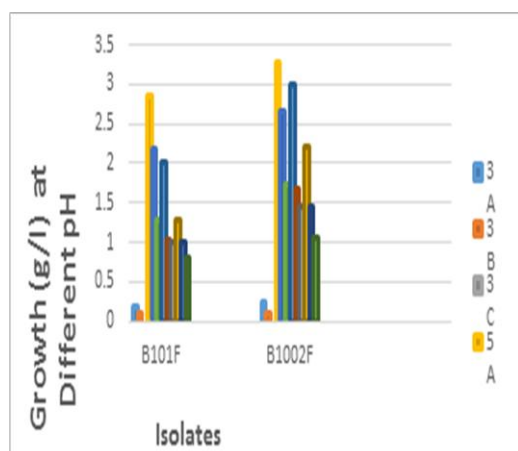
Fig. 5: Effect of pH and Temperature on Utilization of Crude Oil by B101F and B1002F (37⁰C)

TABLE 1: DETERMINATION OF OPTIMUM INCUBATION PERIOD

Dry Cell Wt. (g/l) at Different Days of Incubation	B1002F	B101F	CONTROL
7th			
A (Crude oil)	2.03	0.71	0.11
B(Refinery effluent)	1.19	0.89	0.14
C(Diesel)	0.80	0.60	0.14
14th			
A	3.87	1.49	0.20
B	1.49	1.32	0.16
C	1.20	1.02	0.15
21st			
A	4.17	2.28	0.19
B	1.49	1.49	0.22
C	1.02	1.02	0.20
28th			
A	4.18	2.33	0.19
B	1.75	1.48	0.18
C	1.24	1.30	0.19

E. Effect of Complex Nutrients on biodegradation of Crude oil

The results in Fig. 6 indicate that maize bran extract in crude oil incorporated MSLM gave the maximum growth on the 14th day of fermentation whereas in case of crude oil incorporated MSLM medium, the optimum growth was reached on the 21st day of fermentation. RN-rice bran extract incorporated inthe crude oil incorporated MSLM omitting NaNO₃; BN-beans husk in the crude oil incorporated MSLM omitting NaNO₃ as nitrogen source; MN-maize bran extract in the crude oil incorporated MSLM omitting NaNO₃ as nitrogen source.

F. Crude Oil as both Carbon and Nitrogen Source

Both the isolates can utilize crude oil at 0.5% concentration both as carbon and energy sources in MSLM medium without incorporation of NaNO₃, the conventional nitrogen source. The results are shown in Table 2.

G. Growth of *Penicillium sp.* (B101F) and *Aspergillus niger* (B1001F) on some petroleum hydrocarbons

The results are expressed in Figure 7.
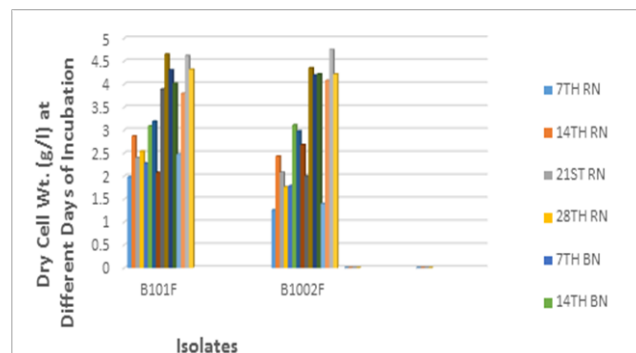
Fig. 6: Effect of Complex Nutrients on Biodegrading Capability of B101F and B1002F

TABLE 2: UTILIZATION OF CRUDE OIL AS BOTH CARBON AND NITROGEN SOURCE

Isolates	Crude oil	Dry Cell Wt. (g/l) at Different Days of Incubation			
		7th	14th	21st	28th
B101F	P⁻	2.20	3.81	4.64	4.40
	P⁺	2.44	3.61	4.60	4.33
B1002F	P⁻	1.44	3.99	4.25	4.68
	P⁺	1.36	4.00	4.45	4.32

P+ with NaNO₃, P⁻ without NaNO₃
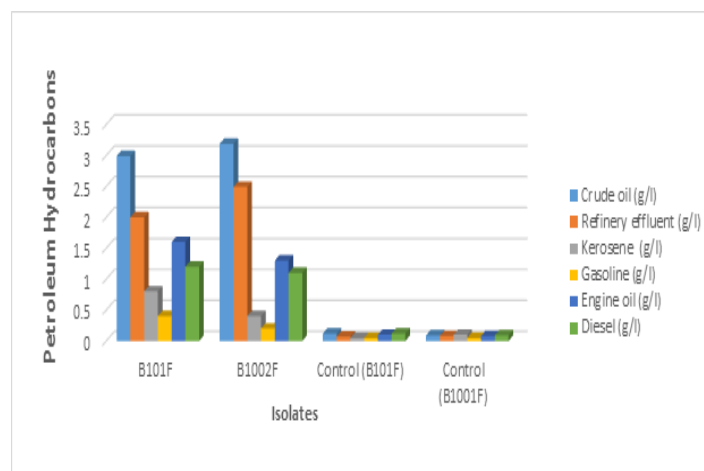
Fig. 7: Growth of Fungal Isolates on Some Petroleum Hydrocarbons

IV.   DISCUSSION

The soil samples were collected at a depth between 15 - 20cm because of the bactericidal effect of sunlight, and inadequate moisture due to evaporation on the surface. Here the fungi were isolated from petroleum contaminated soil to ensure that the organisms have a higher tolerance to the toxicity of hydrocarbons and are resistant to variations in the environment (Dibble and Bartha, 1979). Reference [8] examined the biodegrading capability of the crude oil by white rot fungus Polyporus sp. S133 collected from petroleum contaminated soil. The ability of Polyporus sp. S133 pre-grown on wood meal to degrade crude oil was measured. Maximal degradation (93%) was obtained when Polyporus sp. S133 was incubated in 1000 ppm of crude oil for 60 days, as compared to 19% degradation rate in 15000 ppm. Increased concentration of crude oil decreased the degradation rate. In this study, the optimum concentration of Lagoma light crude oil in MSLM for fungal degradation was 0.5%. This is in contrast to a report by [13] that stimulation of microbial activity is enhanced up to 5% level of hydrocarbon. The increase in concentration of crude PHC likely interfered with medium aeration, hence degradation could not occur because it is an oxidative process.

Also at higher concentration, the PHC could be toxic to the microorganisms. It agrees with the findings of [8] that increased concentration of crude oil decreased the degradation rate. Despite the differences in cell mass, the fungal isolates had same optimum period of incubation of 21 days. The fungal isolates utilized crude PHC at all pHs tested with maximum at pH 5.0. This supports earlier observations of [13] and Debbie and Bartha (1979) that fungi degrade oil most efficiently in acidic medium. At low temperatures, fungi degradative capability was arrested. Optimum growth was obtained at low temperature (28^0C) and higher above that oil degrading capabilities reduced. This is in line with acclaimed work Debbie and Bartha (1979) and [14] that best condition of temperature for maximal fungal activity is the mesophilic range. When complex nutrients were added as nitrogen source with crude oil in MSLM omitting $NaNO_3$, the growth of isolates were almost same as of crude petroleum used as carbon source. However, the optimum growth period was different. The effect of complex nutrients on the biodegradation of crude oil may be due to the presence of inorganic materials and organic nitrogenous substances in the complex nutrients. Crude petroleum could serve as both carbon and nitrogen source for these isolates. Lack of mineral elements as nitrogen, phosphorus and sulphur is said to be a limitation in PHC biodegradation [15, 16] but crude PHC contains small amounts of nitrogen, oxygen and sulphur containing components [17].

When a comparison was made between the degradation of petroleum and other petroleum hydrocarbons, it was observed that the PHCs were utilized as Crude oil > Refinery effluent >Engine oil > Diesel> Kerosene> Gasoline by both the isolates involved. This study investigated the ability of two fungi to utilize kerosene. Reference [7] studied the biodegradation of kerosene by *Aspergillusniger*and*Rhizopusstolinifer*. The highest percentage loss of kerosene concentration by the cultures of fungi was 93% by *A.niger* after 28 days of

biodegradation, but the loss of kerosene concentration in the culture of *R.stolinifer* reached 88% after 28 days. Both strains *A.niger* and *R.stolinifer* were capable of consuming kerosene as a sole carbon source. Reference [6] studied on biodegradation of diesel fuel hydrocarbons by mangrove fungi from Red Sea Coast of Saudi Arabia.Five fungal isolates namely *Alternariaalternata*, *Aspergillusterreus*, *Cladosporiumsphaerospermum*, *Eupenicilliumhirayamae* and *Paecilomycesvariotii* displayed rapid diesel degradation ability, and when used together as a consortium, there was a synergistic effect that enhanced the degradation process.

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Food Security and Technology Nexus in Nigeria: An ARDL Approach

Romanus Osabohien
Department of Economics & Development Studies,
Covenant University, Ota, Nigeria
Romanus.osabohien@stu.cu.edu.ng
Romik247@gmail.com

Ese Urhie
Department of Economics &Development Studies,
Covenant University, Ota, Nigeria
ese.urhie@covenantuniversity.edu.ng

Evans S. Osabuohien
Department of Economics &Development Studies,
Covenant University, Ota, Nigeria
Stephen.osabuohien@covennatuniversity.edu.ng
Pecos4eva@gmail.com

Abstract— **In this paper, we examined the level of technology, (quite low in developing countries, especially Nigeria) and how improved technological know-how can help in achieving food security. The indicators of food security utilised include: prevalence of food inadequacy, value of food production, among others. Regression analysis was engaged in investigating the important role of technology on food security using ARDL (Auto Regressive Distributed Lag). The results, among others, showed that in Nigeria, there is a long-term relationship between the indicators of food security and technology. In the event of distortion, the speed of adjustment from the short-run is rather low but significant. Some policy options to enhance the level of food security are documented in the study.**

Index Terms—Food security; Agricultural machinery; Institutional quality; Economic growth; cultivable land

I   INTRODUCTION

Saying that Nigeria is highly endowed with abundant resources is stating the obvious; hence, it is rather paradoxical that the country is one of the largest food importers in Africa [1]. Its abundance resources and continued economic growth notwithstanding, the issue of undernourishment is still prevalent in Nigeria and has, on the average, increased in recent times. Approximately, 70% of the Nigerian population lives on less than US$1.25 per day. In 2012 Global Hunger Index (GHI) ranking, Nigeria was the 40th out of 79 and 156thout of 187 on the 2011 Human Development Index (HDI) by United Nations Development Programme (UNDP) [2]. The agricultural sector is still an important sector of the Nigerian economy as it employs more 70% of the country's total labour force especially in the rural areas and contributes about two-fifth to the country's Gross Domestic Products(GDP)[3]. Nigeria, which is previously known to be one of the world's biggest producers of yam, cassava and other major food crops, is now said to be food-insecure relying on imported food to meet a number of her nutrient needs [2].

Most of farmers in rural areas of Nigeria engages in peasant agriculture, farms on a small scale and uses traditional implements, which make farming activities tedious and unattractive to the youth. The aftermath is low production, reduced supply of food. Other factors that are militating against food availability include: poor infrastructure and social approximately, there are 20million farmers in less than 20% of the country's total population. Households that have the financial wherewithal to evade extreme poverty seldom experience chronic hunger; while poor houses not only experience the most from unceasing hunger, but are also the section of the population most at risk during food deficiencies and famines.. The major crops like soya, cotton and maize that are currently grown and are intended to stabile food industries in a country. In Nigeria, there is little or no genetically modified (GM) research and development companies on staple food crops This deprive farmers from saving seeds to plant the following seasons.

Food security exists when people, at all times, have access to adequate, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life [5]. In recent times, environmental and economic concern has exacerbated the problem of food insecurity. A feasible result of global warming assumes that major parts of the African continent will   experience massive climatic change s and this will impose severe consequences for the African continent which have more than 75% of the people that depends on agriculture [6].Frequent changes of food prices alongside with the changes in climate will impose additional brunt on the improvement [7]. Food security goes beyond poverty issues; poverty issue; it can be broader seen and taken as it evolves the general food scheme and impacts on all individuals in some ways all: whether families have sufficient food.

Given the above background, this study, therefore, examines how technology can influence food security in Nigeria. The role of institutional framework can play in enhancing food security is also investigated. This is given the recent empirical observations on that most activities by economic agents can be predicated upon the nature of institutional framework that are operational in the said system [8]

[9]The study is structured into sections: following this introduction is brief review of literature and conceptual framework. Next to it is the formulation of the empirical

model used in the study; empirical results from emanating from the estimation techniques and discussion; and conclusion with some recommendations for policy and further research, in that order.

II BRIEF REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

Food security can be said to occur "*when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life*"[10]. [5].for a family, food security simply implies that all members of the family have access to sufficient food at any given point in time for healthy leaving[11].Global population by 2050 will be above 9 billion. Food demand will be driven by population explosion and changes in climate in the coming decades Technology options are many, but transparent evidence-based information has been inconclusive or scarce. In Africa, more than 35% of the total population are undernourished, which is the world's most prevalence 33% [12].

Recently, in SSA especially, Nigeria food insecurity has been on the increase which is a source of major concern to African governments Food and Agriculture Organisation estimates the total number of malnourished persons leaving in SSA countries increases from 165.5 million in 1990-1992 to 198.4 million in 1999- 2001 [5].

Institutions can be taken as the rule of the game or the regulators of the rule. In this study, the former conceptualisation is followed based on the fact that even the latter (the regulators) require the former (the rules) to effectively function [8]]. Thus, institutions are essential for the attainment of food security in any country –Nigeria inclusive. Institutions are government   policies and directives towards achieving a particular goal [13]. Stemming from above, government can undertake some policies such as the funding of agricultural policies like the Agricultural Guarantee Scheme Fund (AGSF), provision of agricultural equipment like tractors to the farmers and educating them on their uses. This will enhance food production and thereby reduce food insecurity in the Country. Example of such policy is the Operation Feed the Nation (OFN) during Obasanjo's regime.

A country that is food-sufficient is one where food is made as human right to enhance food access A country like Nigeria that is, it is widely believed that greatly endowed in resources, there is indeed a lot of food   and it is believed that the issue of hunger results not from shortage of food but mainly form from the misdistribution of food. Allocated according to dietary need, the lacto-vegetarian the supply of food supply alongside with the production reared animals will support up to 85% of the Nigeria's modern population. Researchers' finds that if poor nations and their citizens had enough purchasing power, more food can be produced: the country Nigeria has unutilised ability for the production of food. Without citizens purchasing power, food would not be available to the people except given

as aid. Thus, it is suggested that that for Nigeria that has a than doubled population, the availability of food just have to be increased more than two-fold to commensurate food requirements and expectation of improved diets of a food sufficient nation[12]

Household income can also influence food security. Put differently, household income can directly affect the level of food security [13].The Sustainable Development Goals (SDGs) which succeeds the Millennium Development Goals (MDGs) envisaged that by 2030 there would be enough food for all (food security). Food insecurity and hunger are forerunners to nutritional, health, human and economic development problems of any nation. [14].How far these goes can be realised will be unfolded in the process of time just as the MDGs were not adequately attained in Nigeria the dawn of the end period of December 2015. For instance, in Africa more than 75milion of its citizen have little or no access to food which is required to meet daily energy needs [15].

To better situate the key arguments in this study, Figure 2.1 presents the possible outcomes (options) that will be emanate from the combination of the level of tecnology and institutional quality, *ceteris paribus*. Taking it from the top right in Case I and going clockwise direction, it couldbe observed that high level of food security will be feasible when there is the deloyment of high level of technology coupled with stong institutional framework. This is the most desirable quadrant.

Figure 2.1 Typology of Food Security (Interaction of Technology & Institutions)

Source: Authors'
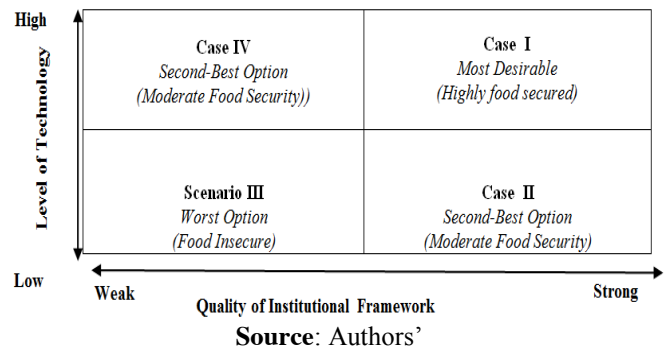
However, there could be some constraints ranging from resources (humn and material), among others, which will make a country to operate at Case II or Case IV. Both cases are somewhat similar as they involve using high technology or strong institutions depending on which one is cheaper based on their production possibility frontiers. The outcome of these two cases will be moderate level of food security. The last case, which is the least desirable, is the situation when there is low level of technology as well as weak institutional framework. The end of such combination is food insecurity.Though it is least food securitylevel, the occurrence

of both weak institutions and low technology will make country to be at that level inadventently.

III THEORITICAL FRAMEWORK

This study draws insight from Solow's tecnological change growth model which provides a useful framework for analysing the need of technony in the agricultural sector for production increase [16].Solow's theory relates to explanation of the determinant of growth in the production of outputs including those for the agricultural sector. In this study, we presume that the quantity of agricural output in an economy is a function of the amounts of technological inputs . In this wise, givendetailed data for an economy's sub-sectors, it will be possible to "explain" (model) the food security by the growth in quantities of food production[1]. Any residual is attributed to "technological change" that is, shift in the food production not due to technological inputs. Solow's result challenged households who thus had seen savings and capital accumulation as the main determinants of food security.

There are many factors that influence food food production, and thisnumber increase as the view is expanded from technological change to include equitable growth and wellbeing. Some of such factors are savings, technological change, innovation systems, human development, economic efficiency, infrastructural and services, governance and security [17].

[18] used multi-econometric method to assess food secuiryy is affected by technologyt impacts In thestudy, the author assessed the impact of trade liberalisation on the Nigerian food production . It wasfound that contrary of Linda's postulation that trade openness is advantageous but in Nigeria the reverse is the case. The study recommend that for the economy to take advantage of trade liberalisation, restriction should be placed on inported food,control of food prices and improve local food production.

[19] A research was conducted on the effects of climate change on Agricultural productivity in Nigeria; it was found that food productivity is crucial , given its effect t in changing livelihood patterns in the country. The finding confirmed that the rate in food productivity was higher from 1981 to1995, which was followed by lower tecnological rate between 1996 and 2000. Furthermore, there was variation in the trend or pattern of electricity supply.Variation in Electricity was revealed to have adverse effect while rainfall change have exerts a positive on food productivity. However, previous year rainfall was negatively significant in affecting current years in food productivity. In their study they found out that in Nigeria, agricultural productivity is critical, given its impact in changing feedingg patterns in the country.

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[1] Food production will affect food availability, which is an essential 'pillar 'of food security. Others (not covered in this study) include affordability and utilisation

IV. METHOD OF ANALYSIS

The methods of analysis engaged in the study involve three main approaches, namely descriptive and econometric techniques. The descriptive method was employed using tabular representations to show some indicators of food security and Technology in Nigeria. While the econometric analysis utilised econometric model that was fitted into data using the approach of Auto Regressive Distributed Lag (ARDL). Co-integration and Vector Error Correction (VEC) techniques were engaged with a view to estimating the long-run relationship between the indicators of food security and technology.

The Econometric Model

The model of the study assumed a functional relationship between indicators of food security and its possible determinants. It hinges on the theoretical underpinning of the Solow growth model, which has technical progress as basic explanatory variables that could explain production capacity of a country, especially in the agricultural sector. The model also allows the incorporation of other variables, in this case, indicator of technology. Other explanatory variable considered essential in the model are: electricity generation and distribution because it has been noted as a major driver for the processing of food [20].Other explanatory variables which were considered essential include: institutional framework (*instfram*) captured by the average value of two indicators (notably: civil liberty and political rights), growth rate of per capita gross domestic product (*pgdpgr*), land available for production (*Lucp*).

Generally, institutional framework can influence the level of food security as it has been said that the quality of a country's institution can determine the extent of growth in food production [21].Thus, food security can be related to the aforementioned explanatory variables, namely: technology, infrastructure captured by Electricity power distribution loss (as a percentage of total power output (EPDL), institutional framework.

The model can be simplified explicitly as:

$$Foodsec_t^K = f(\ tech^j, lucp, insfram, epdl, gdpgr)\text{- ----(1)}$$

Equation (1) can be represented in an econometric form as:

$$food\sec_t^K = \alpha_0 + \alpha_1 tech^j{}_t + \alpha_2 lucp_t + \alpha_3 insfram_t + \alpha_{4t}epdl_t + \alpha_5 gdpgr_t + e_t \ (2)$$

Where:

Foodsec[K:] Indicators of food security. This represents two equations: Average value of food production (*Avfp*) and prevalence of food inadequacy (*pfi*) as indicators to measure food security. Thus, K=1 and 2.

Tech: Technology usage in the agriculture is proxied by two indicators, namely: Agricultural Machinery and

tractors (*amt*) and agricultural machinery (tractors) per 100 square of arable land (*amtl*)

Lucp: land tenure system i. e, Availability of land under food crop production. Arable land helps to increase food production thereby increasing the availability of food [22]

Insfram: Institutional framework. It is measured by taking the average of the two measures of institutions in 2015 Freedom House dataset, namely: political rights and civil liberties. The choice of this source is based on the fact that it covers a long period of time (1978-2015). They measure a broad state of freedom in a country, which is vital for food security. They are reported on a ratio of 1 to7; a rating of 1 indicates the highest degree of freedom and 7 the least degree of freedom. Following the footsteps of [23], this study transformed the data in a way that higher values will mean better institutional quality and as a result the transformed values ranged from 1(worst) to 7 (best). This is to aid interpretation of results. Thus, an average value of 1.0 to 2.5 can be considered not free (weak institutional framework); 3.0 to 5.0, partly-free (moderate institutional framework); and 5.5 to 7.0, Free (strong institutional framework).

Epdl: Electricity power distribution and loss (% of total power output). Power outage affects the processing of agricultural outputs.

Gpdpgr: growth rate of per capita gross domestic product (pgdpgr).

e: Error terms that is expected to be iidN(0, σ2).

The apriori expectation is that $\alpha_i >, i =1, 2, 3$ $\&5>0$, while 4<0. Thus, increase in the explanatory variables (except epdl) is expected to enhance the rate of food security, *ceteris paribus*.

Estimation Techniques

To estimate the above formulated model, the study used time series data from 1990 to 2014 where there is availability of data for the variables. STATA software (version 13) was used in the estimation process. The estimation used logarithmic transform some of the variables because it brings the variables to a more comparable form and also helps to reduce issue of heteroscedasticity [10]

$$\Delta foodsec^K_t = \beta_0$$
$$+ \sum_{t=1}^{n} \beta_1 \Delta techj_{t-1} + \sum_{t=0}^{n} \beta_2 \Delta lucp_{t-1} + \sum_{t=0}^{n} \beta_3 insfram_{t-1} + \sum_{t=0}^{n} \beta_4 \Delta epdl_{t-1}$$
$$+ \sum_{t=0}^{n} \beta_5 \Delta pgdpgr_{t-1} + \gamma ECM_{t-1} + \varepsilon_t \quad (3)$$

Where:

Δ represents the difference operator and the i s the error correction term. γ shows the speed of adjustment from the short-run to the long-run.

To empirically analyse the dynamic interactions amongst the variables of interest, the model was estimated using ARDL technique. The ARDL can be performed without a consideration of the order of integration of the series. In addition, the ARDL can be carried out with small sample and, most importantly, it provides an unbiased long-run estimate and valid t-statistics that are applicable even when some of the regressors are endogenous, 2010). Thus, the ARDL representation is shown as:

$$\Delta foodsec^K_t = \beta_0 + \beta_1 tech^J_{t-1} + \beta_2 \Delta lucp_{t-1} + \beta_3 instframl_{t-} $$
$$---- (4)$$

In ARDL estimation, it is usually essential to ascertain whether the variables are co-integrated by restricting the coefficients of the lagged level variables to be equal to zero (0). Therefore, the null hypothesis (H_0) of no cointegration is stated as:

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ ------------------ (5)

Equation (5) can be tested against the alternative hypothesis of the presence of cointegration among the variables as:

H_1: $\beta_1 \neq \beta_2 \neq \beta3 \neq \beta4 \neq \beta5 \neq 0$ -------------- (6)

The above test can be carried out using F-statistics and asymptotic non-standard distribution variables to determine whether variables are 1(0) or 1(1). If the calculated F-statistics lies above the upper level, then the null hypothesis is not accepted [22].Cointegration was done prior to the estimation of the ECM by comparing the trace statistics and the maximum Eigen-values against the critical values at a given level of significance (1, 5 or 10%). If the former is greater than the latter, then the null hypothesis is rejected and there is evidence of a long-run relationship among the variables.

Variables that are not in rate and index are used in their logarithmic form to bring the variables to a more comparable form and also help to reduce issue of heteroscedasticity [9].

V. RESULTS AND DISCUSSION

Descriptive Analysis

This sub-section presents and discusses data used for analysis of the role of technology on food security in Nigeria. The indicators of food security that are discussed in this sub-section include: average value of food production and prevalence of food inadequacy. While the indicators of Technology are agricultural machineries tractors (AMT, AMTAL),insfram, electricity power distribution and loss(EPDL),growth rate of gross domestic product (GDPGR), Population(POP) ,and Institution framework(INStFRAM)) as obtained from World Development Indicators (WDI),Food and Agriculture Organisation (FAO) and Freedom House .

The results from descriptive analysis are reported Table 5.1.

Table 5.1 Summary Statistics of Variables (1990-2014)

Variables	Mean	Standard Deviation	Minimum	Maximum
Lavfp	5.3062	0.5822	5.1533	5.4161
Llucp	16.638	0.1627	15.9587	16.7813
Amatl	31.8567	6.8208	20.2357	48.5659
Lamt		0.1967	9.5396	10.1186
Pgdpgr	3.0543	6.4919	3.1185	30.34408
Aveinst	3.24	0.9478	1	4
Ecpdl	27.8666	13.3537	5.8654	43.8374

Source: Authors' Computation

Institutional framework in Nigeria in terms of political rights and civil liberties can be considered partly free/moderate .The implication of the above finding is strong institutional framework tend to help boost food security weak institution weaken food security. In terms of population, as population increases without a correspondence increase in food production leads to food insecurity because, more people tends to chase fewer food available.

Econometric Results
This sub-section reports and discusses the empirical results from econometric analyses, notably: cointegration and Vector Error Correction (VEC) technique [11]. The stationary pre-testing was not carried out given the fact that analysis with vector autoregressive (VAR) technique does not necessarily require stationary based on the fact that VAR models used variables in their differenced form [11].

From the results in Table 5.2, the null hypothesis is rejected at 5% level. The table equally reveals that there are at least three Cointegrating equations. This means that the variables are compatible in the long-run. In effect, when there is short-run disturbance there is tendency of the variables to return to equilibrium in the long-run. The implication of this is that institutional framework and electricity power supply are relevant in explaining the variations food security in the long-run. Given the finding that at least one Cointegrating equation exists, as shown in Table 5.2

Table 5.2: Cointegration Test

Max. Rank	EigenValue	Trace Statistics	Critical Value (5%)
0	-	163.4858	94.15
1	0.95647	91.3991	68.52
2	0.87708	43.1869	47.21
3	0.54856	24.8950	29.68
4	0.52212	9.9119	15.41
5	0.25957	0.9997	3.76

Source: Authors' Computation

Table 5.3 Cointegrating Equation

Lavfp	*Lamt*	*Llucp*	*Gdpgr*	*aveinst*	*Ecpdl*
Coef.	-0.2422*	0.4747*	-0.0063*	0.03088*	-0.0039*
(P-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Lavpf	*Llamtal*	*Llucp*	*Gdpgr*	*aveinst*	*Ecpdl*
Coef.	-0.0187*	3.28613*	-.01167*	0.117*	-.00885*
(P-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Pfi	*Lamt*	*Llucp*	*Gdpgr*	*Aveinst*	*Ecpdl*
Coef.	91.3890*	8.6793*	-0.8194*	-0.810*	0.6887*
(P-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Pfi	*Amtal*	*Llucp*	*Gdpgr*	*aveinst*	*Ecpdl*
Coef	-3.515*	317.472*	-0.4585*	25.932*	-0.2745*
(P-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Source: Authors' Computation
Note: *, **, ***Means significant at 1,5 and 10%,respectively. The Lag Selection was based on Akaike Information Criterion (AIC),Schwarz Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQIC).

From the cointegrating equations reported Table 5.3, it is obvious that the chosen explanatory variables are statistically significant in determining the role of technology in food security in Nigeria.

The overall statistics in Table 5.4 point to the fact the regressors are able to account for over 75% variations in food security. Thus, institutional framework together with electricity, machineries, arable land, population, per capita GDP growth rate jointly explains the rate of food security in Nigeria. The variables were significant at varying levels (1, 5 or 10%) and coefficients indicate the levels at which they account for rate of change in the indicators of food security.

Table 5.4: Estimates from VEC Technique

Regressand → / Regressors ↓	D_ Lavfp	D_ Lavfp	D_ pfi	D_ Pfi
ECterm	-0.40280*	-0.102*	-0.024**	0.0034**
	(0.000)	(0.000)	(0.052)	(0.043)
Lavfp(LD)	0.0074	-0.201	0.408	0.660*
	(0.750)	(0.412)	(0.155)	(0.000)
Lamt (LD)	0.3959***		-17.217	
	(0.093)		(0.144)	
Amatl(LD)		0.0009		0.0039
		(0.191)		(0.870)
Llucp(LD)	0.0182***	0.122	0.734	0.535
	(0.079)	(0.119)	(0.614)	(0.748)
Gdpgr(LD)	0.0017*	0.0008***	0.0199	0.080
	(0.002)	(0.054)	(0.389)	(0.935)
Aveinst (LD)	0. 0050**	0.0041	0.0666	0.1008
	(0.047)	(0.513)	(0.748)	(0.613)
Ecpd (LD)	-0.0015***	-0.0014**	-.0236	-0.0106
	(0.076)	(0.037)	(0.196)	(0.611)
Adj. R-sq	0.6557	0.4518	0.8491	0.8297
AIC	1.9213	14.7888	8.1172	21.8258
HQIC	2.5794	15.4469	8.7752	22.4839
SBIC	4.5380	17.4054	10.7338	24.4424

Sources: Author's computation
Notes *, **, ** means significant at 1,5 and 10%, respectively. LD signifies that they were lagged and differenced. The probability values are in parenthesis. Constants and a number of other statistics are not reported due to space.

Implications of Results
The result above revealed that agricultural machineries (tractors and tractors per 100 sq km of Arable Land), Power supply (Electricity) (% of output) and Land under Crop Production (hectares) exert a positive and significant influence on Average value of food production, except Institutional framework which exerts a negative influence. From their coefficients, it could be inferred that a proportionate increase

in Average Value of Food Production, Agricultural Machinery (tractors), Agricultural Machinery (tractors per 100 sq.km of Arable Land), Electric Power Transmission and Distribution (% of output) Land under Crop Production (hectares) will result to about 0.41 ,0.30, 0.08 and 0.84 proportionate increase respectively in food security. On the contrary, Institutional frameworks of the country were found to have a negative effect on food security in Nigeria, consequent upon their statistical significant inverse relationship. This implies that a proportionate decrease in Institutional frameworks of the country will bring about 0.2 decreases in the Country's level of food security.

VI.   CONCLUSION

This study, which was motivated by the expedition of making contribution to research efforts on food security has become a global change, the examined the influence of technology on food security in Nigeria using time-series data (1990-2014). The results from descriptive, statistical and econometric analyses confirms that institutional framework, technology are very essential in explaining the rate of food security in Nigeria. Several other findings were elucidated in the study.

It was noted that the availability of arable was one of the major factors to increase food production to counter the plague of food insecurity. This is very imperative for Nigeria given her abundant land space, which can be adequately cultivated for food production process through active productive means. Thus, the efforts of reducing the rate of food insecurity are essential in this regards. This can also be achieved, among others, by active interactions between government farmers, to make contribution to important planning issues that relate with food production in the country.

With regard to institutional framework, Nigeria is seen to be rated as the least corrupt country in Africa and third in the world, which was one of the reasons for her high living standard that made it comparable to that of Mexico and Turkey. This means that efforts in reducing corruption in Nigeria cannot be overemphasized in the country's quest for food allocation. The strengthening as well as restructuring of anti-corruption agencies especially Economic and Financial Crimes Commission (EFCC) and Independent Corrupt Practices and Other Related Commission (ICPC) is highly recommended in this drive to build our institutions.

An important finding from the long-run relationship was that electricity supply is very vital and highly elastic in impacting food security in Nigeria. Thus, it is recommended that there is the urgent need of improving electricity supply in Nigeria, which can be realised by ensuring a more sincere government commitment as well as private sector involvement. The issue of privatization that is currently contemplated may be needful; however, there should be a clear-cut standard on the extent of involvement, which will require a broad based consultation across the range of stakeholders.

Drawing an insight from Malthus population growth theory, Nigeria is known to be the most populated country in Africa with geometric population growth rate and arithmetic food production growth, as population increases without a commensurate increase in food production will lead to food insecurity. This is because more people tend to chase less food available. In view of this, Nigeria should increase food production to take care of the teeming population.

In summary, this study submits that there is need to improve institutional framework if Nigeria sincerely desires to experience rapid food security as institutions controls all other factors. This can be achieved through the instrumentality of the rule of law and effectiveness of the various agencies of the government to invest massively in agriculture either by subsidising farmers, providing seedlings at affordable rates, providing fertilizer to them, giving loans to the farmers without interest and educating them. Investment should be made on agriculture research to diverse means of modern farming process. This is necessary as strong institutional framework in the country will help in promoting business and economic activities that are relevant components of any meaningful economic transformation. Therefore, the study calls the attention of the managers of the Nigerian food Security Society (NFSS) and those that believe in the Nigerian project to realize that the issue of fiscal indiscipline that manifest in delayed passage of budget, rising budget deficit and excessive public borrowing, and so on, can mainly be addressed through strong institutional mechanism.

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Effect of Birth Spacing on Under-five Mortality in Nigeria: A Proximate Determinant Approach

(Birth Spacing and Under-five Mortality)

Oni Gbolahan A., Samuel Gbemisola W.

Dept. of Economics & Dev. Studies,

Covenant University,

Ota Ogun State, Nigeria.

Email: gbolahan.oni@covenantuniversity.edu.ng gbemisola.samuel@covenantuniversity.edu.ng

Abstract - Many of the studies by social scientists had established the relationship between socioeconomic factors and under-five mortality in developing countries, while researchers in the medical sciences had also established the effects of maternal/biological factors on under-five mortality and found significant relationships for many of such factors. Whereas socioeconomic factors exert indirect effects on under-five mortality, the maternal and biological factors exert more direct effects on under-five mortality. But only few studies have tried to examine how the socioeconomic factors could operate through the more direct factors to influence under-five mortality. Among one of such direct factors is spacing of births. Birth spacing (or interval) is an important predictor of child survival. A short interval between births has a negative impact on child survival. This is because, mothers that waited for about 2 years or more before having the next baby would have regained most body nutrients and blood loss during previous pregnancy and breast feeding. The primary objective of this study is to determine the extent to which birth spacing mediate between socioeconomic factors and under-five mortality in Nigeria. The Nigeria Demographic and Health Survey dataset (NDHS), 2013 was used in this study.Univariate, Bivariate and Multivariate statistical analyses were employed. The bivariate analysis examines the effect of individual background variable, and the proximate variable (i.e., unadjusted effect) on the outcome variable. The multivariate analysis examines the independent effects of the background variables on child death. Multivariate Analysis utilizes the "Binary Logistic Regression" technique. Result of the logistic regression showed that, the model without the proximate variable (i.e. Birth Spacing) had a Likelihood Ratio of 18879.80 on 11 degrees of freedom, while the model with the proximate variable had the Likelihood Ratio of 18348.32 on 14 degrees of freedom. The difference between the two models was 531.48 with a P-value of 0.0000. This is very highly significant, implying highly significant proximate determinants of under-five mortality for those underlying variables in the study. In conclusion, our findings showed that birth-spacing is indeed a very significant proximate variable through which socioeconomic variables such as mothers' education, age, place of residence, and wealth status influence child mortality. We must however add that birth-spacing could not have been the only proximate variable through which these socioeconomic variables influence child mortality. This is evident from the fact that these variables still maintained significant association with child mortality even in the presence of child-spacing in the model. Other biological, environmental and behavioral factors not included in the model could also have been significant proximate determinants through which the socioeconomic variables influence child mortality. However, from the findings of this study, it is obvious that any policy that can influence mothers to limit the frequency of births through appropriate spacing of births (say for 3 years) will help to minimize under-five mortality in Nigeria.

Key words- Socioeconomic; Proximate determinant; Under-five Mortality; Birth-spacing; Nigeria

I. Introduction

Globally, under-five mortality rate was reported to have declined by 49 percent between 1990 and 2013 (UNICEF, 2014). The decline reported was quite low in developing countries, particularly in South Asia and sub-Saharan African countries, even though, most of the diseases that kill children at the early stage of life are known to be preventable(United States Agency for International Development [USAID], 2014; UNICEF, 2014). Several studies carried out mostly by social scientists had observed the significant relationship between socioeconomic, demographic and cultural factors (i.e.

background or underlying factors) on childhood mortality (i.e., under-five mortality). Many of such studies had only assumed the direct effects of the background factors on under-five mortality ((Feyisetan, 1988; Ogunjuyigbe, 2004; Fayehun and Omololu, 2009; Uddin, Hossain and Mondal, 2009; Mondal, Hossain, & Ali, 2009); Antai, 2010; 2011) Similarly, many scientists especially in the medical or health sciences had examined the effects of biological and environmental factors on under-five mortality and found significant relationships for many of such factors (Adeyemi, et al, 2008; Bowembo, 2010; Bello and Joseph, 2014). Whereas the underlying factors exert indirect effects on under-five mortality, the biological and environmental factors exert more direct effects on under-five mortality. Only a few studies have tried to examine how the underlying factors could operate through the more direct factors (also referred to as proximate determinants) to influence child mortality. Mosley and Chen (1984) had developed a framework for doing this. . This study examines the extent to which a major proximate factor (i.e., birth spacing), mediate between socioeconomic factors and under-five mortality in Nigeria.

II. LITERATURE REVIEW

Socio-economic factors are known to have indirect effects on under-five mortality. That is, they operate through other factors called the proximate or intervening determinants to influence mortality. Some of these socioeconomic factors include: maternal education, place of residence, wealth status, religion etc. Maternal education has been referred to as one major social determinant of under-five mortality and was reported to vary at different levels of mother's education. Though, other socio-economic factors influences under-five mortality, but the effect of maternal education had been proven stronger than them. (Caldwell, 1979). Research has shown that higher levels of education are associated with specific types of health knowledge, including awareness of the dangers of not boiling water, the importance of hand washing after latrine use, the proper use of oral rehydration therapy totreat diarrhea, and an understanding of contaminants as causes of diseases (Frost et al, 2004).

Similarly, there is also a strong association between maternal age and child survival. Although, this association is intermediate by other factors such as sanitation, immunization, breastfeeding and previous child deaths (Hobcraft et al, 1985; Machado and Hill, 2005; Kayode et al, 2012). Further, some characteristics present in the neighborhood where children are raised might likely influence the mortality risks of such children (Antai, 2011; Adedini, 2013). For example, children raised in economically and socially deprived communities might be more exposed to the risk of under-five mortality compared to those in developed communities (Adedini, 2013). Poverty makes children from less privilege households vulnerable to inadequate water, poor sanitation, air pollution, undernourishment, etc., which are some of the risks of mortality unlike those who were born to better off families. As a result of this exposure, they suffer diverse diseases

(Adepoju, Akanni and Falusi, 2012; Policy project/Nigeria, 2002; UNICEF, 2010).

While studies have dwell more on linking socioeconomic factors with proximate determinants such as type of cooking fuel, toilet facility, type of drinking water, etc., not so many have been able to disentangle how socioeconomic factors operate through birth spacing to influence under-five mortality in Nigeria. Short birth interval have a strong relationship on child survival as this lead to early weaning of a child, "maternal depletion syndrome," which drains the mother's strength and can result in poor birth outcomes (low birth weight and prematurity) and poorer nutrition for children; and a variety of socioeconomic pressures resulting from the additional drain on household resources (Rafalimanana and Westoff, 2001).

Birth interval have been reported as another key determinants of childhood mortality and it influencesmortality through breastfeeding, survival status of preceding child, multiple pregnancy etc., (Kayode et al, 2012). Birth spacing of at least 36 months helps to reduce deaths of children. In Nigeria, the median birth interval is 31.7 months. About 213 deaths per 1,000 live births occurred among young ones born before two years after the previous births compared with 103 deaths per 1,000 live births that occur among those born three years after the previous birth (National Population Commission [Nigeria] and ICF International, 2014). Therefore, this study seeks to examine how socioeconomic factors operate through birth spacing to influence under-five mortality in Nigeria.

III. MATERIALS AND METHODS

The data used are from the Nigeria Demographic and Health Survey (NDHS) which was conducted in 2013. It was a national representative sample of 38,948 women out which 20,192 had at least one birth during the previous five years of the survey. The child recode data file was used. The number of children born by each woman during the previous five years was used as a "proxy" for her birth-spacing. A woman who delivered two children within a period of five years must have had a shorter inter-birth interval than a woman who delivered just one child during the same period. Similarly, a woman who had 3 children must have had a shorter birth interval than a woman who had 2 children during the same five year period, and so on. Each woman reported any loss of a child during the period. The socioeconomic variables considered included mother's education, age, religion, place of residence and wealth status. Bivariate and multivariate logistic regression analyses were carried out to determine significant relationships.Two multivariate logistic regression models were fitted. The first examined the indirect effects of the background (socioeconomic) variables on under-five mortality. The second model added birth-spacing variable to the background variables in order to examine importance of the former as a proximate variable (determinant) through which the socioeconomic variables influence under-five mortality. The significance of birth spacing as a proximate determinant of under-five mortality is measured by the

difference in the Log Likelihood Ratios of the two models (Kleinbaum and Klein, 2002).

IV. BINARY LOGISTIC REGRESSION

This model is typically used when predicting an event which has two possible outcomes, for instance, 'Pass vs. Fail', 'Alive vs. Dead'. The predictor (independent) variables can be either categorical or continuous, or a mix of both in the model. All predictor variables can be tested to assess their predictive ability, while controlling for the effects of other predictors in the model. The binary logistic model was used in this study in order to examine and predict the likelihood or probability of a child dying before reaching the age of five years in Nigeria. The regression model enabled the estimation of risk of death relative to the various underlying or proximatecharacteristics of interest. In the model, the outcome variable was dichotomized to take the value of "1" if the event occurs (i.e., death of a child), and "0" if the event does not occur (i.e., child survives). Since the probability of occurrence or non-occurrence of an event cannot be less than 0 or greater than 1, the event probability distribution is restricted between 0 and 1.

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n {}^{+\mu} \quad \dots (1)$$

MOSLEY AND CHEN FRAME-WORK

This model was designed purposely to develop a new analytical framework to study the determinants of under-five survival in developing countries[16]. The framework was built on the premise that all social and economic determinants of child mortality necessarily operate through biological mechanisms or proximate determinants that eventually influences childhood mortality. The framework was designed so as to increase research on social policy and medical interventions that will help to improve understanding of factors affecting child survival. In this study, the analytical relationships between the underlying, proximate (or intervening) and the outcome variables can be defined thus:
If a background variable X is known to have a relationship (association) with an outcome variable Z, in order for a variable Y to be called an intervening (proximate) variable for the effect of X on Z, two conditions must be satisfied:

$$X \rightarrow (Y) \rightarrow Z$$

Where, X represent the underlying factors
Y represent the proximate determinants and
Z represent the outcome variable (under-five mortality)

First, variable X must have a relationship (association) with variable Y and second, variable Y must be associated with variable Z. If either or both of these two conditions are not met, variable Y cannot qualify as a proximate (or intervening) determinant when trying to explain how X affects Z. However, it must be noted here that Y may not be the only proximate variable through which X affects Z. That is, X may have multiple proximate variables through which it is affecting Z.

V. FINDINGS

Results of the bivariate analysis to assess the significant unadjusted effects of the socioeconomic variables with under-five mortality showed that all the variables are significantly associated with under-five mortality (P = 0.000). Child mortality was highest for mothers who were under 20 years old (11.9% child deaths) and for mothers 40 years and above (11.2% child deaths). Under-five mortality was lowest for mothers who were 20-29 years old (8.7% child deaths) and 30-39 years old (8.8% child deaths). Under-five mortality declines with mothers' education, being highest among illiterate mothers and lowest among mothers with post-secondary education (11.2% and 4.5% child deaths respectively). Similarly, under-five mortality declines with increase in wealth status, higher among rural mothers than urban mothers and Christians enjoyed lower child mortality than Muslims and other religions. The proximate determinant selected for this study was births in the last five years. The result show that there is a high significant relationship between the variable and under-five mortality (p-value =0.000).

Table 1: Bivariate Relationship between Under-five Mortality and all variables

	Any Child Died?			
Variables	**Yes**	**No**	**χ²**	**P-value**
Socioeconomic Factors				
Mother's Age				
Below 20 years	182(11.9%)	1349 (88.1%)	34.60***	0.000
20-29 years	1296 (8.7%)	13549 (91.3%)		
30 -39 years	1045 (8.8%)	10814 (91.2%)		
40+ years	363 (11.2%)	2884 (88.8%)		
Wealth Status				
Poor	1722 (11.9%)	12740 (88.1%)	257.36***	0.000
Middle	502 (8.0%)	5770 (92.0%)		
Rich	662 (6.2%)	10086 (93.8%)		
Religion				
Christianity	957 (7.6%)	11697 (92.4%)	66.47***	0.000
Islam	1887 (10.3%)	16467 (89.7%)		
Others	30 (9.6%)	284 (90.4 %)		
Place of Residence				
Urban	666 (6.4%)	9685 (93.6%)	138.33***	0.000
Rural	2220 (10.5%)	18911 (89.5%)		
Mother's Education				
No education	1657 (11.2%)	13105 (88.8%)	195.42***	0.000
Primary	596 (9.3%)	5836 (90.7%)		
Secondary	547 (6.5%)	7818 (93.5 %)		
Higher	86 (4.5%)	1837 (95.5%)		
Proximate Determinants				
Birth in five years				
1 Child	615 (5.9%)	9820 (94.1%)	641.21***	0.000
2 Children	1482 (8.9%)	15156 (91.1%)		
3 Children	674 (16.6%)	3385 (83.4%)		
4 Children	115 (32.9%)	235 (67.1%)		

Source: Authors' Computation, 2015
Where: Chi-Square is represented by χ²
level of significance was ***0.001, **0.01 and *0.05

Table 2, shows the bivariate relationship between the socioeconomic factors and the proximate determinants. The result shows that there is a significant relationship between

birth in the last five years and the selected socioeconomic factors in this study. About 67 percent of mothers who are below the age of 20 years reported only one birth in the past years before the survey, while approximately 29.0 and 29.5 percent of women aged 20-29 and 30-39 reported at least one birth within the five year period respectively. The result showed that that the older a woman the higher the number of children reported within the five year-period.

Further, 55 percent of the poor women reported 2 births compared with about 48.9 percent reported by the rich. It can be concluded that the rich reported fewer number of children within the five year-period compared to any other group. Also, there is a highly significant relationship between wealth status and number of births within the five years- period before the survey (P-value= 0.000). Muslim women reported more number of births than any other religious group in this study. Hence, religion is significantly related to birth spacing (p-value = 0.000). Finally, mothers who resided in rural areas and those who have below secondary education reported higher number of births than their counterparts who resides in the urban centers or who have secondary and higher education respectively.

Table 2: Bivariate Relationship between the Proximate Determinant and all the Socioeconomic Variables

Variables	Births in Past five years				χ^2	P-value
	1 Child	2 Children	3 Children	4+Children		
Mother's Age						
Below 20 years	1030 (67.3%)	430 (28.1%)	63 (4.1%)	8 (0.5%)	1387.14	0.000
20-29 years	4307 (29.0%)	8294 (55.9%)	2088 (14.1%)	156 (1.1%)		
30-39 years	3503 (29.5%)	6556 (55.3%)	1647 (13.9%)	153 (1.3%)		
40+ years	1595 (49.1%)	1358 (41.8%)	261 (8.0%)	33 (1.0%)		
Wealth Status						
Poor	4254 (29.4%)	8048 (55.6%)	1986 (13.7%)	174 (1.2%)	212.98	0.000
Middle	2145 (34.2%)	3336 (53.2%)	705 (11.2%)	86 (1.4%)		
Rich	4036 (37.6%)	5254 (48.9%)	1368 (12.7%)	90 (0.8%)		
Religion						
Christianity	4693 (37.1%)	6112 (48.3%)	1704 (13.5%)	145 (1.1%)	206.25	0.000
Islam	5578 (30.4%)	10284 (56.0%)	2295 (12.5%)	197 (1.1%)		
Others	127 (40.4%)	146 (46.5%)	33 (10.5%)	8 (2.5%)		
Place of Residence						
Urban	3736 (36.1%)	5164 (49.9%)	1320 (12.8%)	131 (1.3%)	69.50	0.000
Rural	6699 (31.7%)	11474 (54.3%)	2739 (13.0%)	219 (1.0%)		
Mother's Education						
No education	4321 (29.3%)	8306 (56.3%)	1971 (13.4%)	164 (1.1%)	300.14	0.000
Primary	2118 (32.9%)	3392 (52.7%)	834 (13.0%)	88 (1.4%)		
Secondary	3170 (37.9%)	4032 (48.2%)	1065 (12.7%)	98 (1.2%)		
Higher	826 (43.0%)	908 (47.2%)	189 (9.8%)	0 (0.0%)		

Source: Authors' Computation, 2015

Table 3,shows the results of the logistic regression testing for the significant independent (i.e., adjusted) indirect effects of the socioeconomic variables on under-five mortality. Again, all the variables indicated significant independent effects on under-five mortality except religion. The relative risk (or odd ratio) of child death for rural mothers was about 21.3% higher than for urban mothers (OR = 1.23; P= 0.001). Mothers who had no education were about 70% more likely to have had a child death than mothers who had post-secondary education (OR = 1.79; P= 0.000). The higher the level of education of a mother, the less likely that she would suffer a child death. Also, the higher the wealth status of a woman, the less likely that she would suffer a child death. A poor woman was about 50% more likely to have lost a child than a rich woman (OR = 1.50; P = 0.000).Finally, mothers who were 20-29 and 30-39 years old were respectively, about 20% and 16% less likely to have lost a child compared to mothers whowere less than 20 years old (OR = 0.80 and o.84 respectively, P < 0.05). For mothers who were 40 years and older, under –five mortality was the same as for mothers under 20 years of age (OR = 1.01, P=0.95). The Log Likelihood Ratio (LLR) for this

model is 18879.80, Chi-square = 325.80 on 11 degrees of freedom, P=0.000. This indicates a very good fit.

Table 3: Effects of Socioeconomic Determinants on Under-five Mortality

Variables	Odds Ratio	P-value	[95% Confidence Interval]	
Place of Residence				
Urban	**RC**			
Rural	1.213	0.001	1.087	1.354
Mother's Education				
No education	1.698	0.000	1.316	2.191
Primary	1.641	0.000	1.284	2.097
Secondary	1.330	0.018	1.050	1.686
Higher	**RC**			
Mother's Age				
Below 20 years	**RC**			
20-29 years	0.800	0.009	0.677	0.946
30 -39 years	0.839	0.043	0.707	0.995
40+ years	1.006	0.949	0.830	1.220
Wealth Status				
Poor	1.501	0.000	1.315	1.713
Middle	1.077	0.279	0.941	1.233
Rich	**RC**			
Religion				
Christianity	**RC**			
Islam	1.018	0.739	0.917	1.130
Others	0.881	0.522	0.108	0.168
Constant	0.135	0.000	0.108	0.168
-2 Log likelihood = 18879.80	Chi-square = 325.80; df. = 11; P-value= 0.000			

RC – Reference Category, it has the odds ratio of 1

Table 4, shows the results when birth-spacing variable was added to the socioeconomic variables. All the four socioeconomic variables still maintained their significant indirect association with under-five mortality. Also, the birth spacing variable shows a highly significant direct effect on child mortality. The higher the number of children a woman delivers during the previous 5 years, the higher the likelihood that she would suffer a child death. Women who had 4 or more children delivered during the five year period had about eight times the risk of child death compared to women who had just one child during the five years (OR = 8.2; P= 0.000). The LLR for this model was 18348.3, Chi-square= 857.3 on 14 degrees of freedom, P= 0.000). This indicates a verygood fit. The significance of birth-spacing as a major proximate variable through which the socioeconomic variables operate to influence child mortality is determined by the difference in the LLR between the first model andsecond model. This difference is 531. This is also the difference betweenthe Chi-square values of the two models. The difference is a Chi-square distribution on 3 degrees of freedom (i.e., the number of extra parameters contributed to the second model by the

birth-spacing variable). Hence Chi-square = 531 on 3 degrees of freedom; P = 0.000.

Table 4: Effects of Socioeconomic and Proximate Determinants on Under-five Mortality

Variables	Odds Ratio	P-value	[95% Confidence Interval]	
Place of Residence				
Urban	**RC**			
Rural	1.245	0.000	1.115	1.391
Mother's Education				
No education	1.493	0.002	1.155	1.930
Primary	1.446	0.003	1.130	1.852
Secondary	1.215	0.110	0.957	1.542
Higher	**RC**			
Mother's Age				
Below 20 years	**RC**			
20-29 years	0.595	0.000	0.501	0.708
30 -39 years	0.621	0.000	0.520	0. 741
40+ years	0.869	0.158	0.714	1.056
Wealth Status				
Poor	1.441	0.000	1.260	1.648
Middle	1.073	0.313	0.936	1.229
Rich	**RC**			
Religion				
Christianity	**RC**			
Islam	1.034	0.533	0.931	1.149
Others	0.892	0.572	0.601	1. 325
Birth in five years				
1 Child	**RC**			
2 Children	1.596	0.000	1.442	1.765
3 Children	3.330	0.000	2.952	3.756
4+ Children	8.151	0.000	6.397	10.385
Constant	0.100	0.000	0.080	0.126
-2 Log likelihood = 18348.32	Chi-square = 857.28; df= 14; P-value =0.000			

RC – Reference Category, it has the odds ratio of 1

VI.   DISCUSSIONS AND RECOMMENDATIONS
A number of research studies have been done to determine the relationship between birth-spacing and child survival and most studies have found that short inter-birth interval is detrimental to the survival of a child. Many studies have recommended a waiting period of at least 2-3 years between births. However, the United States Agency for International Development (USAID) have suggested that longer period of 3-5 years might be more advantageous. In this study, we have used the number of children born by a woman within the period of five years as a proxy for birth spacing. We used it as a proximate determinant through which socioeconomic variables operate to

influence under-five mortality. Our findings showed that birth-spacing is indeed a very significant proximate variable through which socioeconomic variables such as mothers' education, age, place of residence, and wealth status influence child mortality. We must however add that birth-spacing could not have been the only proximate variable through which these socioeconomic variables influence child mortality. This is evident from the fact that these variables still maintained significant association with child mortality even in the presence of child-spacing in the model. Other biological, environmental and behavioral factors not included in the model could also have been significant proximate determinants through which the socioeconomic variables influence child mortality. However, from the findings of this study, it is obvious that any policy that can influence mothers to limit the frequency of births through appropriate spacing of births (say for 3 years) will help to minimize under-five mortality in Nigeria.

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Changing Levels and Patterns of Under-five Mortality: Empirical Evidence from Nigeria Demographic and Health Survey

(Changing Levels and Under-five Mortality)

Gbemisola W. SAMUEL, Gbolahan A. ONI

Dept. of Econs & Dev. Studies

Covenant University

Ota, Nigeria

Email: gbemisola.samuel@covenantuniversity.edu.ng; gbolahan.oni@covenantuniversity.edu.ng

Abstract - This study examined the levels and patterns of under-five mortality in Nigeria within 2003-2013 using the Nigeria Demographic and Health Survey datasets for this periods. In the study the mortality trends was related to some socioeconomic and health variables to explain factors that could have contributed to mortality changes. The descriptive approach through the use of tables and charts was adopted in the analysis. Results show that under-five mortality rate had declined from 187 in 2003 to 128 in 2013 (i.e., a decline of 32 percent). Under-five mortality declined with increase in mothers' education especially among mothers with less than secondary education. During the ten-year period, children who had DPT3 increased from 10.4 percent to 22 percent. Households who drank water from safer sources increased from 14.4 percent to 49.7 percent for urban areas and 2.3 percent to 32.7 percent in rural areas. Childhood diarrhea incidence declined by 45.2 percent. The study concluded that decline in under-five mortality may be attributed to improved immunization, safer water sources, and reduced incidence of childhood diarrhea. This study, therefore, recommended that both the national and state governments of Nigeria should intensify efforts to increase childhood immunization coverage, provide more communities and households with safe drinkable water in order to drastically reduce diarrhea diseases – a major cause of deaths in children. This will help to accelerate the decline in under-five mortality rate in the country.

Key Words- Under-five mortality; Trend; Immunization; Drinking water; Diarrhea; Nigeria

I.   INTRODUCTION

Globally, under-five mortality rate was reported to have declined from 90 in 1990 to 48 in 2012 (United Nations Children's Fund, 2013). In Africa under-five mortality varies, ranging from one-quarter to one-third of children dying before reaching the age of five. Further, within the under-five age group, there are specific periods of increased vulnerability. For example, more than half of under-five deaths can be attributed to deaths that occur at the first year of life, especially within the first 24 hours (Marx et.al, 2005).

About 8.8 million children were reported dead in 2010 despite the global intervention to improve child survival (Black et.al,

2010). UNICEF in conjunction with other international organizations and national governments launched the Child Survival Revolution in 1982, which brought about the development of four intervention strategies of growth monitoring, oral rehydration, breastfeeding and immunizations majorly to improve on the level of child survival globally (Victoria and Barros, 2005). The major killer diseases of under-five children in the world are four, namely; pneumonia, diarrhoeal, preterm birth complications and birth asphyxia (UNICEF, 2011).

Some of the countries in sub-Saharan Africa that had made substantial progress in reducing under-five mortality were those that have invested in the public health care services to those at the grass root and designed nutrition interventions, such as vaccination, breastfeeding, vitamin A supplementation, and safe drinking water. Although, report showed that coverage of low-cost curative interventions against pneumonia, diarrhoea, and malaria, which together cause over half the under-5 deaths in the region was generally low and this needs to be expanded (Policy Project, 2002). Child survival rate in a country shows the level of well-being in that nation. High rate of under-five deaths indicates that level of socio-economic development in such country is very low and vice-versa. This establish the findings of Mondal, Hossain and Ali (2009), that mother's education, father's occupation and the family's economic condition have strong impact on infant and child mortality. Therefore, the aim of this study was to examine the levels and trends of under-five mortality in Nigeria and identify factors that might have contributed to the movement using the Nigeria Demographic and Health Survey Data from 2003 - 2013.

II.   LITERATURE REVIEW

Studies have shown that under-five children in Nigeria still die as a result of preventable diseases, which had made the country one of the unsuccessful African countries that could not make tangible improvements in child survival over the years (WHO, 2012; Olumide & Odubanjo, 2009; Policy project/ Nigeria, 2002). An infant born in Nigeria was reported to be at higher risk of dying (30 times more likely to die) before the fifth birthday, when compared to an infant born in a developed country (Policy project/Nigeria, 2002). Although, considering the mortality trends in Nigeria since 1960, it can

be deduced that under-five deaths are falling, but the figures are relatively small compared to the MDG target of a two-thirds reduction in 2015 (Ojewunmi & Ojewunmi, 2012; Fayehun & Omololu, 2010).

According to Fayehun and Omololu (2009), child mortality in Nigeria has majorly been influenced by ethnics' disparities and these disparities are in form of mothers' education, birth order, age of mother, place of residence and wealth index. Furthermore, Ogunjuyigbe (2004) reported that beliefs and behavioural practices played a significant role in determining child mortality. The study further shows that mothers do not have clear perception of illness and treatment, while some linked deaths of under-five to cultural beliefs.

DETERMINANTS OF UNDER-FIVE MORTALITY IN NIGERIA

Mother's Educational Attainment

Studies have shown that there is a close relationship between mothers' educational attainment and lower mortality rates (Ojewunmi & Ojewunmi, 2012; Fayehun & Omololu, 2010; Uddin, Hossain and Ullah, 2009; Olumide & Odubanjo, 2009). This was further established through the findings in the NDHS Report (2008), mothers who had little or no education had under-five mortality rate of 209 compared to under-five mortality rate of mothers who had more than secondary education which was 68. The more educated a mother is, the more her chances of ensuring a healthy environment, nutritious food and proper health care for her child (Pandey, 2009; Uddin et.al, 2009; Frost et al, 2004).

Poverty

Children from poorer or rural households were reported to be more vulnerable those children who were from richer or households in the urbanized regions (UNICEF, 2010). A child born to a financially deprived and less educated family is at risk of dying perinatally or within the first month of life, since the mother was probably poorly nourished during pregnancy. Further, because of her poverty state which may not be to afford the cost for antenatal care or utilize the health facility for delivery of her child. Even though, the child is able to escape death in the first month, the child is then exposed to childhood illnesses, such as malaria and diarrhoea, due to poor living conditions, limited access to safe water and inadequate sanitation, malnutrition from household food insecurity, or ignorance about good child feeding practices. There is high level of competition for available resources when the family is large; due to this, members of the family are inadequately catered for, including the very young ones. All these factors are further aggravated by limited access to health services due to poor income and low levels of maternal education, often leading to the non-immunization of the child (Policy project/Nigeria, 2002).

Access to Safe Water and Good Sanitation

According to World Bank (2001), one-fifth of the total burden of disease in low income countries can be associated with environmental risk. WHO (2002), reported that among the 10 identified leading mortality risks in high-mortality developing countries, about 3% of these deaths (1.7 million) are attributable to environmental risk factors (Mutunga, 2004). Children in unhealthy or polluted environments are likely to be exposed to disease-causing agents, predisposing them to high mortality risks (Antai, 2011). Also increase in the prevalence rates of diarrhoeal diseases, cholera, and typhoid is seen in situations of unsanitary refuse, excreta disposal, and use of unsafe drinking water. In addition, inadequate drainage and accumulated waste water encourage breeding of mosquitoes with increased malaria attacks (Policy project/Nigeria, 2002).

Antenatal Care

Antenatal care (ANC) attendance is considered as one of the core elements of the Safe Motherhood Initiative package. When a pregnant woman fully utilize the antenatal care services there is always a good pregnancy outcome, because each visit made by the woman gives her access to timely medical check-ups and advice about possible serious complications during pregnancy or delivery in a health care facility (Wablembo and Doctor, 2013).

Other Factors

In the work of Antai (2011), there exist a wide variation in mothers' health practices among the six major regions in Nigeria. This health practices ranges from child immunization, maternal and child health care utilization, differences and child nutrition. The northern region recorded the highest proportion of home delivery, complications during childbirth, younger age of first marriage, younger age at first birth and inadequate knowledge and use of contraception when compared to their counterparts in the southern region.

III.   DATA SOURCE AND METHODS

The data used were from the three National Demographic and Health Surveys (NDHS) carried out in 2003, 2008 and 2013. The National Population Commission of Nigeria and ORC *Macro, USA* (NPC and ORC Macro, 2003, 2008 and 2013) conducted the surveys. At each survey (i.e., 2003, 2008 and 2013), the total number of women interviewed were 7,620, 33,385 and 38,948 respectively. The descriptive Approach through the use of tables and charts were used to present the findings of this study. The information in the tables and charts were estimated in rates and percentages.

IV.   FINDINGS

Findings from this study revealed that under-five mortality in Nigeria has reduced by 32% between 2003 and 2013. That is, from 187 deaths per 1,000 live births to 128 deaths per 1,000 live births respectively as presented in figure 1. Although, over the ten-year period, there had been a decline in under-five mortality rate in the country, however the rate of decline was low when compared with what was required to achieve the

Millennium Development Goal of a two-third reduction in child mortality in 2015.

Figure 1: Levels of Under-five Mortality in Nigeria

Table 1, showed the rates of under-five mortality by mothers' educational attainments. It showed that mothers with secondary and higher education reported lower rates of under-five deaths compared to mothers who had little or no education. Generally, there was a decline in childhood mortality across all the educational categories during the 10 year period, however, the decline was much greater among children of mothers with primary education or less than for those mothers who had secondary or higher education. Between 2003 and 2013, under-five mortality declined by 33 percent, 32 percent and 20 percent for mothers with no education, primary education and secondary education respectively.

Table 1: Under-five Mortality rates by Mother's Education

Mother's level of Education	Under-five Mortality Rates			
	2003	2008	2013	Percent Decline
No Education	269	209	180	33.1%
Primary	186	159	128	31.2%
Secondary	113	116	91	19.5%
Higher Education	80	68	62	22.5%

Source: Authors' Compilation, 2015

Table 2, showed that the pattern of under-five mortality rates among women based on their wealth status had reduced between 2003 and 2013, although, relatively small. But there was an observation in the rates of women who were classified as richest, it was observed that in 2003 it was 79 deaths per 1,000 live births but increased to 87 deaths in 2008 and declined in 2013 to 73 deaths per 1,000 live births.

Table 2: Under-five Mortality Rates by Mothers' Wealth Status

Wealth Index	Under-five Mortality rates		
	2003	2008	2013
Poorest	257	219	190
Poorer	297	212	187
Middle	215	165	127
Rich	179	129	100
Richer	79	87	73

Source: Authors' Compilation, 2015

Figure 2a and 2b show that households who drank from safe water sources (i.e., municipal tap or borehole) increased from 41.7 percent in 2003 to 60.6 percent in 2013. Also during the same period, two-weeks incidence of childhood diarrhea decreased from 18.8 percent in 2003 to 10.3 percent in 2013 (Figure not shown). While there was an increase among households who depended on borehole as source of drinking water in both centers, it was observed that the percentage of

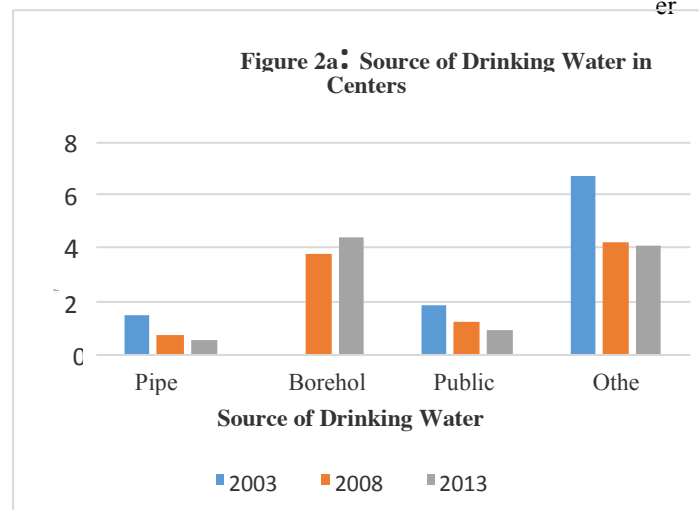Figure 2a: Source of Drinking Water in Centers

Figure 3, show that the percentage of children who received DPT3 (i.e., those who received the required 3 doses of DPT) increased over the 10 years period. There was an increase of 114 percent in DPT3 coverage between 2003 and 2013 (from 10.4 percent in 2003 to 22.2 percent in 2013).

Fig. 3: Percentage of Children who received DPT 3 as indicated by Vaccination Card
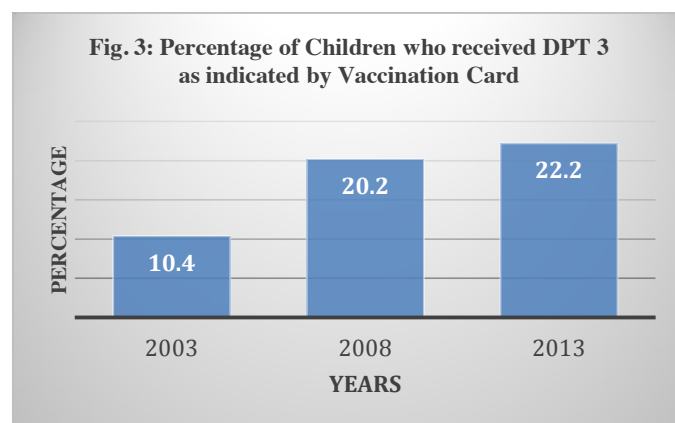
V.   DISCUSSION

One of the findings of the study was that there was an improvement in the number of household whose of drinking water was borehole and pipe water (i.e., safe water). This improvement could have been as a result of government intervention programs particularly in providing safe source of drinking water for the people. The improvement in safe water source could have been contributed to the decline in childhood diarrheal diseases. Further, there was also an increase in the

level of immunization coverage and it can be deduced therefore, that the improvement might have contributed to the decline in childhood mortality by reducing the exposure rate to preventable diseases or illnesses.

VI. CONCLUSION AND POLICY IMPLICATIONS

From the findings we concluded that there was moderate decline in under-five mortality in Nigeria between 2003 and 2013. The decline may have resulted from improvements in childhood immunization coverage, improved source of drinkable water and reduction in the incidence of childhood diarrhea diseases – which was a major cause of under-five mortality. This study, therefore, recommended that both the national and state governments of Nigeria should intensify efforts to increase childhood immunization coverage, provide more communities and households with safe drinkable water in order to drastically reduce diarrhea diseases – a major cause of deaths in children. This will help to accelerate the decline in under-five mortality rate in the country.

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Occupy Development-Towards a Caring Environment in Nigerian Urban Cities

Oludele Mayowa Solaja
Department of Sociology,
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
Email: solaja.mayowa777@yahoo.com

Ademolu Adenuga
Department of Sociology,
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
Email: adenugaademolu@gmail.com

ABSTRACT:
Occupy Development (OD) stems from the yearning to explore transition and transformation strategies at both conceptual and practical levels in a democratic, inclusive and sustainable manner. Its main goal is to advance sustainable paradigm in the context of meeting people's imageries and visions of a better life through cautious utilization of the environment and its resources. Unfortunately, previous research showed that the altitude for a caring environment in Nigeria is still abysmally low particularly in urban areas and the repercussion is becoming evident in the harsh socio-economic challenges that the people now face. Based on this reality, this paper advocates for occupy development towards a caring environment in Nigerian urban cities. Pollution Control Model (PCM) was adopted as theoretical guide. Methodology employed includes explanatory survey design. Extensive deskwork was conducted on secondary data retrieved from current and relevant academic publications, official bulletins and reports. Findings from the paper provided detailed knowledge on how to promote a free and just environment in Nigerian urban centres.

Keywords: Attitude, Development, Environment, Pollution, Urban, Nigeria

1. INTRODUCTION

Development is imbued with people's imageries and vision of a better life - a life which is materially enriched, ecologically improved, institutionally well-organized and technologically more advanced. Thus, development as a concept goes beyond the lines of what poor nations should do to become richer, or asking for financial or nonfinancial assistance from developed countries, to a well-encompassed direction towards achieving a simultaneous growth in social, economic and environmental conditions (Solaja, Omobowale & Alliyu, 2015). However, avalanche of literatures have established the fact that the process of attaining people's imageries and visions of a better life may be delayed or truncated if the environment that is supposed to serve as the resource foundation is fraught with problem of pollution or degradation. As a fact to be conceived, studies have revealed that the rapid demeaning of environmental quality has been the source of climate change, food insecurity, water shortage, heat wave, flood, disease outbreak and many other ecological challenges that stand as stumbling blocks on the road to accomplish the dreams and imageries of a better life for the populace (Bucheim, 2004; Kreis, 2006; Solaja, Omobowale and Kalejaiye, 2014).

One of the major potholes on Nigeria's developmental route is environmental degradation. In Nigeria, issues arising from environmental degradation have been a great concern for discerning individual, researchers, organizations and governments who have devoted huge amount of resources (financial and nonfinancial) in dealing with environmental challenges facing them in their neighbourhoods and communities. As such, it suffices to drive home the point that living with pollution or in a degraded environment hinders people's and nation's prospect for development. Therefore, there is need to move towards a caring environment in Nigeria's developmental pursuit. To further substantiate on the need for a caring environment, scholars have identified the problem of environmental mismanagement in the course of engaging in social and economic activities in Nigeria and the repercussion of this is becoming evident in the harsh socio-economic challenges that the people now face (Adelakun, 2003; Adesiyan, 2005; Adewole, 2009 & Adimekwe, 2013).

This posture can be buttressed with the way at which all kinds of waste (i.e. plastic, pure water sachet, paper, smoke, and gaseous-chemical) are discharged on major roads, open places and drainages particularly in urban centres where there is increasing population, business organizations and industries coexisting. Of great importance is the immense efforts made by the government, civil society and Non-governmental organizations (NGOs) in the

struggle for environmental sustainability in Nigeria particularly in urban areas. However, instead of recording improvement in the quality of environmental resources, current reports still read that majority of the socio-economic activities conducted in urban areas still produces pollution such as noise, sewage wastes, industrial effluent and chemical discharges which contend with the quality and quantity of environmental resources (i.e. water, air and land) in Nigerian urban cities (Atolagbe & Tanimowo, 2006; Adewole, 2009; Adimekwe, 2013; Weli, 2014).

Trekking further on the issue, empirical studies have attested to the fact that the rising environmental degradation in Nigerian urban centres concomitantly affects Nigeria's development agenda (Adesiyan, 2005, Adimekwe, 2013; Weli, 2014; Solaja, Omobowale & Kalejaiye, 2014). Sources of environmental degradation in Nigerian urban cities include prolong and extensive deforestation, illegal mining, poor sanitation, inadequate town/urban planning, uncontrolled industrial activities, oil spillage, gas flaring and many other environmental malpractices. These are the major causes of environmental degradation in Nigerian urban centres such as Port-Harcourt, Lagos, Abuja, Imo, Akure to mention but few (Atolagbe & Tanimowo, 2006; Adewole, 2009; Adimekwe, 2013; Weli, 2014). Based on this reality, this study examines occupy development towards a caring environment in Nigerian urban cities with the aim to:

i. Examine the term occupy development and environment within the context of sustainable development
ii. Highlight the relevance of environment in development process
iii. Explain the need for a caring environment in Nigerian Urban Centres
iv. Map out strategies for extenuating the menace of environmental pollution in Nigeria.

2. CAPTURING CONCEPTS

To advance the understanding of this study, brief clarifications on the meanings conveyed by key concepts adopted are presented below.

What is Occupy Development?

In order to understand the term Occupy Development, it is important to first and foremost define the two words Occupy and Development separately. Occupy depicts a leaderless common movement, that is based on local development and justice issues among communities affected by same injustices. On the other hand, the term Development

is the process of raising peoples' standard of living from undesirable state to desirable state through application of relevant growth processes in generating favourable condition for the purpose of increasing peoples' self-esteem and freedom to lead quality life, and to overcome certain developmental barriers in order to transcend into comfortable and desirable existence (Olutayo and Omobowale, 2002, Obono, 2010; Alliyu, 2013). With this background, the term Occupy Development (OD) was developed by Wichterich (2014) to mean a process of identifying the rationale of care and maintenance of a development path that is socially, economically and environmentally compatible. OD can equally be construe as the desire to revitalize, rethink or reconfigure the transition and transformation strategies deployed societal stakeholders to achieve development in a democratic, inclusive and sustainable manner. It is an effort to make a change out of a failing system and into a new system that is highly promising (Hayes and McNally, 2012). However, in this study, OD represents the movement of people towards promoting environmental impartiality through informative processes to empower and enable them to become agents of change – to become active citizens in a change of unjust environmental mismanagement which is impeding socio-economic development in Nigeria. In other words, OD is a kind of intellectual movement against all forms of environmental mismanagement in order to enhance people's access to clean water, air, and sufficient supplies of renewable resources in needed quantity as at when due.

Environment: Defined

The term 'environment' has often been defined as the aggregate of geographical, physical, biological, socio-cultural and political settings that determine one's survival, development and the ability to meet existential developmental needs. In a simple expression, Einstein construes the environment to mean "everything that is not me" (Singh, 1995). This simply means that environment comprises of entire surrounding, space or condition that encircles an individual, organism, species or race; without which survival will be impossible (Aluko, 2001; Adesiyan, 2005). The growth, life and death of all individuals depend on the environment in which they exist. In the same vein, United Nations Development Programme (2006) emphasized that environment is the source of global economy thus it must be protected and sustainably managed. This is inherently efficacious in accomplishing the vision of a better life for present and future generations.

Environmental Resources and their Consumption Patterns

Human environment is blessed with copious life supporting resources. Some of these resources have intrinsic value of their own and for long term utilization by humans while others do not. Awan (2013) identified four types of environmental and natural resources which are available for human utilization and survival.

i. **Renewable Environmental Resources**: These are resources which are capable of natural regeneration into useful products within specific period of time. As such, these kind of environmental resources are always available for consumption as long as their capacity to regenerate is not interrupted by human activities and natural disasters. E.g. soil, clean air and water.

ii. **Non-Renewable Environmental Resources**: These are natural resources that lack the capacity to regenerate or the rate of renewable is slow thus they are relatively scarce for consumption or fixed in quantities. E.g. ground water, minerals etc.

iii. **Continuous Environmental Resources**: These are resources that are constant and available with the immunity of solar energy. They are cannot be affected with gross management but they could be affected by atmospheric pollution. E.g. wind, gravity, tidal energy and solar energy

iv. **Extrinsic Environmental Resources**: These are resources which can breakdown or deflate in quality and quantities however; there availability can be guarantee if effectively managed. E.g. human skill, institutions' management abilities.

From the foregoing, it is obvious that irrespective of the type or category of environmental resources, it is clear that environment and its resources demand total care from all and sundry. In effect, any form of misuse (including pollution) must be reduced, controlled, managed or completely eradicated for the sustenance of the society.

Exploring the Relationships between Environment and Development

Environment plays vital roles in the pursuit of a better life. This is because human environment consists of interrelated and interdependent surroundings (natural, physical and material) that influence the well-being of the people, organizations and institutions that made up the society (UNCTAD, 2013). For instance, it is the environment that supplies the resources (materials and non-material) and other conditions which people and organizations depend on; in terms of how to survive, produce and function optimally. Resources such as natural air, soils, minerals, plants and animals are tapped from the environment (Atolagbe & Tanimowo, 2006; Solaja, Omobowale & Alliyu, 2015). Thus, environment is the source of all resources required for achieving desirable development. It is impossible for any country that allows it industrial or domestic activities to operate at the expense of the environment to achieve sustainable development. Sustainable development can only be achieved through sustainable management of various environmental assets (UNCTAD, 2013). The underdevelopment challenges which Nigeria faced today can be partly attributed to lack of care for the environment and unsustainable management of environmental assets in pace of changing social drivers, such as population growth, economic activities and consumption patterns in Nigeria (Aluko, 2001; Adesiyan, 2005).

Occupy Development towards a Caring Environment in Nigerian Urban Centres

The term "Caring Environment" connotes the act of mitigating environmental degradation (domestic and industrial pollution) and promoting afforestation, efficient consumption patterns and sustainable environmental management in order to achieve quality environment with the possibility of achieving desirable development for the populace. Attempt to care for the environment is to move the motion against environmental mismanagement and pollution which have negative consequences on the people's access to clean water, air, safe drinking, and sufficient supplies of renewable energy in needed quantity as at when due. Therefore a change of paradigm is inevitable to break up the logic of unfettered consumption of environmental resources in people's mindsets. This change must not only be localized but also institutionalized in cross-regional and global dimensions as countries of the world continue to depend on the environment for provision of basic needs, economic growth and socio-economic development though in differential quantities (Bucheim, 2004; Kreis, 2006). More so, transition towards a caring environment demands judicious utilization of resources to gain a balance between short-term and long-term developmental targets. In this regard, it is right to assert that the time for global collaboration and coordination toward addressing the issue of environmental degradation occasioned by excessive use of environmental resources, bad

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attitude toward environment, selfishness, corruption and mismanagement is now.

The extent to which environment sustains development can also be inferred from the words of Brundtland (1987), who noted that *for any society to develop sustainably, the three fundamental pillars (social, economic and environment) that constitute development must be maintained simultaneously*. It is also worthy to note that majority of environmental resources are 'finite resources' which means they are limited and can be exhausted, if development is pursued at the expense of the environment (Livernash & Rodenburg 1998; Meadows et.al, 1972). Owing to this condition, one irresistibly reiterates neo-Malthusians environmentalist perspective of *Limit to Growth* (Meadows, Meadows, Randers, and Behrens, 1972). According to Meadows, Meadows, Randers, and Behrens (1972) the pioneers of *Limit to Growth* thesis, the counties of the world are fast overwhelming the Earth's finite resources (i.e. supply of natural gas, water, oil and other energy sources are already dropping abruptly and will continue to drop) except there is conservation policies among nations and effective control of production and use of resources in industrialized societies, there will be environmental deficit- a situation where environmental goods become debilitated and can no longer provide support for the populace to enjoy desirable development- in nearest future (Macionis, 2005). And, what shall it profit a nation who utilized all her endowed environmental resources in the sake of development and yet, the people in the country languish in poverty, diseases, insecurity, hunger and other environmental vulnerabilities. There is no gain but loss which comes inform of *Environmental Deficit*. For example, an environment that is polluted with toxic waste will experience depletion in its natural composition which possibly may cripple its utilization for industrial production, labour capacity and wellbeing of people at all ages, in which all efforts to achieve desirable development may be undermined.

Another important factor of caring environment is "culture". Culture is the total way of life of a group existing in a society. It is practically impossible to refer to a group of people validly except within the framework of culture because, culture is the people and the people are the culture. (Olutayo & Akanle, 2012). In this regard, Culture defines attitudes, values norms and goals which the people as individuals and groups learn consciously and unconsciously through socialization and observation (Okechukwu, 2010). Evident upon the study conducted by some scholars

regarding the issue of environmental pollution and degradation, it was inferred that the culture of some group of people contribute to the increasing depletion of environmental resources. Some social groups constantly engage in several activities that harm the natural composition of human environment in Nigeria. For instance, Okebukola (2001) who observed that there is indiscriminate disposal of gaseous-chemical waste in urban areas among manufacturing industries and the result of this act had been the spread of gastrointestinal and parasitic diseases among residents of Port-Harcourt in Nigeria. In another study, Adewole (2009) exposed that about $10,000 \, M^3$ of untreated industrial waste-water are being discharged into lagoon on daily basis by industries located in Lagos State, Nigeria which has result in high rate of water pollution, freshwater shortage and water-related diseases. More so, Akanni (2010), Weli (2014) submitted that the volume of noise pollution from places of worship with amplifiers, motorists, machines and frequent use of power generators in industries, worship places and households led to growing numbers of people (particularly those living and working around these noisy environs) with hearing difficulties, high blood pressure and other deadly diseases in Nigerian urban cities. In addition, the study conducted by Solaja, Omobowale and Kalejaiye (2014) revealed that there is unethically discharged of solid-metal waste on fallow land, around residential houses, public space and even under the overhead bridges in different locations of Lagos State, Nigeria. This phenomenon may not be unconnected from the growing numbers of urban slums and ghettos where urban poor or vulnerable people reside. Adimekwe (2013) also reported that human faeces are frequently passed into gutters, open places and dump sites in most of the urban slums and ghettos in Nigeria. All these unethical behaviours point to the fact that the altitude for a caring environment is still very low in Nigerian urban centres which is also an indication of lack of eco-friendly culture among Nigerian urban residents.

3. THEORETICAL ELUCIDATION

Often time, theoretical attempts at interpreting the role of environmental resources in development process tend to rely more on System Theory and the ubiquitous Game Theory (Hug, 2001, Ordeshook, 2003; Macionis, 2005). For the present purpose, this paper will adopt Theory of Pollution Control (TPC) which was developed by Rudiger (1976) and expanded by Blowers (1997), Ostrom, Dietz and Stern, (2002) and Helfrand, Berck & Maull (2003) to provide theoretical explication.

Theory of Pollution Control (TPC) was developed based on the supposition that environmental resources are crucial inputs in developmental pursuit. Hence, it must be protected against any form of human and non-human degradation. Theory of Pollution Control sees environmental degradation as a social hazard that mostly occurs from poor attitude towards a caring environment. According to TPC, large proportion of man-made activities alters the natural composition of human environment and its resources. It postulated that when environmental resources such as land, air, water, and raw materials are commonly shared by multiple users and they are freely extracted for economic and social purposes without any legal or state agency controlling it; it will leads to over exploitation and abuse of the resources which may result in environmental pollution and degradation (Ostrom, Dietz & Stern, 2002; Helfand, *et. al.,* 2003).

TPC further emphasized that environmental degradation is unavoidable reality particularly when there is no clear property right and/or access rationing of environmental resources for private benefits as against public benefits. In pursuit of the need for environmental resource control, TPC maintained that when environmental resources are exploited or used for private benefits more than for social benefits there will be increasing production of ''*negative externalities''* in the society (Helfand, *et. al.,* 2003) Mankiw (2008) defined negative externalities as situations where polluters of environmental resources do not bear the cost of the injury done to the environment alone but with other people who do not involve in the pollution. This is so because; when pollution arises it goes beyond the atmosphere or environment of its occurrence to become a community issue. This fact form part of the reasons why pollution is refers to as 'external cost', 'spill-over cost' or 'neighbourhood cost' with concomitant economic, social and health implications on the people under its manifestation (Adewole 2009; Gutti, Aji & Magaji 2012).

Furthermore, TPC believes that the issue of environmental degradation and pollution environmental may continue to persist if environmental resources are left in hands of individual-private users to extract or use for private benefits rather than for the general benefits that would engendered the attainment of people's imageries and visions of a better life. Therefore, TPC affirmed that in order to reduce or revert negative externalities arising from environmental mismanagement, there must be efficient and proactive pollution control policy which can either be regulatory (command-and-control regulation, market-based policies and hybrid instruments) or non-regulatory (voluntary initiatives). It is through this medium that environmental resources can be used to transform the wellbeing of the people, their livelihood and the development process of the society positively.

The theoretical position of TPC can be understood within the context of this study. Nigerian urban centres are suffering from multiple challenges: challenges of poverty, hunger, uncontrollable population increase, socioeconomic underdevelopment, insecurity, pollution as well as environmental degradation. Majority of these challenges is caused by lack of sustainable management of environmental assets or resources. It has been reported that the population size of people and industries in urban cities in Nigeria is increasing. This is due to the economic and social benefits lying in urban centres however; the phenomenon brought a simultaneous increase in consumption and exploitation rate of environmental resources by urban residents. The exploitation and consumption rate of environmental resources like land, air, water etc. are often left in the hands of individual-private users rather than government controlling the distribution of environmental resources among the people. Such that there is little or no rationing of natural and mineral resources needed for accomplishing the visions and dreams of a better life for the populace.

The situation became so complex due to unplanned population explosion, insufficient waste management facilities and enormous transition of land from forest and poor sanitation attitude among urban residents both at household level and industrial level (Magbagbeola, 2001; Adesiyan, 2005 & Adewole 2009). The inability to manage the waste generated in Nigerian urban centres also resulted in a phenomenon where tons of garbage and refuse (biological, organic and synthetic) consistently wait on roads, street corners, motor parks, markets and industrial outlets in urban cities for pick up, the odour from the garbage indicates that the waste has spent several days unattended to, which in effect causes serious pollution in the environment.

The epistemology behind such unethical act is that, economically it is more costly and expensive for industries, household and other waste producers to operate cleanly. Likewise, it is physically impossible for these actors to carry out production and commercial activities that will not produce any waste. Particularly, in urban areas where majority of the industrial and domestic activities involve production of biodegradable and non-biodegradable products such as rubber and tyre, cement and asbestos production there is bound to be waste.

Furthermore, studies revealed that there is unethical discharge of unfiltered gases in the air in Port Harcourt (Atolagbe & Tanimowo, 2006; Tawari & Abowei, 2012) while in Imo state, it was reported that industrial plants and installations discharge of toxic gaseous substance which contaminate the air and the environment itself (Adimekwe, 2013). Such pollution may cause serious respiratory diseases or even damage the respiratory organ which can lead to untimely death or life-time usage of medication. Since, atmospheres in which harmful gases are discharged contains the air which every individual breath in and out to support life. Consequently, there is need for government to begin to enforce stringent environmental regulations that will limit how environmental resources or "public goods" are unethically consumed and treated in the context achieving social and economic development in Nigeria.

4. METHODOLOGY

Methodology adopted in the study is explanatory survey design. Explanatory design was directed toward collecting information from relevant literatures to understand the nexus between the variables understudy and sought how to balance the interaction between them. Data were obtained from secondary sources which include academic publications, official bulletins, articles and reports.

4. WAY FORWARD

In response to the call for a caring environment, efforts must therefore be made to balance the interaction between development and environmental sustainability in Nigeria. This fact can be also be seen in Basiago (1999) who reported that alternative models of cultural development in Curitiba, Brazil, Kerala, India, and Nayarit, Mexico embody the integration of economic, social, and environmental sustainability. According to him, Curitiba has become a more liveable city by building an efficient intra-urban bus system, expanding urban green space, and meeting the basic city by building an efficient intra-urban bus system, expanding urban green space, and meeting the basic needs of the urban poor. Similarly, Kerala reached social harmony by emphasizing equitable resource distribution rather than unfettered consumption by restraining reproduction activities that can spark out tension or the destructive behaviours among the divisions of race, caste, religion, and gender. In the same vein, Nayarit sought to balance development with the environment by framing a nature-friendly development plan that set to protect the natural ecosystems for urban development and that involves public participation in the development process. However, to achieve effective conservation and rationing of environmental resources in Nigerian urban centres the following strategic techniques must be adopted.

Proactive Urban Investment and Planning

One of the major challenges facing developing countries is the features of unplanned cities and towns which also lead to environmentally unacceptable location of industries, lack of adequate drainage, sewage disposal system and other modern infrastructural facilities that can cushion the effect of increasing growth in population, industries, production, use of resources and new ecosystem (Adesiyan 2005; Magbagbeola 2001; Jegede 1977). Therefore, there is need for proactive urban investment and planning to mitigate the consequences of environmental pollution and degradation operating concurrently with socio-economic development. Thus, Nigerian government need to embark on proactive *renewal* and *removal* projects. The renewal project includes provision of adequate sewage disposal system and drainage, pollution abatement equipment and usage of environmentally sound technologies in industries should gain utmost priority in development agenda. On the other hand, the removal process entails relocation and reallocation of industries (particularly polluting industries) that are close to residential areas must be moved to new industrial layout.

Urban mining, Recycling and Reuse Programmes

Mining of waste resource involves processes of extracting useful material(s) from waste rather than discarding it completely (Hogland, Hogland & Marques, 2015). While the recovery of resources involves the removal of selected materials from the solid waste and using technologies or method such as recycling, energy generation and compositing to obtain valuable resources from it (Abiti, 2013). The main objective of resource recovery is to engage in a selective and efficient removal of products that have useful benefits to the society from waste loads so as to reduce the volume of waste loads to its barest minimum. This process reduces societies' over reliance on virgin resources developmental pursuit (Wikipedia, 2013 cited in Abiti, 2013). Government must therefore promotes Utility Wastes Conversion Programmes (UWCP) such as the one introduced in Mexico, Indonesia, and Switzerland in order to encourage indecent wastes disposal and inculcate positive attitude of ensuring clean and safe environment in Nigeria. As well, government and private investors should see *International Wastes*

Shipments (IWS) to countries like Switzerland, United Kingdom, China, US and Republic of Ireland as a way to promotes green entrepreneurship as business opportunity that can contribute to national development.

Proactive Environmental Pollution Control

Constant inspection and examination of environmental quality must be carried out by ministry of environment especially in industrial areas in urban areas in order to regulate the consequences of industrial within residential and industrial environments.

Provision of Sufficient Waste Collection and Disposal Facilities

Adequate supply of municipal waste tanks and facilities must be made in areas lacking it. Also, government need to ensure that the charges of waste disposal are affordable in order to encourage the populace to avoid discharging waste indiscriminately and to utilized government approved waste collection agencies in disposing their wastes. Also, industrial organizations should support government at every level by financing public health care service, neighbourhood clean-up support, drilling of boreholes, and distribution of pollution coping materials for residents living within polluted industrial environment. This could serve as corporate social responsibilities and a way in which organization contribute to the development process of Nigeria.

5. CONCLUSION

The pollution level in Nigerian urban centres is high above what can be overlooked. It is the major constraint to the process of achieving desirable socio-economic development and better life for the citizens of Nigeria. Increasing pollution and environmental degradation in urban centres have resulted to hash socio-economic conditions which engendered the present call for Occupy Development towards a caring environment in Nigeria. It is clear that a caring environment is a process or an act of giving preference to eco-friendly practices, culture and enforcement of rights over efficiency consumption and individual utility or maximization of environmental resources as the ultimate goal of economic, social and environmental sustainability activities. In order to expand the sense of care for the environment against the logic of growth and unfettered consumption, a triple R (redefinition, redistribution and a revalidation) – process with regard to environmental sustainability and sustainable consumption pattern is necessary. Because, development paradigm that is compatible with the environment tends to promote peace and security,

contribute to infrastructure growth, foster trade and investment, reduce vulnerability to external shocks, and enhance the quality of life of the populace.

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Above-Ground Pipeline Monitoring and Surveillance Drone Reactive To Attacks

Eluwande Abayomi David; Ayo Olayinka Omowunmi
Department of Electrical and Information Engineering
Covenant University
Ota, Nigeria
yomi.eluwande@gmail.com
olayinka.ayo@covenantuniversity.edu.ng

Abstract— **With Pipeline infrastructures vastly distributed across Nigeria, to ensure continuous supply at the places needed, the monitoring of these pipelines for protection and operational safety has become very important given the numerous cases of vandalization and crude-oil theft. This has proven to be a challenging task considering the numerous security infrastructures and agents required, hence expensive in nature. This concept paper shows a proposed solution using an Unmanned Aerial Vehicle (UAV) technology for real-time monitoring and surveillance of the entire pipeline network. The overall aim was to build a drone (quadcopter) together with a pipeline monitoring system which acted as a surveillance system and reacted to attacks on above-ground oil pipelines, majorly for areas not easily accessible by security personnel. With an already designed quadcopter, the pipeline monitoring system was designed using a software called Fritzing which allowed for the use of breadboards and electrical components. The pipeline monitoring system comprised of microcontrollers, sensors and a GPS module. The system was tested using the sensors to sense attacks (excessive impact on the body of the surface platform), once it determined the impact was enough to be considered as an attack, it sent a message to the control center. The message consisted of the attack and the GPS coordinates. The GPS coordinates was then used to direct the quadcopter to fly to that location autonomously and inspected and reported via a live video feed. This system provided a working method to monitor pipelines and provide a first-line response solution to the problems of vandalization and crude-oil theft of pipelines in Nigeria.**

Keywords— Pipeline Monitoring, Pipeline Vandalization, Surveillance Drones, Unmanned Aerial Vehicles.

I. INTRODUCTION

Pipeline attacks are a very serious thing in Nigeria and in other countries of the world. It is a very desperate and insensible act that only causes wastage and maybe even death as a result of oil spillage. While some security agencies have been deployed to areas where there are pipelines, some pipelines exist in inaccessible areas with even security agencies but still suffer attacks on pipelines. Many times, when oil pipelines are attacked, it's very hard for these security agencies to take action based on their location in riverine areas, or in an area too secluded for them to notice the vandalization.

The Nigerian National Petroleum Corporation, NNPC, recently stated that whenever there are pipeline attacks, there is a loss of about 60,000 barrels of crude oil daily and this causes condensation. This in turn means, millions of naira wasted and this is bad business for all its stakeholders involved.

Research by survey has shown that pipeline failure is often caused by third-party external damage, like ploughing of buried lines, or the impact of trawl gear against (unburied) sub-sea lines. Moreso, many areas in the Niger Delta region of Nigeria, has shown that the impacts of sabotage or vandalism must never be neglected [1].

This problem is particularly interesting because, after all these years, there seems to be not one single solution and it even appears that the criminals who commit this act are growing in confidence due to a lack of action.

Based on this, this concept paper proposed a solution using the technology of an Unmanned Aerial Vehicle (UAV). The aim was to build a drone that acted as a surveillance system and reacted to attack on above-ground oil pipelines based on information from a pipeline sensor system. This served as a custom built drone to monitor oil pipelines and acted as a first line of response to attacks on pipelines among other applications. This was to curb and reduce the number of occurrence of above-ground oil pipeline attacks and also aid other existing solutions towards eradicating pipeline attacks in Nigeria, given the importance of Oil flow to its economy.

II. OVERVIEW OF PIPELINE NETWORK

Pipelines have been efficiently used overtime to convey fluids over long distances, from production locations to the consumer end. They are essential structures for oil and gas production and required for carrying, storing and selling of natural gas, crude oil, and refined petroleum products in every country.

A petroleum pipeline is a very unique infrastructure for transport as when compared to other types of transport systems like roads, does not enhance access for people in communities to move around [2]. They relatively inhibit interactions and if situated near houses, are potentially hazardous to lives.

Pipelines are vastly used in Nigeria. The nation's network is estimated to be over 3,000km large [3]. They convey fuel products from oil plants and import-receiving docks to storage depots. In Nigeria, these pipeline spans across the whole country's geo-political zones going *from the subsea swamp, rain forest to the savannah grass lands* and are faced with different climates and soil conditions with erratic consequences like the leaky petroleum products with harmful effects for the communities and environment [4]. The map of the Nigerian pipeline network is as shown in Fig 1 below.
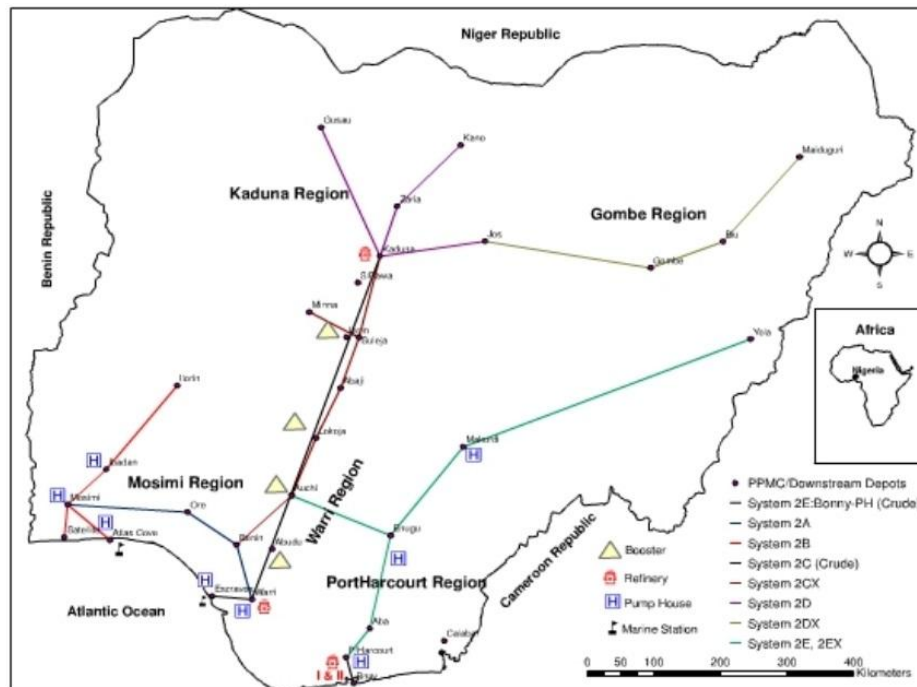

Fig 1. A map of Nigeria showing Pipeline Network [14]

III. IMPACT OF PIPELINE VANDALISATION IN NIGERIA

Most of the pipelines, located in the Niger Delta often route through rivers, creeks, swamps and farmland, a location known for being a waterlogged and very sensitive to stress [5]. A good example is with the Shell Petroleum Development Company which has 95 km trunk line spanning from Nembe Creek field to Cawthorne Channel field navigating thirty five communities and crossing sixty rivers and creeks with different sizes. Other areas with oil and gas pipelines linking petroleum products storage depots includes Aba, Enugu, Gombe, Gusau, Ibadan, Ikorodu, Kaduna, Kano, Lagos, Ilorin, Maiduguri, Markurdi, Ore and Yola, and a refinery at Kaduna [11].

Most times, the state of the pipelines being used are not in great condition due to negligence on the part of the oil companies and also due to vandalism from the outside world. It has also been observed that many pipelines are often left to rust, after long periods of not being in use by some of the Oil corporations as they aren't prepared to maintain or repair them. Periodic monitoring are also not done as at when due after the implementation of the pipelines. Monitoring is key for maintaining the integrity of pipelines and wellbeing of the inhabitants where the pipelines are located. The oil corporations often link most oil spillage to sabotage, but the societies have argued it is to be caused by failed pipelines and leakages [10].

The mangroves of the Niger delta represents a highly endangered biologically diverse habitats as Hectares have been evacuated periodically irrespective of the local environmental legislations or global environmental best practices. This has greatly affected habitat area and natural populations, causing a reduction and distortion in biological breeding. Pipeline leaks caused by failure or sabotage are also harmful to the environment. This has led to a radical change in the distinctive biodiversity of the Niger Delta region has changed with numerous important species gone [13].

Some of the Environmental Impacts of Pipelines vandalisation are:

- Damage to seabed from dredging for pipeline installation

- Sedimentation along pipeline pathway

- Water pollution

- Pipeline Explosion due to vandalisation or sabotage

- Damage of environmentally sensitive estuaries wet lands

- Erosion and flooding

IV. OVERVIEW OF UAVs

An Unmanned Aerial Vehicle (UAV), commonly (a drone), also called a Remotely Piloted Aircraft (RPA) by the International Civil Aviation Organization (ICAO), is an aircraft without a human pilot aboard. It is maneuvered either autonomously by onboard computers or by the remote control of a pilot on the ground or in another vehicle.

Drones are used in cases where flight by humans are seen as too dangerous and have been in use since 1981. They have become increasingly popular over the years and there are various forms in which you can classify a drone:

Fixed wing drones: These are drones that have fixed wings and do not use rotors. These types of drones make use of gliders to launch.

Multirotor drones: These are also called VTOL (Vertical Takeoff and Landing) drones, because they do not need a glider to launch, instead they take off vertically. Multirotor drones are quadcopters, hexacopters, and octocopters.

Usage of drones is gradually shifting from military usage to commercial and civil applications. Some uses of drones in our modern age include:

- Aerial surveying of crops

- Search and rescue operations

- Counting wildlife

- Delivering medical supplies

- Forest fire detection

- Land surveying

- Crowd monitoring

V. OVERVIEW OF QUADCOPTERS

A Quadcopter also known as a Quadrotor Helicopter or quadrotor is a multirotor helicopter, elevated and thrusted by four motors. Quadcopters make use of two pairs of motor-mounted propellers; two propellers operating in both the clockwise and anti-clockwise. These propellers achieve control by using independent variation of the speed of each motor. Maneuvering the speed of each rotor can produce the preferred total thrust; to detect the center of thrust laterally and longitudinally; and generate a desired total torque, or turning force. An assembled quadcopter is shown in Fig 2 below.

Quadcopters generally work by obeying Newton's third law of motion; "For every action, there is an equal and opposite reaction". The four propellers and motors exert force on the system in a downward motion (Action) and in turn a reaction takes place, which is the quadcopter lifting itself into the air.

Fig 2. The Assembled Quadcopter (As built)

The portable size and mechanical simplicity of small-sized quadcopters makes them far cheaper and more practicable/ stronger than traditional helicopters [6]. Their smaller blades are also beneficial as it implies less kinetic energy, minimizing its tendencies to bring harm to anyone [7].

However, bigger sized quadcopters tend to have more disadvantages over traditional helicopters as increase in its blade size implies more momentum. This leads to longer times in increasing the speed of the blade, negatively affecting its control. On the other hand the increase in the blade size gives an enhancement of efficiency as it requires less energy to create thrust, but this brings about control issues. Helicopters rarely face this as changes in the rotor disk size does not expressively affect the control of the blade pitch [8].

VI. PIPELINE LEAK DETECTION SYSTEMS

As established above, pipeline networks are the cheapest and safest way for transporting oil, gases and other fluid products.

Of utmost importance is the need for pipelines to meet high demands of safety, reliability and efficiency, especially in long distance transport. With adequate maintenance pipelines be used indefinitely without leaks. Research has shown that, the most noteworthy leaks are due to intentional attacks on pipelines or nearby excavation equipment; therefore it is important to notify authorities prior to excavation to ensure no pre-buried pipelines in the locality. Lack of maintenance of pipelines can lead to its corrosion, specifically at construction joints, and low points where moisture can be found,

Though, these defects can be detected by inspection tools and modified before becoming a leak.

Pipeline leak detection systems are important as they can improve productivity and system reliability relative to minimal downtime and inspection time. This makes them key in pipeline technology.

Methods of Leak Detection Systems

A. Pressure/Flow Monitoring

A leak in the pipeline network changes the normal state of hydraulics of a pipeline. The change above affects the pressure or flow reading after a period of time. Constant monitoring of the pressure flow can therefore serve as a simple leak detection system.

B. Acoustic Pressure Waves

This method examines the rarefaction waves generated during a leak. . A breakdown in the pipeline wall causes fluid or gas discharges, similar to high velocity jet. This causes a reduction in the pressure of the waves, detected and analyzed while moving along the directions of the pipeline.

C. Digital Oil Leak Detection Cable

The Digital Sense Cables contains semi-permeable internal conductors covered in permeable insulating molded braid. It works by having an electrical signal cross the internal conductors being examined with an inbuilt microprocessor in the cable connector. Leaky fluids permeate the external permeable braid to reach the internal semi-permeable conductors.

This brings about a variation in the cable's electrical properties spotted by the microprocessor. The microprocessor works to as low as 1-metre resolution along its length giving a good signal to monitoring systems or operators. The Digital sense cables are often draped around the pipelines, embedded sub-surface with other pipelines or fixed as a pipe-in-pipe configuration.

D. Fibre Optic Leak Detection

Two methods are known of fibre-optic leak detection which are: Distributed Temperature Sensing (DTS) and Distributed Acoustic Sensing (DAS).

The DTS method requires fitting the fibre-optic cable along the length of pipeline under observation. The measureable substances touch the cable during a leak, altering the cable's temperature and causing changes in thee reflection of the laser beam pulse, to show a leak. The specific location is determined by knowing the time delay between the emitted laser pulse and the detection of the reflection. The criteria for this method is that the temperature of the substance must vary from the ambient temperature. The temperature along the pipeline can also be measured through the scanning of the whole length of the fibre. This also leads to the detection of leaks [12] [13].

The other method, DAS method, comprises of an analogous implementation of fiber-optic cable along the pipeline length under observation. Vibrations from a substance leaving the pipeline via a leak are measured. Time delays between the emitted laser pulse and the reflection are also used to determine the location of the leaks. This technique can sit well with the DTS method to give the pipeline's temperature profile.
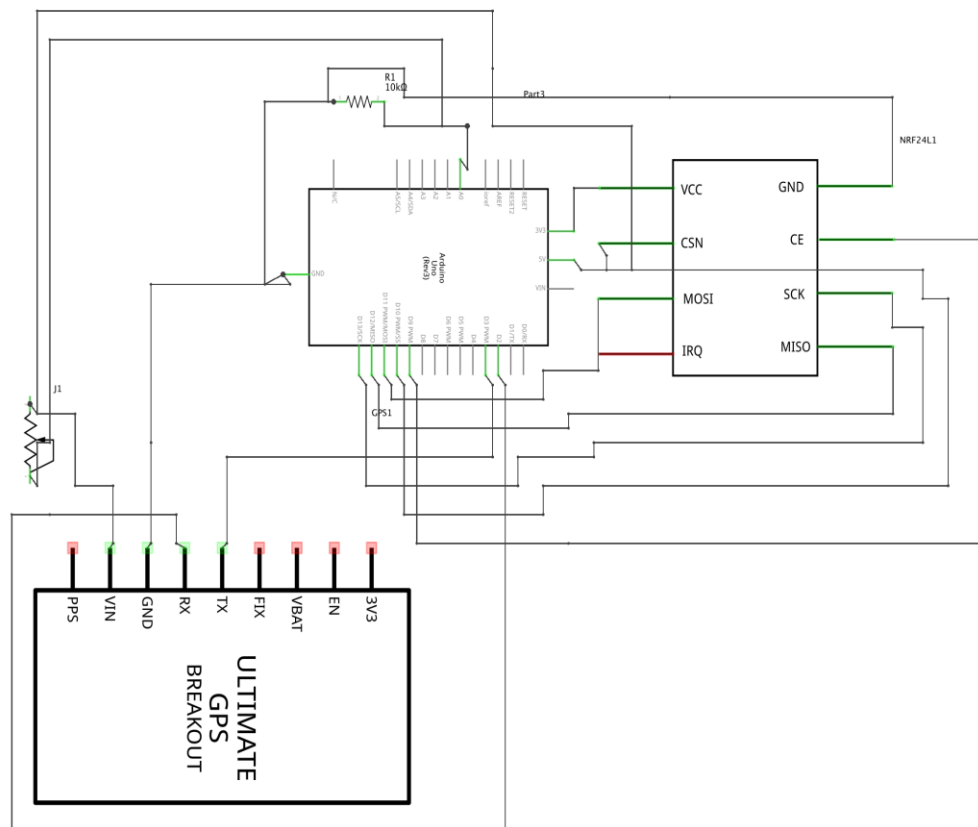

Fig 3. Schematic Diagram of Pipeline Sensor System designed with Fritzing

Pipeline Monitoring System

From the schematic in Fig 3 above, there are four main components used in the Pipeline Sensor System; the Arduino Nano, the sensors, the GPS module, and the nRF24L01 Radio Transceiver. All work in conjunction to make the Pipeline sensing system.

The Pipeline Sensor System has the following major components, the microcontroller board, sensors, radio transceivers, and the GPS module.

The microcontroller is an Arduino Nano microcontroller board that has similar characteristics with the popular Arduino Uno board but differs in size. The Nano board provides both the computing for the pipeline sensor system and power supply.

Three types of sensors are used in the design of the system. They are Force Sensitive Resistor, Sound Sensor and Piezoelectric element.

A Force Sensitive Resistor is a sensor that allows for recognition of physical pressure, squeezing and weight. It is a resistor that basically alters its resistive value with changes in force/pressure. It is made of 2 layers separated by a spacer and as force is applied, the impact of active element on the semiconductor causes the resistance to reduce.

A Sound Sensor is a small board that consists of a microphone and processing circuits. It gives an audio output and a binary indication of the presence of sound together with an

analog representation of its amplitude.

A Piezoelectric element is a device that employs the use of the piezoelectric effect, to detect and measure fluctuations in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.

The Radio Transceivers are for communication between the microcontroller boards and the GPS module broadcasts the current location via coordinates.

When in place, the pipeline sensor system consists of all the components listed above and is a compact system. The sensor system is placed on the pipeline and it listens for excessive impact/pressure on the pipeline via the sensors. When the sensors determine that the impact is above the predetermined threshold value range, it sends a message to the control center. The message is sent with the help of the radio transceiver and the message consists of the status of the pipeline and the GPS coordinates of the pipeline. A voltage of just 5V is needed to power the whole system.
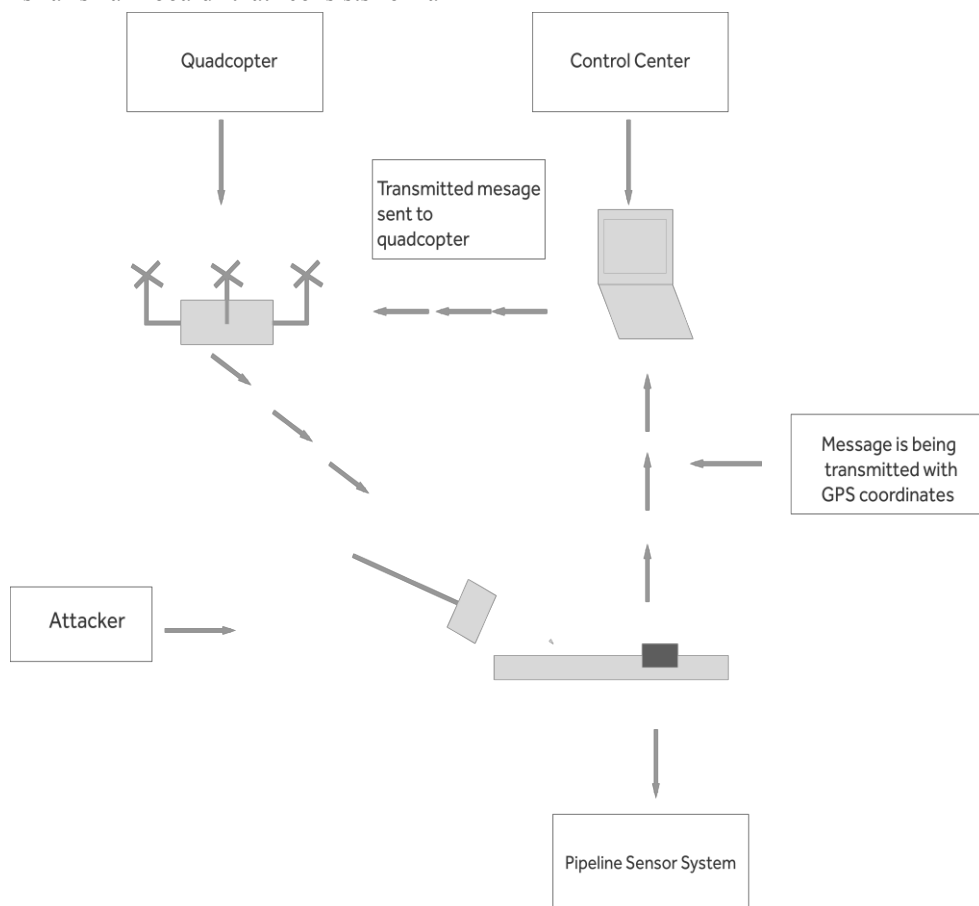
Fig 4. Diagram of quadcopter deployment made by Sketch Application

Interconnection with Quadcopter

As outlaid in Fig 4 above, the message gotten from the pipeline monitoring system helps to determine whether a pipeline is being attacked.

In a situation whereby an attack is going on, the message sent consists of the status and the GPS coordinates. The GPS coordinates gotten, plays an important part in directing the quadcopter to the location of the attack.

The GPS coordinates gotten from the pipeline monitoring system is used and entered into a software called Mission Planner. Mission Planner is an open source software that works with the flight controller used to build the quadcopter and it allows autonomous flights.

By entering the GPS coordinates into the Mission Planner software, the quadcopter can then be directed to fly to that location and inspect any activity that is going at the pipeline site.

VIII. TESTING AND RESULTS

The sensor system is placed on the pipeline and it listens for excessive impact/pressure on the pipeline via the sensors. When the sensors determine that the impact is above the predetermined threshold value range, it sends a message to the control center.

The maximum threshold value that can be attained is 1023. The reason for that is that the sensors to be used in the system are analog devices, because the microcontroller is a digital device, an Analog to Digital Converter is needed.

The pipeline sensor system was tested by placing the system on a platform which when "attacked", the image below is a sample of how the message would be sent back to the control center.
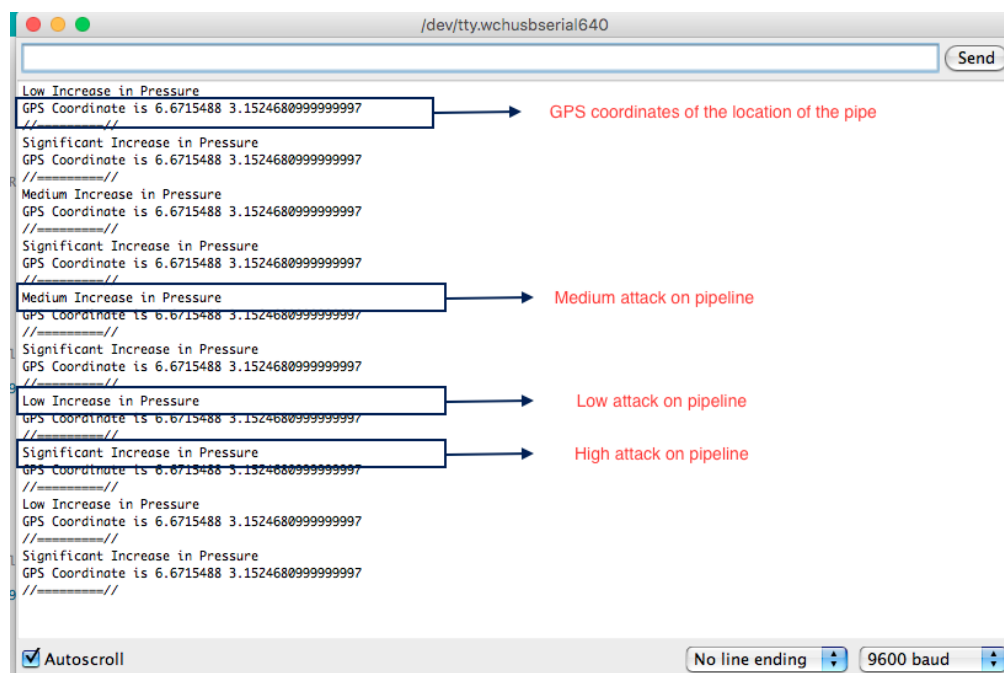
Fig 5. Sample of Message

From Fig 5 above, a sample of the type of message sent to the control center can be seen.

Whenever an impact occurs, the GPS coordinate is sent, regardless of the type of impact.

There are three types of impact; Low Increase in Pressure which has its threshold set at less than 200 and is not considered a threat, Medium Increase in Pressure has its threshold set at less than 400 and should be monitored for immediate attacks and the last type of impact which is the Significant Increase in Pressure and should be considered a threat in which the quadcopter should be deployed.

System Advantages and Improvements

The proposed solution has the following advantages:

1. Remote monitoring of pipelines

2. Remote deployment of UAV

3. Remote deployment of security response

4. Fast response time

IX. CONCLUSION AND RECOMMENDATION

The main aim of this concept paper was to provide a solution to the problem of attacks / vandalisation on pipelines in Nigeria. The solution employed the use of piezoelectric elements as a pipeline leak detection system, which solves it to a certain degree as messages were sent when the threshold value of the assumed pressure of flow were exceeded. From testing, it was discovered the system still requires more improvement in terms of performance and accuracy.

It is concluded that in order to provide a solution that works and provides 100% accuracy, it is advisable to employ better pipeline leak detection systems albeit expensive and used with a drone (autonomous quadcopter) so as to deploy a first-line response system to attacks on pipelines.

The following improvements are suggested:

1. The piezoelectric element used as in the pipeline sensor system can be better improved on in terms of quality and quantity.

2. Better pipeline leak detection system can be deployed e.g. Fibre Optics

3. The current quadcopter in use for the system is very limited in terms of capability and performance. This can be improved upon by using a quadcopter with better frame, flight time, cameras and sensors.

4. The flight controller used is an open source flight controller that does a lot of things. It would be a better system if a flight controller is built from scratch for this solution.

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Intelligent Railway Cross Level Gates and Signaling System using Fuzzy Logic Control Technique

[1]Olaniyi* O. M., [2]Abdullahi, I. M., [3]Maliki, D., [4]Lasore T.M.
[1234]Department of Computer Engineering
Federal University of Technology, Minna, Niger State Nigeria
*mikail.olaniyi@futminna.edu.ng, amibrahim@futminna.edu.ng, maliki.danlami@futminna.edu.ng,
oluwatosin1234@gmail.com

Abstract— **Current manually operated gates at the railway cross levels of developing countries are stressful and time wasting. This has exposed pedestrians to high rate of accident resulting to loss of lives and drastic reduction of the country's economy. Different systems have been developed to prevent rail accidents at the level crossing but they are not effective and in most cases are too expensive to implement. This study presents a prototype model of an intelligent railway cross level gates and signaling system using Mamdani fuzzy logic control technique. The intelligent system has the ability to detect the arrival/departure of a train and close/open the cross level gates respectively. The system response was evaluated with respect to time. The results after the evaluation of the developed system showed that the system with fuzzy intelligent control technique has a high response with respect to time compared to a system without an intelligent technique. The large scale implementation of the developed intelligent railway cross-level gate and signaling system can be used to prevent avoidable accident occurrence at the level crossings and thus, reduces loss of lives as well as improvement of the nation's economy through efficient delivery of goods and services in Africa.**

Keywords — ***Signaling System, Cross levels Gates, Fuzzy Logic, Railway, and Intelligence.***

I. INTRODUCTION

Transportation is the movement of people, good and services from one geographical location to another. Different modes of transportation include air, land and water. Transportation enables trade between persons and this is essential for the development of civilization [1]. Since road transportation system could not ascertain safety and its accident could not be accurately prevented, the railway transportation system is the most suitable and cheapest mode of transportation for heavy traffic flows with its greatest carrying capacity in overland transport modes and freight movement within different parts of the country [2].

In Nigeria, over eighty percent of rail accident occurs on railway crossings [3]. In the light of this, the high rate at which derailment occur at the railway cross levels had caused loss of lives, goods, services which had degraded the Nigeria's economy [4]. Common manually operated gates in Nigeria at cross levels include: Okuku-Oshogbo, Iddo-Apapa, Agbado-Ijoko, Agege and Ikeja,Lagos State, Nigeria. This operational method has a lot of bottlenecks including stress and energy consumption on the attached workforce and high cost of manpower management involved for opening and closing of such cross level gates.

An intelligent system capable of emulating these properties of imprecision and vagueness in some aspects of human intelligence at cross level gates could be adapted to effectively monitor and control railway cross level gate and signalling signs for pedestrians. This technological development will provide preventive measures for motorists, and pedestrians against train-motorists and train-pedestrians accident especially at the cross levels. In rail network, signalling is globally seen as the backbone to safety and efficiency.

In this paper, the concept of Fuzzy Logic Controller designs in Fuzzy expert system development is used to develop an intelligent prototype model of cross level gates and signaling systems for effective management of motorist and pedestrians at railway cross levels. The develop model is capable of controlling motorists and pedestrians passage at cross levels through prior alerts, audible warning sound and closure of gates. The large scale adaptation of the developed intelligent railway cross-level gate and signaling system at developing countries railway is expected to prevent avoidable accident occurrence at the level crossings and thus, reduces loss of lives as well as improvement of the nation's economy through efficient delivery of goods and services.

The remaining section of the paper is organized into: Section 2 provides review of related works; Section 3 gives system mathematical modelling; Section 4 presents System design and development Methodology; Section 5 gives the Results; Section 6 Conclusion and scope for future improvements.

II. RELATED WORKS

A number of related works have been reported in the development of railway cross level gates for the prevention of accident at the level crossing thereby enabling safety of lives and property.

In the approach of [5], load cells were used as pressure sensors to detect the arrival of the incoming trains through the exertion of trains on the load cells. This process was used control the operation of cross level gates. The approach enjoyed fair efficiency and ease of implementation. The

limitation of this work lies in its cost of implementation. Also, load cells are highly affected by environmental condition like temperature.

Similar Field Programmable Grid Array (FPGA) based System on Chip (SoC) was developed in [6].In this work, FPGA-SoC was used to prevent accident on railway cross levels. The system uses two Radio Frequency (RF) transceivers for communication between the incoming train and the cross levels. The SoC was used to prevent accident at the cross levels based on the communication of the two RF transmitters. The system enjoyed better wireless data communication to avert possible railway cross level accident. The developed system of [6] was, however, expensive to implement. Besides, obstruction of Fresnel Zone could result in accident in the system design. The design consideration in [6] attempt was not resource friendly. Only five out of four hundred and seventy five pin was used for system development. RF transceiver can be affected by other Signal generating devices and thus, lead to fatal accident at cross levels.

In [7], a microcontroller based railway gate and crossing control system based on magnetic sensors was developed. The magnetic sensors were used to detect the trains to control the operation of the cross level gates. The system was capable of reducing high level of human involvement at cross levels. The system is, however, flattered by high power consumption and very high delay in the process of cross level gate closure. This much longer delay could lead to unnecessary road traffic at the cross levels. Also in [8], Programmable Logic controller for automatic level crossing that uses sensors to detect the arrival and departure of trains and use of many devices to control the operation of the gates was developed. Flexibility and efficient operation are the strength of this work. The system suffers from design complexity which could lead fatal and unexpected accident at the crossing levels. It is not economical because it is too expensive to implement.

Similar system developed around vibration sensors in obstacle detection in railway network was developed in [9]. The vibration sensors are used to detect the arrival of trains and signals are sent to Infrared sensor so that the gates at the cross levels are operated based on the received signals. This work enjoyed good performance, human involvement and errors reduction. High-level human expertise is needed in the mounting orientation of the vibration sensors.

Also authors in [10] developed an automatic railway gate control system using a microcontroller. This system uses inductive sensors to detect the arrival of trains to control the operation of the gates at the cross levels. The strength of this system lies in low power consumption and its efficient operation. However, the system cannot detect obstacles and thus could lead to high rate of accident at the level crossings. The system design proposition is time wasting at cross levels which could lead to high traffic congestion at the cross levels.

In this paper, we improved on these baseline related works by developing intelligent system capable of detecting the arrival/departure of a train on the rail track to control the operation of the cross level gates using Mamdami Fuzzy logic control technique. Fuzzy Logic addresses the ambiguity in human thinking in perceptions and interpretations by its ability to mimic human reasoning using a small number of rules and

still produces a smooth output. The developed system has the capacity to reduce high human involvement, errors, time wasting and unnecessary traffic congestion at the level crossings. It is very easy to implement and prevent accident at the cross levels thereby ensuring safety of lives and property as well as efficient delivery of goods and services for the improvement of the country's economy.

III. SYSTEM MATHEMATICAL MODEL

The main focus of this study is effective control of accidents through closure and opening of gates at the level crossing by the use of DC motors. The Fuzzy Logic Control of this control environment is shown in Figure 1.
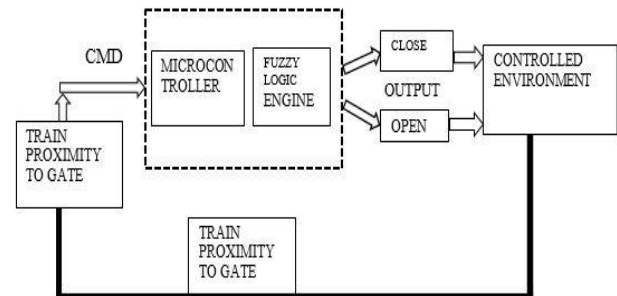

Fig.1. Fuzzy logic control environment

Where:

CMD = Targeted train proximity

Train proximity to gate = Feedback from sensor in the controlled environment

Output = Close, Open

Fig.1. Fuzzy Logic Controller for the Intelligent System

From Figure 1, the behavior of DC motor output was modelled and used to evaluate the system response in gate control. The motor consists of the armature, inductor powered by applied voltage (Va). Torque, back e.m.f. and armature current are generated when the motor is powered by the applied voltage. The mathematical modelling of both electrical and mechanical system of Figure 2 is as follows:
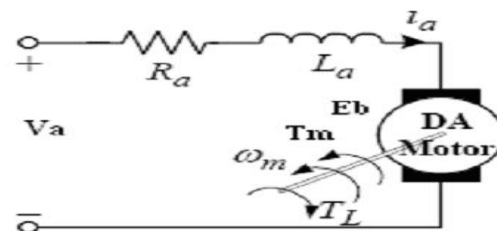

Fig. 2. Modelling diagram of gate control of the intelligent Railway system

For the Electrical System

$$Va(t) = Raia(t) + La\frac{di(t)}{dt} + Eb(t)$$

$$Va(s) = RaIa(s) + LaSIa(s) + Eb(s)$$

$$\text{(1)}$$

$$Tm(s) = K_t ia(t)$$
$$Tm(s) = K_t\, Ia(s)$$

$$Ia(s) = \frac{Tm(s)}{K_t}$$

$$\text{(2)}$$

<u>For the Mechanical System</u>
Torque:

$$Tm(s) = (JmS^2 + BmS)\theta m(s) \qquad \text{(3)}$$

Back e.m.f.:

$$Eb(t) = Kb\frac{\partial \theta m(t)}{\partial t}$$

$$Eb(s) = KbS\theta m(s) \qquad \text{(4)}$$

From Equation (1)

$$Va(s) = RaIa(s) + LaSIa(s) + Eb(s)$$

Substitute Equation (2) into Equation (1)

$$Va(s) = Ra\frac{Tm(s)}{K_t} + LaS\frac{Tm(s)}{K_t} + Eb(s)$$

$$Va(s) = \frac{RaTm(s) + LaSTm(s)}{K_t} + Eb(s)$$

$$Va(s) = \frac{Tm(s)[Ra + LaS]}{K_t} + Eb(s) \qquad \text{(5)}$$

Substituting Equation (3) into Equation (5)

$$Va(s) = \frac{(JmS^2 + BmS)(Ra + LaS)\theta m(s)}{K_t} + Eb(s)$$

$$\text{(6)}$$

Removing back e.m.f $Eb(s)$
Substituting Equation (4) into Equation (6)

$$Va(s) = \frac{(JmS^2 + BmS)(Ra + LaS)\theta m(s)}{K_t} + KbS\theta m(s)$$

$$Va(s) = \frac{(Ra + LaS)(JmS^2 + BmS)\theta m(s)}{K_t} + KbS\theta m(s)$$

$$Va(s) = \frac{(Ra + LaS)(JmS + Bm)S\theta m(s)}{K_t} + KbS\theta m(s)$$

Factorising out $S\theta m(s)$

$$Va(s) = S\theta m(s)\left(\frac{(Ra + LaS)(JmS + Bm)}{K_t} + Kb\right)$$

$$G(s) = T.F. = \frac{Output}{Input} = \frac{\theta m(s)}{Va(s)}$$

$$G(s) = \frac{1}{S\left(\dfrac{(Ra + LaS)(JmS + Bm)}{K_t} + Kb\right)}$$

$$G(s) = \frac{1}{S\left(\dfrac{(Ra + LaS)(JmS + Bm) + K_t K_b}{K_t}\right)}$$

$$G(s) = \frac{K_t}{S\big((Ra + LaS)(JmS + Bm)\big) + K_t K_b}$$

Where:
$Ra\;=\;Armature\ resistance$
$La\;=\;Armature\ Inductance$
$Jm\;=\;Motor\ inertia$
$K_b\;=\;Back\ e.m.f\ constant$
$G_s = Transfer\ function$
$I_a = Armature\ current$
$V_a = Applied\ Voltage$
$Tm_{s=}\ Motor\ Torque$
$K_t = Torque\ Constant$
The following values were obtained based on the proposed DC motor to be used for the intelligent system.

TABLE 1: SOME PARAMETERS VLAUES

Parameter	Value
Kt	2NM/Amp
Kb	1 V/rad/sec
B	16.25 MN/rad sec
J	4 Kg/m2
Ra	0.35Ω
L	0.4H

Substituting the following values into the transfer function:

We have:

$$G(S) = \frac{2}{2S^3 + 7S^2 + 6S + 2} \qquad \text{(6)}$$

IV SYSTEM DESIGN AND DEVELOPMENT

The intelligent prototype of cross level gates and signaling systems was developed around Mamdani's Fuzzy Inference system modelled and simulated in MATLAB 2013a. The system with Mamdani Fuzzy Logic Controller gave high response with respect to time compared to a system without an intelligent technique. This significantly improves the performance of the system because intelligent techniques are important tools for decision making. Arduino IDE software was used for the programming of the Atmega2560 microcontroller chip, the fuzzy engine, which aids the effectiveness and efficient control of the entire working of the system

A. Hardware Subsystem Development Considerations

The hardware subsystem consists of five different units namely: Power Supply Unit, Gate Control Unit (Servo motors), Signaling Unit in Liquid crystal Display (LCD),

Lighting system in Light Emitting Diode {LED}, Buzzer), Fuzzy Control Unit (ATMEGA 2560) and the Sensing Unit using Passive Infra-red (PIR)). Figure 3 describes overall system block diagram.
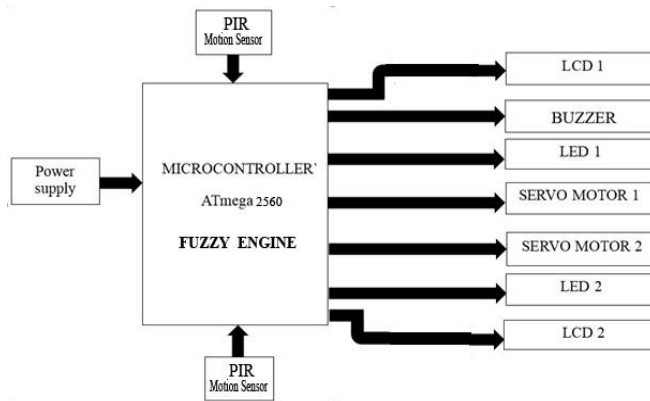

Fig.3. Overall System Block Diagram

In developed system, the Passive Infrared Sensors detect both the arrival and departure of a train and sends a signal to the Atmega2560 microcontroller which enables the Buzzers, LCD and LED's to display safety control measures to all road users and the Servo Motor to open or close the gates at the railway level crossing. Figure 4 shows the inter-operability of each electronic device in the overall circuit diagram of the developed system.
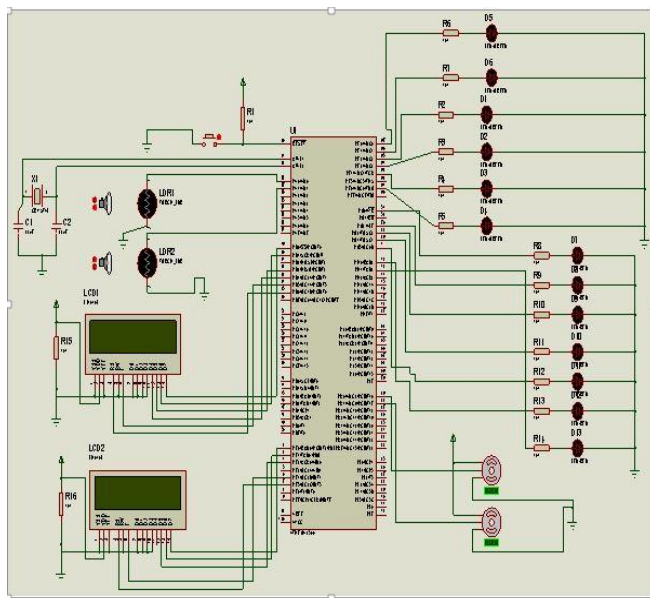

Fig. 4: System Circuit Diagram

B. Software Design consideration: Fuzzy Logic Controller Design

For the design of controller for the intelligent railway cross level gates and signaling system, input and output variables that affect the operation of the cross level gate were taken into consideration. These input and output variables were further defined by means of membership functions. The input variables are speed and distance while the output variable is the gate control. The five stages of Mandami's Fuzzy inference system in Fuzzification, Fuzzy rules combination, consequence, aggregation of output and defuzzification were modelled in MATLAB 2013a Fuzzy Logic Toolbox. The speed input variable was fuzzified from crisp input into linguistic variable of Low, Average and High. Usually the speed of Railway is from zero to sixty five kilometer to cross level. This universe of discourse (0-65km) was used to assign linguistic values to fuzzified linguistic speed variables as follows: Low (10.75 0), Average (10.75 32.5) and High(11.04 65) using Gaussian Membership function as shown in Figure 5.
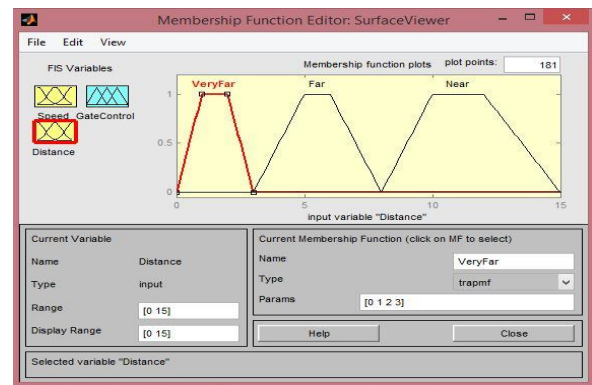

Fig.5. Speed Membership Function

Consequently, the distance (PIR Sensor Sensing distance) input variable was fuzzified from crisp input into linguistic variable of Very far, Far and Near. Usually the distance of Railway is from zero to fifteen meter to Cross level. This universe of discourse (0-15m) was used to assign linguistic values to fuzzified linguistic distance variables as follows: Very far (0 1 2 3), Far (3 5 6 8) and Near (8 10 12 15) using Triangular Membership function as shown in Figure 6.

Also, the output (Cross Leve Gate opening/closure) variable was fuzzified from crisp input into linguistic variable of Fast, Moderate and Slow. Usually the optimum time to open and close the Railway gate at cross level is from zero to twelve seconds. This universe of discourse (0-12s) was used to assign linguistic values to fuzzified linguistic distance variables as follows: Fast (0 2 4), Moderate (4 6 8) and Slow (8 10 12) using Triangular Membership function as shown in Figure 7.
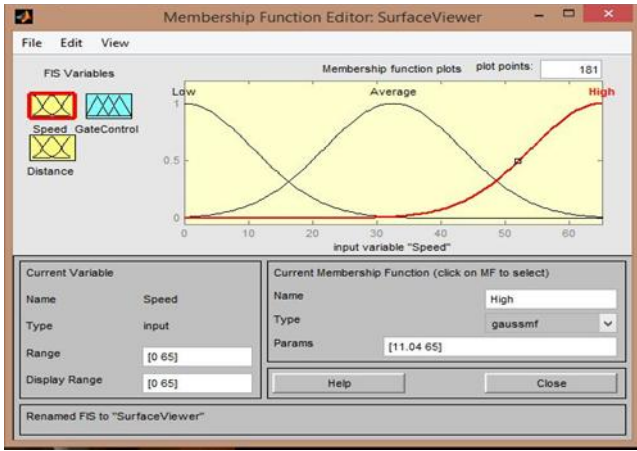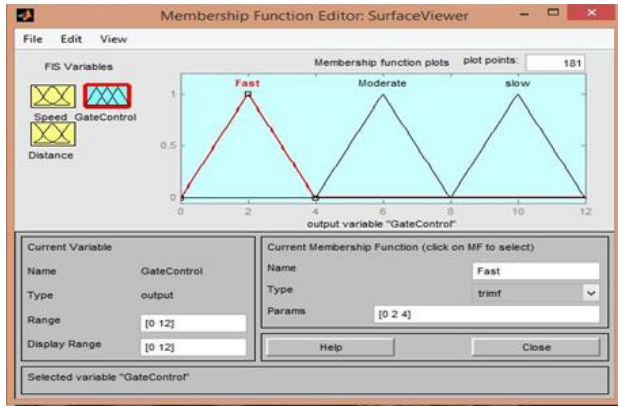
Fig. 6. Distance Membership Function

Fig.7.Gate Control Membership Function

The fuzzy rule for the intelligent system was modelled based on these fuzzified input and output variables using IF and Then statement related in Table in 2.

Table 2: Railway cross level and signaling system linguistic rules

Rule No	Rule statement
Rule 1	If the Speed is low and the distance is very far, gate operation is slow
Rule 2	If the Speed is average and the distance is very far, gate operation is slow
Rule 3	If the Speed is high and the distance is very far, gate operation is fast
Rule 4	If the Speed is low and the distance is far, gate operation is slow
Rule 5	If the Speed is average and the distance is far, gate operation is moderate
Rule 6	If the Speed is high and the distance is far, gate operation is fast

Rule 7	If the Speed is low and the distance is near, gate operation is fast
Rule 8	If the Speed is average and the distance is near, gate operation is fast
Rule 9	If the Speed is high and the distance is near, gate operation is fast.

Using the rule editor in Figure 8, the linguistic rules

in Table 2 was used to map input space to output space to control the entire system. The rule editor determines the overall operation of the system. The Linguistic rule consists of two antecedent block (IF and THEN) and these two is joined with the "AND" statement.

The execution of the rule that fires a specific output was designed in a way to match the desired output. The rules used are based on the fuzzified input of the speed and distance and their range. Consequently, a 3x3 matrix of nine rules was developed and these inputs were capable of giving desired output of the system as shown in Figure 10. The output is the probability that the gate control will be (S) slow, Speed, (M) moderate and (F) fast.
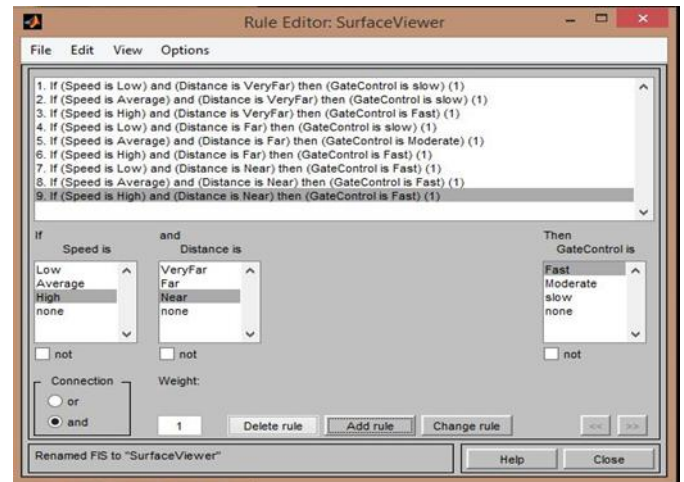

Fig. 9. Rule Structure using MATLAB fuzzy rule   editor

Figure 10: Fuzzy Rule Matrix of the Intelligent System

There is an evident equilibrium to the matrix after the conclusion had been transferred from the nine rules to the matrix. The column side represents the speed while the row side represents the distance. The system flow chat is represented by Figure 11. The system is always in the "Safe Mode", when a train is detected "Unsafe Mode" it triggers the gates to close. The system returns back to "Safe Mode" at the departure of the train.
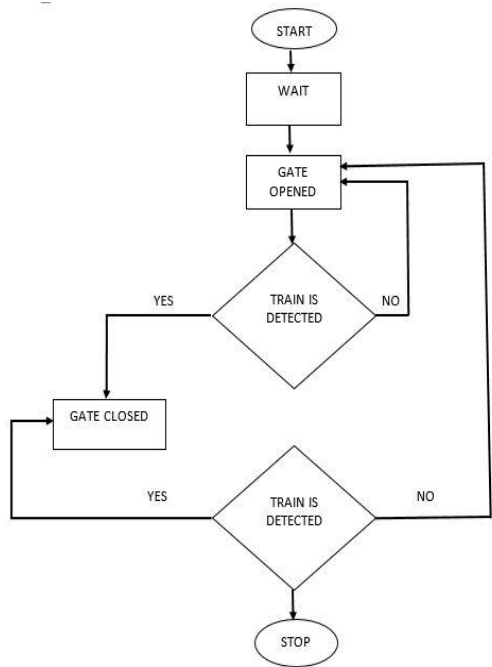

Fig.. 11. The intelligent Railway System Flowchart

Figure 12 shows the Simulink representation of the intelligent system fuzzy logic controller design in sections 4.3 with the transfer function of the developed mathematical modelling of controlling motors in equation 6.. The result of the system response with and without Fuzzy logic Controller is reported in section 5.
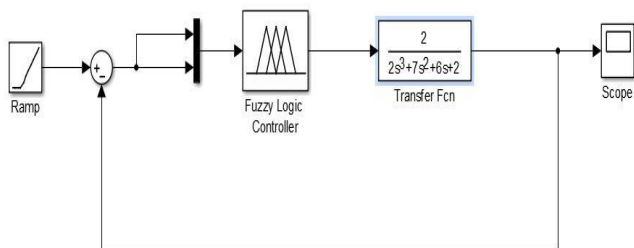

Fig.12.. Matlab Simulink Diagram for the investigation of System Response

V RESULTS AND DISCUSSIONS

Figure 13 shows the surface viewer, the result of the functionality of the developed system in terms of the relationship of the speed, distance and the gate control membership functions. On the surface viewer plot, X-axis represents speed, Y-axis represents Distance and the Z-axis represents the Gate Control. The Fuzzy Logic Controller ensures that both membership Function and the rule matrix were carefully taken into consideration for the control of the gates at the railway cross levels.
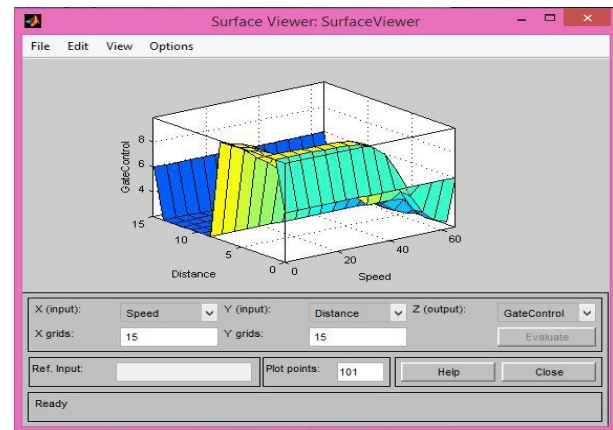
Fig.. 13. Surface Viewer of Input and Output Relationship

Considering Figure12, two different outputs were obtained to justify the use of fuzzy Logic control in evaluating the system response. First, system output response without the implementation of Fuzzy Logic Controller is represented by figure 14. Fuzzy Logic controller block in Figure 12 was removed. The absence of fuzzy logic controller within the system as shown in Figure 14 makes the performance of the system unstable
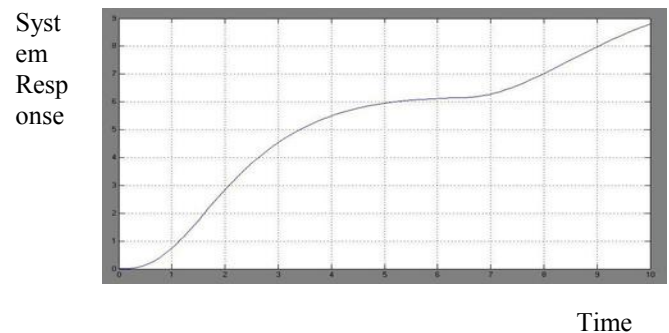
Fig. 14. System response without FL controller

However when the Fuzzy Logic controller was added to Figure 12, the system instability was reduced to the lowest minimum and better system performance was achieved as shown in Figure 15.

The overall prototype diagram of the developed intelligent Railway cross level gates and signaling systems is shown in Figure 16.

Fig. 15. System response with r fuzzy logic controller

Fig. 16: Developed prototype of an Intelligent Railway Cross level gates and signalling System

VI. CONCLUSIONS AND SCOPE FOR FUTURE RESEARCH

In this paper, we have presented the design and development of prototype model of an intelligent railway cross level gate and signalling system using fuzzy logic control technique. The qualitative test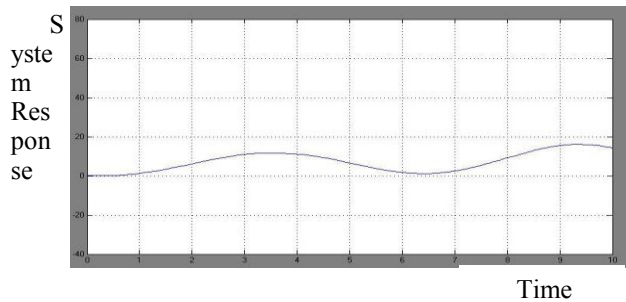ing of the developed system showed that it is efficient in the prevention of accident at the cross levels. The developed prototype of the intelligent system is capable of detecting both the arrival and departure of a train and control automatically the operation of the railway cross level gates. Also, appropriate signage and audible measures were integrated to display and control road users at the level crossing thereby reducing high human involvement, time wastage and heavy traffic flow at the level crossings. The system's low cost of implementation and high response proved that the performance at various conditions is preferable when compared to existing systems. The large scale implementation of the developed intelligent railway cross-level gate and signaling system can be used to prevent avoidable accident occurrence at the level crossings and thus, reduces loss of lives as well as improvement of the nation's economy through efficient delivery of goods and services in Africa.

The following scopes are suggested for future research endeavours:

1. Sensing design and development of the system could be investigated with an analogue accelerometer or a magnetometer for improved performance of the Intelligent Railway System.

2. Investigation of other artificial intelligent techniques such as Particle Swarm Optimization (PSO), Genetic Algorithm (GA) to evaluate the performance of different intelligent techniques and make recommendations based on the results obtained.

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Adequate Compensation as a Tool for Conflict Resolution in Oil Polluted Wetlands of Niger Delta Region of Nigeria

Bello, Oyewole Mustapha; Olukolajo, Michael Ayodele

Department of Estate Management, Federal University of Technology, Akure
oyewolebello@yahoo.com; maolukolajo@futa.edu.ng

Abstract—**Nigeria as a nation is battling with conflicts in virtually all geopolitical zones of the country. A major conflicting region is Niger Delta where oil and gas resource of the nation domicile and this has become a major threat to the national development as well as the economic base of the nation. The conflict in Niger Delta has many dimensions to it and has given birth to unrepentant militant whose aim is to truncate the nation if their demands were not met. Although attempts have been made by the government at various levels as well as the multi-national oil companies to address the problems emanating from the negative effect of oil and gas exploration, production and transportation in the region, the desired peace is yet to be fully realized. As part of the solution to the conflict in Niger Delta, this paper argued that adequate compensation to oil pollution victim is a right step in right direction. However, to arrive at such compensation value, there is need to review the legal framework, composition of heads of claim, as well as the procedural guide to the conduct of compensation valuation among the Nigerian Estate Surveyors and Valuers.**

Keywords — Compensation; Conflict Resolution; Estate Surveyors; Niger Delta; Oil Spill

I. INTRODUCTION

Nigeria as a nation has suffered a great deal of conflicts virtually in all her geo-political divisions. While some of the conflicting issues are as old as the nation, the recent struggles include the menace of boko haram which has assumed an international terrorism status; and conflict over oil resource control in Niger Delta region of the nation. Some of the pioneers and leaders of these struggles have vowed never to allow the nation experience peace until they realize their goals. Although some of the conflicts have been condemned by many and their demands described as frivolous, others especially those relating to oil resource control and environmental pollution in Niger Delta cannot not be disregarded. The situation in Niger Delta has been described as pathetic and unfortunate; the crisis in the Niger Delta has economic undertone at the onset but has now become a hydra-headed monster, threatening both the political and economic security of the nation; degenerating to source of friction between and among communities and nationalities in the oil bearing region [1]. The conventional methods of dealing with conflicts have failed to broker peace but instead have heightened tension and insecurity in the region [2].

Since the discovery of oil in Oloibiri in 1956, the Niger Delta has been exposed to varying degree of oil spillage arising from exploration, exploitation, transportation, loading and off-loading of crude oil and its product. Reference [3] described the region as one of the most oil-polluted places on the planet and reported the inconsistencies in the records given on oil spills in this region. Thousands of barrels of oil has spilt in Niger Delta since oil discovery and this has meted untold hardship on the residents of oil producing communities culminating into loss of means of livelihood and sustainability [4, 5]. Reference [6] asserts that "the people of the Niger Delta region have continued to pay the price of development of the nation with their lives, health, cultures, environment and other means of livelihood". The impoverishment of Niger Delta land has led to internally displacement of many residents from their native land [7, 8].

For losses suffered from oil spill by its victims, the standard practice is to award compensation that will launch them back to the position they were before the mishap. Reference [9] observed that inadequate or meager compensation for oil spill damage is a major cause of conflict in the oil producing communities and some of the fallout of this is destruction of oil and gas installations, income loss, loss of man hours, loss of peaceful coexistence, and abduction of expatriates and indigenous oil workers. From the foregoing therefore, this paper seeks to identify various issues responsible for inadequacies in compensation for oil spill damage in Niger Delta region with a view to recommend measures geared towards improving the present situation and forestall avoidable crisis

II. THE NIGER DELTA WETLAND AND OIL PRODUCTION

The Niger Delta region traverses the South-South, South-Western and South-Eastern geopolitical zones comprising nine states - Akwa Ibom, Bayelsa, Delta, Edo, Cross River, Imo, Rivers, and Ondo states of Nigeria. The region occupies a surface area of 112,000 square kilometers, a home to about 3000 communities with a total population of over 31 million people [10]. The ethnic groups in the region include the Urhobo, Ijaw, Isoko, Itsekiri, Efik, Etche, Ibibio, Ikwerre, Ogoni, Andoni, Kwale-Igbo and Edo. The Niger Delta region is Nigeria's largest wetland with a landmass of 70,000 square kilometres. It is the largest wetland in Africa and among the three largest in the world. It hosts huge deposits of oil and gas in Nigeria and exploitation of these resources provides over ninety five percent of the foreign exchange earnings of the country [11].

The Niger Delta's environment comprises four ecological zones, that is, coastal barrier islands; freshwater swamps; mangrove swamp forests and lowland rainforest [12]. Many people in the region depend on services provided by the

ecosystem for their survival. The occupational structures of the people are mainly farming, fishing, traditional mangrove exploitation, raffia/oil palm etc. The introduction of oil exploration in this fragile ecosystem dated back to 1938, when Shell D'Archy was granted an exploration license to explore the region for possible crude oil extraction. Oil was first discovered at Oloibiri (presently in Bayelsa State) in 1956 and commercial production began in 1958. With this success Nigeria witnessed the influx of many foreign oil producing companies operating both onshore and off shore Niger Delta; thus, Nigeria joined the Organisation of Petroleum Exporting Countries (OPEC) in 1971. (See figure 1).

Reference [13] highlighted the effect of oil exploration and production on both natural and built environment, public health, employment in the peasant economy, and socio-economic impact on individual and Institution (See figure 2). Not less than 90% of oil spill in Niger Delta is yet to be cleaned up [14], therefore resulting to cumulative environmental problems with grave consequences on the residents particularly.
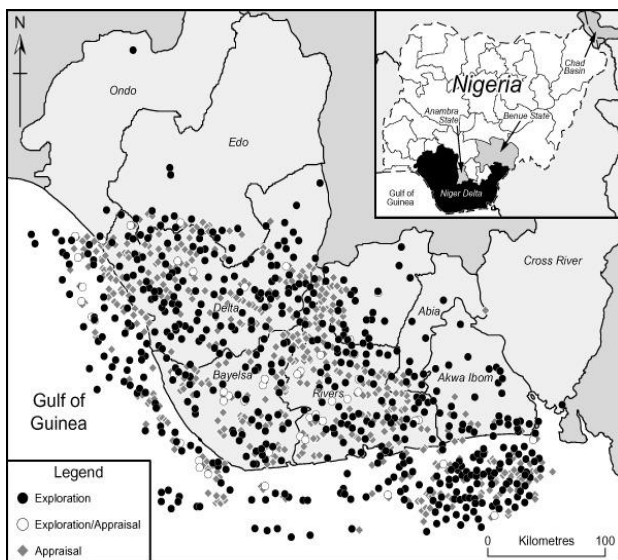

Figure 1: Map of the Niger Delta region of Nigeria showing the nine States and categories of oil well.
Inset: Map of Nigeria showing the Niger Delta, the Chad Basin and Anambra and Benue States
Notes: Exploration well – dark dot; exploration/appraisal well – hollow circle; appraisal well: diamond shape.
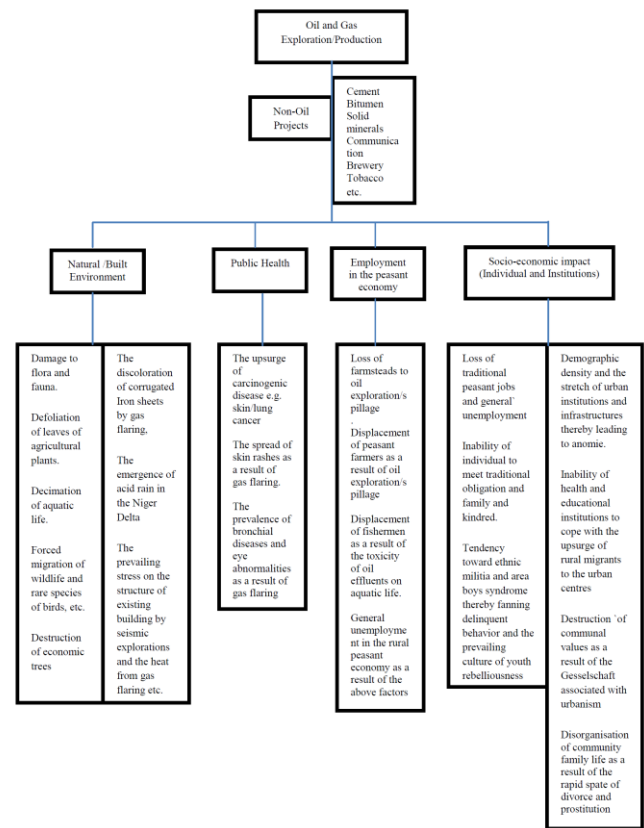Source: Adapted from Anifowose, Lawler, Horst, and Chapman (2014).

Figure. 2.   How oil exploration and production have adversely affected every facet of life of the Niger Delta people (Source: Jike, 2010).

III. NATURE OF CONFLICT IN NIGER DELTA

As a mainstay of Nigerian economy, crude oil commonly referred to as black gold to Nigeria is a blessing whereas the communities where this resource is extracted perceive the black gold as a curse [15]. Reference [16] gave three dimensional perspectives of contending issues underpinning oil conflict in Nigeria's Niger Delta as connection between institutional, ecological and social factors. The most important of the institutional perspective of the conflict is the arrogation and monopolizing access to the oil-bearing land by the state via the instrumentality of Land Use Act 1978, and denial of courts' jurisdiction over any matter relating to compensation on land. Under Nigerian law, local communities have no legal rights to oil and gas reserves in their territory. In term of ecological and social perspectives, [16] argued based on the residents' view, that oil conflict in Niger Delta is attributable to incessant oil spill in the environment by multi-national oil companies and the believe that there is an alliance between government and oil companies to the detriment of the people who bears the brunt of environmental damage.

Reference [11] identified sources of conflict in compensation payment in Rivers State, Nigeria. These include unwillingness on the part of the oil prospecting companies to pay adequate compensation, carefree attitude of the oil and gas prospecting firm, protracted litigation, selfishness of some community representatives, and lack of basic infrastructures in oil producing communities. Reference [1] argued that conflicts in the Niger Delta resulted from abject poverty and environmental degradation to which the region has been subjected over the years. One way by which oil companies have sought solution to incessant faceoff with their host communities in Niger Delta is instituting or intensifying

corporate social responsibility (CSR); however this has failed to lessen incidence of violent conflict [17].

Reference [17] conceptualized the conflict in Niger Delta as multifaceted, the root cause of which is political and economic factors. These two causes gave rice to proximate causes which are expressed in both marginalization and poverty, and environmental factors. The results of these are frustration and feeling of powerlessness, increased grievance due to loss of livelihood and widespread sense of relative deprivation (see figure 3).
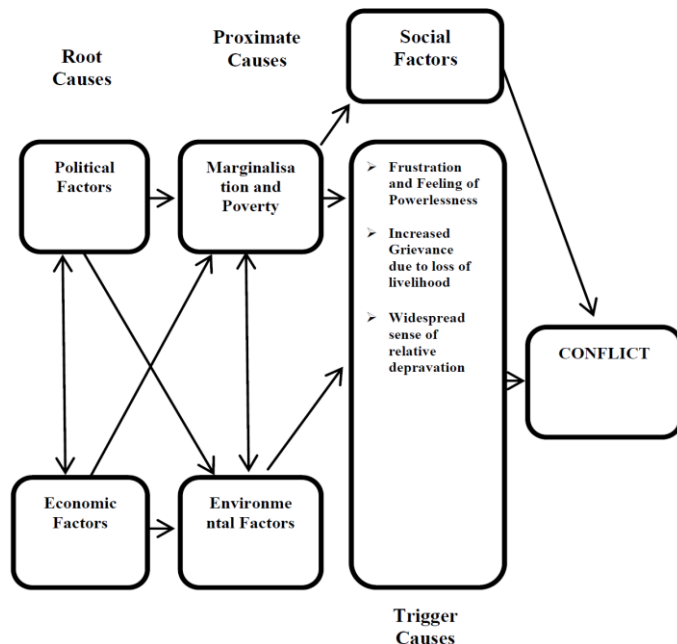

Figure 3.   Causes of Conflict in the Niger Delta
(Source: Idemudia & Ite, 2006)

Reference [18] traced intractable problem over compensation for oil spill damage in Nigeria to colonial origin of the oil industry and skewed template of laws which disregard the interest of victims of the negative externalities from the oil industry; the compensation paid by oil industry does not reflect market price and fall short of international standard. The nature of impaired interest in Niger Delta extend beyond goods that are traded in open market, hence [19] claimed that apart from use-goods, oil spill in Niger Delta also affect non-use goods.

In order to effectively manage conflict in Niger Delta, [2] proposed collaborative problem solving method. By this approach, participants, especially the voiceless are given equal chance to express their grievances, views, and have input to the final decision. This improves the understanding of policy makers of the issue at stake and boosts the community trust in government and its intentions. Although this approach is not new, the policy makers have only been playing lip services to issues over the years, the reason why the desired peace seem unattainable.

IV.   SOURCES OF INADEQUACIES IN COMPENSATION FOR OIL
SPILL DAMAGE ASSESSMENT

Although many researchers have advocated for Total Economic Value (TEV) as the correct basis for compensation valuation in Nigeria [20, 21, 22, 19], the current valuation method and existing legal framework underlining the practice are incongruent to the motion. From literature, many factors

have been identified as sources to inadequacies in compensation valuation. Reference [23] scrutinized the process as well as the method employed by valuers in compensation valuation for oil spills damage in Niger Delta and classified potential inadequacies into type 1, 2, and 3 errors. He argued under type 1 error that most of value estimates submitted for compensation claims were speculative and superfluous because of lack of input from professionals such as micro biologists, soil scientists, marine biologists, health, and safety experts etc who could have given scientific evidence to back up the claims. Although he did not state categorically whether the practice had led to under or over valuation, he opined that the figures were not reliable to be regarded as adequate for the intent of equitable compensation since most of the assertions in the valuation reports are not within the primary purview of a valuer. Reference [24] had earlier submitted that the use of environmental experts' input in valuation is the best ways to estimate the impact of contamination to avoid inaccurate estimation of values. Also this input will assist in precise estimation of remediation costs and determination of remediation period. The type-2 category of inadequacy approach is in the estimation of compensation value based on equivalent reinstatement cost method for intangibles goods such as fishing right, use of "one best judgment" by some valuers - which is unconventional, untested, unknown and lack acceptability and, reliance on OPTS (Oil Producers Trade Section of the Lagos Chamber of Commerce and Industry - a private sector group which represents the interests of oil and gas producing companies in Nigeria) rate which lack legal footings for valuation of crops/economic trees contribute to unjust compensation. The last category (type 3 error) is the use of improvised or arbitrary data in estimating compensation value.

Reference [24] identified inadequacies in policies and regulation entrenched in Land Use Act, 1978 as contributing factor to inadequate compensation valuation in Nigeria. The Act is silent on the issues bothering on injurious affection and disturbance which may accompany compulsory acquisition or any other form of pollution damage. The current legislations guiding compensation practice in Nigeria would always result to inadequate compensation [25]. In the same vein, [26] observed non-inclusion of bare land among head of claims, exclusion of certain classes of crops and trees, and adoption of depreciated cost method against investment method for economic tree among others, leads to undervaluation of claimants' interests. Although the OPTS rate for compensation is considered better in scope and amount than the rate an "appropriate officer" under Land Use Act prescribes, [21] opined that apart from the fact that the rates are not updated regularly, their application in valuation for compensation exercise is inconsistent with correct valuation practice of income yielding properties and thereby leads to unreliable value opinion. He proposed the use investment method of valuation in place of this rate. Reference [27] opined that lawfulness of the OPTS rates being adopted by the oil companies is doubtful; hence its enforcement is sometimes questionable and meet with fierce resistance.

Non-inclusion of non-use goods in the calculation of the amount due to claimant was identified by [22] as another source of inadequacies in compensation valuation. The sampled populations from oil producing communities in Niger Delta were asked to express their level of satisfactions over 64 satisfaction questions via contingent valuation method. The results shows that the value of none-use goods which the

existing legal framework does not recognize was estimated to be N5,696,708,185.00, whereas the opinion of experts expressed on use-goods was N156,600,000.00. This indicates that the value of non-use goods far exceed the use-value. They concluded that the agitation for adequate compensation among the oil producing communities stem from non-payment of compensation on their non-use goods. Their study identified dissatisfactions among claimants over the compensation paid for oil spills in the region. Reference [28] analysed the content of Land Use Act, 1978 in respect of its provision for compensation heads of claim. He argued that the Act leaves open a number of claims of the victims for valuers and courts to decide. The undefined claims bring about undervaluation of the victims' interests. Reference [26]) also identified that the provisions of Land Use Act which did not include bare land in head of claims, exclusion of certain classes of crops and trees, adoption of depreciated cost method against investment method among others leads to undervaluation of claimants' interests.

Legal framework for compensation can be described as adequate only if it achieves the fundamental principle of placing the injured in the earlier situation prior the mishap. There had been many criticism of the current legal framework guiding compensation valuation in Nigeria. Reference [5] observed that due to many grey areas in various statutes governing compensation in oil and gas operation in Nigeria, oil multinational giants have found grounds to either avoid fair compensation to the pollution victims or deliberately cause undue delay through faulty Nigeria judicial system. Eventually, the victims most time loose the case on technical grounds and sometimes find payment for legal charges difficult. Reference [29] observed that the existing legal system on compensation for damage seems to push oil victims towards seeking redress in the courts because of the inadequacies inherent in the alternatives. Reference [21] had contended that policy and legal framework to assess full economic value arising from damage to natural resources to individual species based on economic functions in Nigeria is lacking.

Reference [30] claimed that the legal framework guiding valuation for compensation purpose of oil pollution damage in Nigerian does not specifically take into cognizance the natural resource damage. The injured only rely on common laws to make recovery for damage to their property because most of the existing statutes and regulations confer no right to private action. Because of the difficulties in measurement of lost to ecosystem goods and services, many government trustees prefer to quantify the damage through resource replacement cost. Reference [31] posited that this approach has nothing to do with the actual social wealth damages that have already occurred on account of ecosystem resource loss or degradation. Even though, the replacement cost may be more than the avoided social cost however, most times the latter is vastly under represented.

From the foregoing discussion, sources of inadequacies in compensation for oil spill damage can be summarily categorized under four headings, namely, inadequate legal framework, incomprehensive heads of claim, inappropriate approach to valuation method, and lack/poor input to valuation assessment by other experts (see figure 4). The conflict generated by the inadequate compensation has reached a point whereby peace must be sought in earnest in order to curb the consequence already ravaging the region.
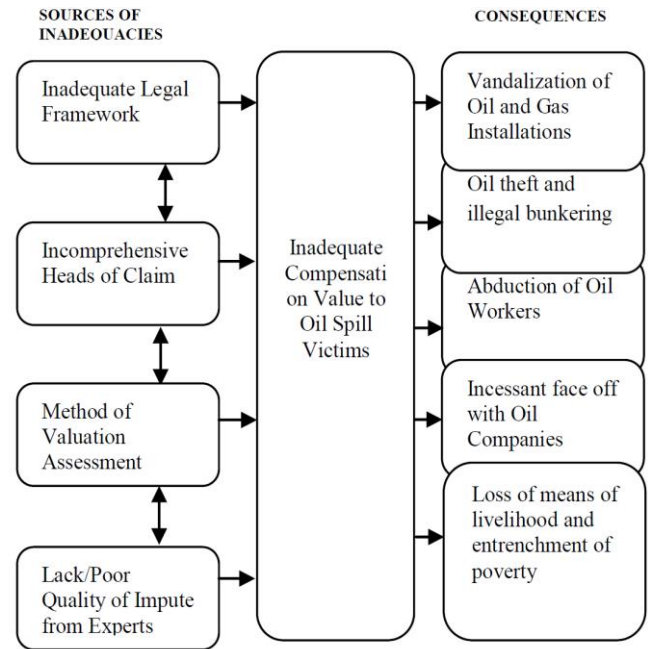

Figure 4. Sources of Inadequacies in compensation for oil spill damage and their consequences in Niger Delta Region

V. ATTEMPTS TOWARDS RESOLVING CONFLICT IN NIGER DELTA

Attempts have been made by the Governments at Federal and States as well as multinational oil companies to respond to the conflict in NDR. The very first effort towards addressing the grievances of the ethnicity minority in the region was traced to 1957 when the Nigerian government set up Willink commission with the mandate to investigate the agitation of the people and measures to alley their fear [32]. Findings of the commission indicated that there were inequalities in the allocation of resources from oil and gas extracted from their communities, degradation of natural environment, air pollution, and gross feeling of neglect among the people. Willink report submitted in 1958 led to the establishment of the Niger Delta Development Board (NDDB) in 1961. The mandate of this Board among others was to advise the federal and the regional government of the then Eastern and Western Nigeria on the developmental need and development of the Niger Delta. Not much success was recorded in all these moves.

Reference [32] described the establishment of NDDB as misunderstanding of the right approach to solving NDR problem. There were inherent structural, administrative and funding challenges in the establishment of NDDB and all these hindered it from achieving the desired results. For instance, nobody from the region was appointed to be among the Board members. Failure of NDDB to contribute meaningfully to resolving crisis in NDR led to the establishment of Niger Delta Basin and Rural Development Authority (NDBDA) in 1980 by Alhaji Shehu Shagari civilian regime. The focus of NDBDA was not limited to the Niger Delta, thus revenue from oil was not adequately released for its funding and this further aggrieved the people of NDR with feeling of frustration and neglect.

Oil Mineral Producing Areas Development Commission (OMPADEC) was established by Decree 23 of 1992 as a notable response to the crisis in Niger Delta by Military President Ibrahim Babangida. Through OMPADEC, the government geared up the financial allocation to oil producing state from 1.5 to 3 percent. Although OMAPDEC was perceived as the best approach to solving the environmental degradation caused by the activities of the oil companies, the latter event turned out in the contrary as the commission became a platform to perpetrate corruption [33]. Activities such as award of contracts to the traditional rulers, retired military officers, non-execution of awarded contracts, marred the success of the Commission.

At the return of the political power to the Obasanjo's government under democracy in 1999, one of the early bills sent to the National Assembly was the creation of Niger Delta Development Commission (NDDC) as a replacement for OMPADEC. The NDDC was inaugurated on December 21, 2000 with a mandate to *"facilitate the rapid, even and sustainable development of the Niger Delta into a region that is economically prosperous, socially stable, ecologically regenerative and politically peaceful"*. Reference [34] appraised the performance of NDDC in providing solution to the conflict in Niger Delta with particular focus on Ikot Abasi, Akwa Ibom State. The findings indicated that although development projects were carried out in the communities, 70% of the surveyed population opined that the strategies adopted by the government in tackling poverty in the region did not yield positive results due to non-availability of the fund to the rural poor, lack of community involvement in programmes design, handling and implementation.

A recent move to resolve conflict in the Niger Delta was the amnesty programme instituted by President Yar' Adua in 2009. The Niger Delta militants were given between 6th August to 4th October, 2009 (a 60-day window) to disarm and assent on the amnesty register. At the end of the amnesty period in October, a total of 2,760 arms of different classes and caliber, 3 155 magazines, 287 445 ammunitions, 763 explosives and sticks of dynamite, 1 090 dynamite caps, and 18 gun boats20,192 were recovered from ex-militants and non-militants in Niger Delta by the Presidential Amnesty Committee [35]. The amnesty programme has three dimensions to it - disarmament, demobilization and reintegration (DDR) of the militants, a tool commonly used in conflict. The programme aims at giving more to the militants in Niger Delta following several national embarrassments and sharp decline in daily oil production which led to substantial loss of revenues to the nation. The initial five years of the programme lapsed in December 2015 but has been extended by another two years by the Buhari's government.

Reference [36], summarized the Nigerian government efforts in addressing the incessant oil-related conflicts in NDR as three-pronged strategy. These are the derivation principle, the establishment of developmental bodies and the militarisation approach. The derivation principle increased the oil revenue to the states in Niger Delta from $1\frac{1}{2}$ % to 3% and currently to 13%. The second strategy was the establishment of developmental commissions which brought about Niger Delta Development Board (NNDB) in 1960, the Oil Mineral Producing Areas Development Commission (OMPADEC) in 1992, the Petroleum (Special) Trust Fund (PTF) in 1995, the Niger Delta Development Commission (NDDC) in 2000, and the establishment of the Ministry of Niger Delta Affairs in 2008. Thirdly, the militarisation approach, witnessed the establishment of Joint Task Force. The force grossly violated human rights; this move remains a pointer to the fact that compensation for oil pollution-related conflict is yet to be resolved.

Considering the various moves towards resolving the environmental and developmental conflict in NDR, the situation is yet to attain the desired end. Reference [37] observed that the bitter complaints about abject poverty and ruinous oil pollution, which aggravated the earlier rebellion in NDR, remain largely unaddressed as there is increased threat by the ex-militants to pick up their arms.

VI. RECOMMENDATION

There is urgent need to promote peace in Nigeria and especially the Niger Delta which bear the oil resource on which the economy of the nation rests. This cannot be achieved when private interest and rights is violated especially due to oil pollution. Having highlighted the various issues which made compensation for oil spill damage far from being adequate, it is pertinent to ameliorate the situation. Conceptually, figure 5 shows sources of compensation inadequacies diagrammatically and in line with this thought, the following recommendations are made
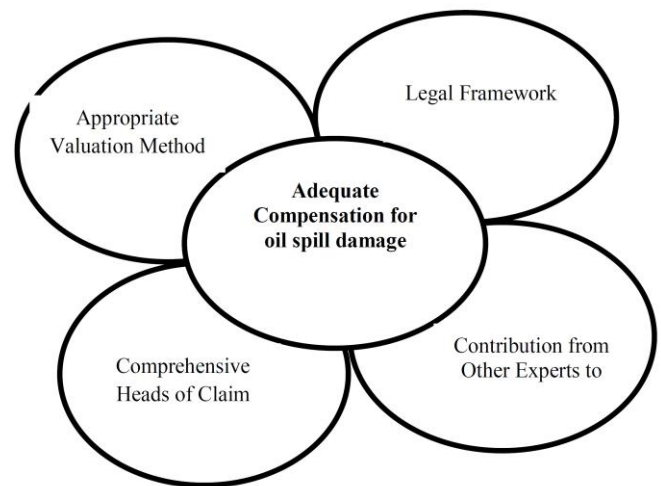
Figure 5: Approach to correcting inadequate compensation for oil spill in Niger Delta

A. *Appropriate Valuation Method*

There is need to revisit the imposition or adoption of predetermined value of claimants' interests by the use of OPTS rate of compensation and other similar rates compiled by the state or oil companies. Adequate compensation goes beyond arriving at figures. Reference [38] had warned that *once valuation becomes divorced from its theoretical roots, numbers can be produced which have little content or meaning, and are defensible only in terms of their political role rather than theoretical basis*. The use of predetermined rate as a substitute to valuation assessment carried out by a qualified Estate Surveyor and Valuer should be discouraged as

this will only fan the already heated atmosphere. Estate Surveyors and Valuers by their training are equipped with right knowledge and skill to determine (using appropriate method of valuation) an equitable value for impaired interests of oil victims. It is also pertinent that the Nigerian Institution of Estate Surveyors and Valuers (NIESV) and Estate Surveyors and Valuers Registration Board of Nigeria (ESVARBON) should continue to educate their members via Continue Professional Development (CPD) and other education platforms on the valuation of wetlands and natural environment. This will update their knowledge and furnish them with developments in environmental valuation which many of these professionals are not well informed about.

B. Comprehensive Heads of Claim

Studies have shown that certain claimants' interests are excluded from compensation assessment. This sometimes is as a result of reliance on OPTS rate as the guiding document for valuation purpose. Non-inclusion the items considered valuable to the compensation claimants most often constitute conflict in the region. For example some trees which are categorised as non-economic tree may not always be so in all communities. Also the spiritual attachment to some sacred forest in Niger Delta required specific activities which only the natives or designated persons can be involved in especially when such forests are desecrate by oil spill. The work of [39] corroborates the importance of cultural heritage to compensation claimants. The study reported that compensation claims were presented in respect of desecration of Inyosa family Juju shrine, and Ikhimwin-no-zokpa shrine at the bank of Ikpoba River in Edo state. Thus there is need to conduct investigation of what constitute heads of claim in the Niger Delta region as a guide to conducting equitable compensation in the region. In conducting such investigation, bottom –top approach is advocated

C. Contribution from Other Experts to Assessment

Oil spill damage assessment sometimes requires scientific investigations which fall outside a valuers' professional competence; hence it is expected that other experts such as soil scientist, land-surveyor, environmental scientists, hydrologists, ecologists, fisheries scientists, chemists, marine scientists, micro biologists, medical and health experts etc. should have input in the assessment. Reference [23] faulted many valuation reports submitted for compensation claims in NDR because they lack input from such experts. Thus the claims could not be substantiated. Report submitted by the experts should be incorporated into the claims or attached as an addendum to the valuation report.

D. Legal Framework

There is need to revisit the legal framework guiding compensation practice in Nigeria. The existing legal framework is not clear and contradictory in some vital areas [23]. Although there are a number of statutes that provide for compensation in matters relating to land or landed property acquisition, only the Oil Pipelines Act, Cap145, LFN, 1990 contains provisions that directly address matters relating to compensation arising from oil spillage. Other statutes such as the Land Use Act (1978), Minerals Act Cap 121 of 1946, and Petroleum Act No. 51 of 1969 now Cap 350 LFN 1990, Mining Act No 24 of 1990, Oil in Navigational Water Act, Cap 337 LFN 1990 are only superficial relevant to compensation for oil spillage; they deal primarily with land acquisition rather than injurious affection [28]. It is hereby recommended that laws regulating oil spill damage should be collapsed into a single document that will address all aspects of compensation for oil spill and other contamination damage. This compensation code should have sufficient input from all stakeholders especially the oil producing communities who are already having a feeling of marginalization in terms of oil resource management.

VII. CONCLUSION

The study has highlighted conflicting issues in compensation for oil spill damage in Niger Delta and various efforts geared towards resolving conflict therein. Four aspects of identified inadequacies in compensation valuation - inadequate legal framework, incomprehensive heads of claim, inappropriate approach to valuation method, and lack/poor input to valuation assessment by other experts - must be holistically addressed in order to ameliorate conflicts relating to oil spill damage in Niger Delta.

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Constraints to Foreign Direct Investment: The Nigerian Experience (1980 - 2015)

Achugamonu, B. Uzoma, Ikpefan Ochei Ailemen, Taiwo,   J. N
Department of Banking and Finance,
College of Business and Social Sciences, Covenant University, Ota, Ogun State

uzoma.achugamonu@covenantuniversity.edu.ng
Okorie UchechukwuEmena
Department of Banking and Finance, College of Business and Social Sciences, Covenant University, Ota, Ogun State

Abstract—**Foreign Direct Investment is considered as an invaluable tool for achieving economic growth in developing countries. In order to achieve the objective of a higher rate of economic growth and the efficiency in the utilization of resources, developing countries the world over have embarked upon various policy measures at attracting FDI. The study is an empirical investigation (using a time series data between 1980-2015) into the factors that constrain the inflow of FDI into the Nigeria economy. The Phillip Perron (PP) unit root test was used to test stationarity of the variables, Johansen Co-integration approach was conducted to test for long run relationship between the variables used, Vector Error Correction Model was used to establish the short run dynamics and the long run relationship as well as ascertain the speed of systemic adjustment in the model. The study found that government external and domestic debts, inflation rate and exchange rate appreciation (in favour of the domestic currency) have significant long run relationship with foreign direct investment in Nigeria. It therefore recommends among others a more prudent management of both domestic and external debt of Nigeria and that our monetary authorities should devise effective ways of fine-tuning and managing such macroeconomic tools and variables as the rate of inflation and exchange rate.**

Keywords—*Foreign Direct Investment, Inflation rate, External Debt, Domestic Debt, Foreign Exchange*

I. INTRODUCTION (*Heading 1*)

Nigeria is endowed with rich human and natural resources. Given these wealth in economic potentials, it is ironical that Nigeria is still rated as one of the poorest economies in the world. It is true that Nigeria has great economic potentials but her poor economic 'know – how' leaves her disadvantaged and at the receiving end of the ever highly competitive global economy. In order to be a relevant force in the global economy, the country must devise means of efficiently extracting and utilizing her numerous economic potential and improving her productive capacity without which, she will remain in her poor and low economic state. Physical and human capital can only be accumulated through investment. Most growth models have come to ascribe the rate of growth of an economy as being determined by the amount of physical and human capital, the efficient use of resources and the ability to acquire and apply modern technology. Since investment determines the rate of accumulation of physical capital, it thus became an important factor in the growth of productive capacity and in turn, contributes towards the growth of the economy.

Despite the increased flow of investment, especially, to developing countries, Sub-Saharan Africa (SSA) countries still lag behind other regions in attracting foreign direct investment. The uneven dispersion of FDI is a cause of concern since FDI is an important source of growth for developing countries. Not only can FDI add to investment resources and capital formation, it can also serve as an engine of technological development with much of the benefits arising from positive spillover effects. Such positive spillovers include transfers of production technology, skills, innovative capacity, and organizational and managerial practices, Osinubi and Lloyd (2009) [5].

Domestically, Nigeria has been unable to generate sufficient investment to adequately propel her economic growth process. This has resulted in Nigeria government 'looking for more efficient source of investment. In other words, the government has resorted to wooing of foreign investors. Among the various sources of investment, Foreign Direct Investment (FDI) is considered as the most invaluable for economic growth in developing countries like Nigeria. FDI serves as a stimulus to additional investment in the recipient country and is perceived as the most efficient source of investment for economic growth for developing countries including Nigeria. The success or failure of the past and present governments at wooing sufficient investment for growth and the success and failure of FDI to bring about the desired level of growth in the economy is hinged upon the prevailing political and economic circumstances in the country hence, foreign investors need to master these circumstances which characterize the Nigeria government at wooing foreign investment with little or no significance. Studies have found that there is a strong correlation between the growth situation in developing countries and their success at attracting Foreign Direct Investment.

Statement of the Problem

Many empirical researches have concluded that there is a positive relationship between Foreign Direct Investment (FDI) and economic growth [6]. It has also been stated that economic growth in developing countries is largely dependent on their success in attracting FDI. Hence, the concerted effort of the Nigerian government, both the past and the present, to attract FDI is not out of place. The inflow of FDI into the country has not been very encouraging due to the various policy measures of the government towards its mobilization, especially in the late 80s. For example, the average ratio of FDI inflow to GDP from 1990 was mere 0.05 (5%). This outcome questions the concerted policy measures of the government towards foreign investment especially when this period falls within the structural adjustment programme (SAP) regime that took off in 1986. Furthermore, it seems difficult to ascribe the economic growth in Nigeria to the inflow of FDI especially when the growth rate has, in the early 80s, been recorded as negative even when FDI inflow was growing (but slowly). Even a high FDI inflow does not always coincide with a high real GDP growth rate, though the growth rate has been inconsistent. For instance, in 1990, the growth in FDI inflow was negative (-4.3%). Also, in 1997, 1998 and 1999, the growth in FDI of 4.8, 3.6 and 1.2 percent yielded a real GDP growth of 2.8, 2.9 and 0.4 percent respectively.

According to the World Bank, Nigeria's macroeconomic performance over 2005 and 2006 was commendable. The economic reform efforts showed positive results.

However going by the latest ranking of 189 countries by World Bank ease of doing business global index, 2015 edition, Nigeria scored 169th position out of 189 countries ranked [9]. This result showed that Nigeria lacks the capacity to grow its local industries let alone attract reasonable foreign direct investment especially in the face of dwindling oil price and exchange rate volatility. The World Economic Global Competitive Index 2015, ranked Nigeria as 38th out 144 countries with 286.5 billion US dollar using gross domestic product as an indicator [10]. This result is nothing to cheer about as the same index ranked Nigeria, 111th out of 144 countries also using GDP/Per Capita Income as an indicator. This implies that even as gross domestic product improves, its result does not reflect on the living standard of the citizens.

II. THEORETICAL AND EMPIRICAL LITERATURE REVIEW

This study shall focus on the Classical and Product life cycle theory. The classical theory claims that FDI and multinational corporations are very vital and contribute to the development of host countries through several channels. These channels include; the transfer of capital, advanced technological equipment and skills, improvement in the balance of payments, the expansion of the tax base and foreign exchange earnings, creation of employment, infrastructural development and the integration of the host economy into international markets [11]. The product life cycle theory states that FDI exist because of the search for cheaper cost of production. It states that many manufactured products will be produced first in the countries in which they were researched and developed. These countries are typically industrialized. Over the product life, production will tend to become capital intensive and will shift to foreign locations. So overtime, a product initially introduced in a country and exported from that country may end up becoming a product produced elsewhere and then imported back into that country [11]. Past studies have cited the host country's market size (measured by the Gross Domestic Product, GDP) as an important determinant of FDI inflows (Raggazi, 1973; Moore, 1993; Wang and Swain, 1995; Chakrabarti, 2001 and Masayuki and Ivohasina, 2005) as cited in Obida and Abu (2010) [7]. This could not be possible however if the host country is only used as a production base due to low production costs and after which the finished product is exported back to another or home market, with this in view, the market size may be less influential or insignificant in determining FDI inflow. Aside from market size, inflation and exchange rate are other determinants of FDI inflow. If inflation rate is low, foreign investors are encouraged to invest in such a country leveraging on the cheap cost of production, likewise, where the exchange rate of a country depreciates vis a vis its trading partners, it attracts FDI since foreign firms may merge with or acquire domestic industries without having to spend their lives savings or borrow at cut throat interest rate before investing.

Foreign Direct Investment is the distinctive feature of multinational enterprises (or transnational corporations); a theory of foreign direct investment is a theory of multinational enterprise as an actor in the world economy Hennart, (1982). Based on this theory, the extension of an enterprise from its home country into a foreign host country is FDI rather than an international transfer of capital [3]. The extension of an enterprise involves flows of capital, technology and entrepreneurial skill and, in more recent cases, management practice to the host economy where they are combined with local factors in the production of goods and services. Alfaro L, Chanda A, and Selin Sayek (2004), discovered that countries with better financial system and financial market regulations can exploit FDI more efficiently and achieve a higher growth rate [4]. The study argues that countries need not only a sound banking system but also, functioning financial markets to allow entrepreneurs obtain credit to start a new business or expand on existing one. In this way, countries are able to benefit from inward investment to achieve a higher growth rate. Robu (2010) asserts that FDI is usually sought by countries that are going through the transition period and/or those that face severe structural unemployment. This is the situation of Nigeria [8]. Balasubramanyam V. N, Salisu M.A and Sapsford D (1996) finds that the impact of FDI on growth is stronger in countries with a policy of export promotion than in countries that pursue a policy of import substitution [2]. Export promotion policy is characterized by a free play of market forces and allocation of resources on the basis of comparative advantage, furthermore, because of the neutrality policy orientation it offers none of the incentives for rent seeking which the import substitution provides is observed. The competition it allows from both international trade and domestic sources encourages research and development and investment in human capital.

Borensztein, Eduuardo, Jose De Gregorio and Jong-Wha Lee, (1998) found that the positive impact of FDI on growth is enhanced when the host country's education exceeds a certain threshold [2].

III. DATA SOURCE AND ECONOMETRIC RESEARCH METHODOLOGY

Time series data collected from various editions and issues of the CBN Financial Review, and Central Bank of Nigeria Statistical Bulletin for the period 1980 to 2015 were used.

The Phillip Perron (PP) unit root test was used to test stationarity of the variables, Johansen Co-integration approach was conducted to test for long run relationship between the variables used. The Vector Error Correction Model was used to establish the short

run dynamics and the long run relationship as well as ascertain the speed of systemic adjustment in the model. The vector error correction model is a variant of regression model which offers a robust and detailed analysis of the variables under investigation.

Model Specification
This study is based on the assumption that the inflow of FDI is constrained by the explanatory variables specified in the model below:
FDI = f (EXT. DEBT, DOM. DEBT, INFL, EXR) …………… …………………………….....… (1)
Where
        FDI   = Foreign Direct Investment Inflow

EXT. DEBT   = External Debt
DOM. DEBT   = Domestic Debt
INFL   = Inflation Rate
EXR   = Foreign Exchange Rate
The statistical form of the model is thus:
FDI = $\alpha_0 + \alpha_1$EXT.DEBT + α_2DOM.DEBT + α_3INFL + α_4EXR + e………………………………….. (2)
Where:
α_0 = The Intercept
α_1 = The Parameter Estimate of EXT.DEBT
α_2 = The Parameter Estimate of DOM. DEBT
α_3 = The Parameter Estimate of INFL
α_4 = The Parameter Estimate of EXR
e = The Random Variable or Error Term

Empirical results and Discussion

Table 1: Unit Root Test Results

Levels				1st Difference		
Variables	PP-Statistic	Critical Value at 5%	Remarks	PP-Statistic	Critical Value at 5%	Remarks
LFDI	-3.455018**	-2.951125	Stationary	-10.42546***	-2.954021	Stationary
LGEXDT	-2.210515	-2.951125	Non-stationary	-12.44585***	-2.954021	Stationary
LGDDT	-2.029498	-2.951125	Non-stationary	-40.43871***	-2.954021	Stationary
LINFL	-5.087512***	-2.951125	Stationary	-17.72616***	-2.954021	Stationary
LEXR	-1.855120	-2.951125	Non-stationary	-4.877442***	-2.954021	Stationary

Source: Author's Compilation 2016
NB;,***, **, indicates stationarity at 1 percent and 5 percent levels.

The results of the Phillip Perron (PP) test are shown in Table 1 above. At 5% levels the test statistics for the log levels of government external debt, government domestic debt and exchange rate were statistically insignificant. This therefore suggests the null hypothesis of a unit root present among the series cannot be rejected at levels for these variables. At 5%levels only two of the series were stationary; hence, all variables were differenced once to achieve stationarity at first differencing using 5 percent level

of significance. This result thus informs the use of first difference in our model. However, a stationary series was obtained for all the variables at first difference. Hence the PP test rejects the joint null hypothesis for the individual series at the 5 per cent level. Thus, from all of the tests, the unit roots tests indicate that the variables were integrated of order one. The stationarity of the variables in the models allow the outcome of the models to have policy implications.

Table 2 Co integration result

Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Prob.**	Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.643156	90.33870	76.97277	0.0034	None	34.00506	34.80587	0.0621
At most 1 *	0.612921	56.33364	54.07904	0.0310	At most 1 *	31.32121	28.58808	0.0218
At most 2	0.280531	25.01243	35.19275	0.3995	At most 2	10.86498	22.29962	0.7622
At most 3	0.219882	14.14745	20.26184	0.2794	At most 3	8.194219	15.89210	0.5247
At most 4	0.165065	5.953233	9.164546	0.1943	At most 4	5.953233	9.164546	0.1943

Source: Author's Compilation 2016

On the evidence of the stationarity of two or more series which consists of different order of integration I (0) and one I (1)), the necessary procedure is to confirm the long run relationship of these series such that a linear combination of two or more series would result to co integrated series of the higher order 1. Hence this study employs Johansen and Jusulis (1992) multivariate co integration procedure to verify if there is a long run relationship among the variables of the model as presented in tables 2 above. In the result from the above table (2); the trace and maximum Eigen value statistic test were examined in the process. The result of the trace and maximum Eigen statistic test indicates the existence of at most one co integrating relationship among the variables considered by the study. It thus suggests the presence of a long run equilibrium relationship among the series which consists of foreign direct investment (as the dependent variable) government external debt, government domestic debt, inflation rate and exchange rate.

Table 3 Normalized co integrating relationship

Normalized co integrating coefficients (Standard error in parenthesis)				
LFDI	LGEXDT(-1)	LGDDT(-1)	LINFL(-1)	LEXR(-1)
1.000000	-0.576294	-0.548776	-0.246761	1.170940
	(0.13974)	(0.23970)	(0.12565)	(0.32294)
	[-4.12399]	[-2.28940]	[-1.96392]	[3.62584]

Source: Author's Compilation 2016
Note: Standard error and T-statistics are stated in parenthesis as () and [] respectively.

Table 3 above shows the estimated result for the long run relationship between foreign direct investment (FDI) as the endogenous variable and government external debt, government domestic debt, inflation rate and exchange rate as the exogenous variables. Further analyses of the result showed that all the estimated lag coefficient of the variables indicate a significant relationship with foreign direct investment in Nigeria. Cumulated government external debt shows a significant inverse relationship with foreign direct investment and statistically significant. A percent change in government external debt will result to 0.576 percentage change in foreign direct investment all things being equal. Thus government external debt could be considered a significant determinant of foreign direct investment in Nigeria within the scope covered by this study.

The analysis of the government domestic debt indicates a significant inverse relationship with foreign direct investment. All things being equal a percentage change in government domestic debt will bring about 0.549 percentage change in foreign direct investment. This further show that changes in government domestic debt has significant effect on foreign direct investment. Hence the degree of the responsiveness of foreign direct investment to the changes in government domestic debt is found to be inelastic.

The result of the estimated lag co efficient of inflation rate shows that a percentage change in inflation rate will result to a 0.247 percentage change in foreign direct investment at 1 percent significant level holding other variables at a constant. A proportionate change in inflation rate results to a less proportionate change in foreign direct investment. It could therefore be observed that the degree of the responsiveness of foreign direct investment to the changes in inflation is highly inelastic. The above result thus provides significant evidence in support of significant effect inflation could pose on private foreign direct investment in Nigeria.

Analysis of the co efficient estimate for cumulated effect of exchange rate suggests a significant direct relationship with foreign direct domestic investment at 5 percent level of significance. A detailed analysis of the empirical result shows that a percent change in exchange rate appreciation in favour of domestic currency would lead to 1.171 percentage change in foreign direct investment in Nigeria. The estimated elasticity shows that the degree of responsiveness of foreign direct investment to changes in exchange rate movement in Nigeria is elastic. This implies that a proportionate change in inflation rate will bring about a more proportionate change in foreign direct investment. Evidence from inflation rate shows significant relationship with foreign direct investment with the highest resultant effect in magnitude and direction.

Hence this study concludes that government external and domestic debt, inflation and exchange rate as macroeconomic variables reveals a significant long-run relationship with foreign direct investment in Nigeria and therefore must be adequately managed within the context of Nigeria economic to foster higher international relations with other economies of the world. Every foreign investor will prefer to invest their huge resources in an economy that is relatively stable and promises good returns on investment

outlay which invariably depends on management of aggregate fiscal and monetary policy instruments of such an economy.

Granger Causality Analysis

With Co integration, the dynamic causal interactions among the variables should be phrased in a vector error correction form. This allows us to assess both long-run and short-run causality, respectively, on the χ^2-test of the lagged first differenced terms for each right-hand-side variable and the t-test of the error correction term. The results of the test are presented in Table 3.

The analysis of the granger test reveals a unidirectional causality from exchange rate to foreign direct investment (FDI) at 10 percent level of significance. This implies that exchange rate granger causes FDI. Causality is observed between government domestic debt and inflation rate such that unidirectional causality runs from government domestic debt to inflation, hence indicating that government domestic borrowing do granger causes inflationary pressure within the economy. However, evidence from the foreign direct investment model shows error correction term was correctly signed and

statistically significance at 5 percent. Further evidence from the error correction result reveals that over 50 percent of the errors from external shocks to the system will be restored per time. The result suggests there is possibility of convergence in the system with moderate speed of adjustment from the short-run to the long-run equilibrium state.

IV. STUDY RECOMMENDATIONS

The outcome of this study shows that FDI, despite the inherent limitations it is faced with, has a good prospect of growth in Nigeria. To increase the inflow of FDI and its performance, the following recommendations from this study were propagated.

➢ The responsiveness of foreign direct investment to the variations in cumulated lag effects of exchange rate is elastic. Hence a proportionate change in exchange rate has a significant elastic time lag effect on foreign direct investment. Therefore exchange rate policies formulation and implementation towards foreign direct investment should be critically examined with adequate consideration of it time lag effects.

Table 4: Granger Causality Results based on VECM

Dependent Variable	Independent Variables					ECT$_{t-1}$ coefficient (t-statistic)
	χ^2-statistics of lagged 1st differenced term [p-value]					
	ΔLFDI	ΔLGEXDT	ΔLGDDT	ΔLINFL	ΔLEXR	
ΔLFDI	--	4.224148 [0.1210]	2.042097 [0.3602]	0.232635 [0.8902]	5.423346* [0.0664]	-0.509496** [-2.73184)
ΔLGEXDT	0.550331 [0.7594]	--	1.424918 [0.4904]	0.030176 [0.9850]	0.497010 [0.7800]	-0.268987 [-1.40522]
ΔLGDDT	4.552735 [0.1027]	0.246390 [0.8841]	--	2.691119 [0.2604]	1.569642 [0.4562]	0.051445 [0.98149]
ΔLINFL	1.739344 [0.4191]	1.245834 [0.5364]	5.551742* [0.0623]	--	0.283775 [0.8677]	0.692870* [1.72296]
ΔLEXR	1.775053 [0.4117]	0.263683 [0.8765]	0.554028 [0.7580]	1.090352 [0.5797]	-	-0.159463 [-1.30046]

*Note: *and ** denotes significant at 10% and 5% significance level, respectively. The figure in the parenthesis (...) denote as t-statistic and the figure in the squared brackets [...] represent as p-value.*

- Government external and domestic debt apparently suggests a significant inverse relationship with foreign direct investment. This further implies that the management of government internal and external debts has many implications on its attraction of foreign capital through foreign investment inflows to the host country. Hence more prudent management and administration of government debts engender FDI inflow. If government borrowings are curtailed by the debt managers, foreign investors will have confidence and invest in the economy.
- Further evidence from the study reveals that high inflationary pressure within the economy could significantly affect the level of foreign capital inflows and consequently discourage prospective investors from entering into the market. The monetary authorities should intensify effort at sustaining the one digit inflationary target as a catalyst to attracting more foreign investors and also enable the Nigerian economy to harness its potential investment opportunities given its significant lag effect on foreign direct investment in Nigeria.
- Since most developing economies like Nigeria stands to gain much economic benefits from FDI when they are open to foreign trade. The present study suggests that the Nigerian government should intensify effort to reduce the bureaucratic bottlenecks in foreign trade transactions which is characterized by stringent custom duties and port- authorities' regulations.

V. CONCLUSION

Foreign direct investment no doubt has many beneficial effects for the growth and development of the national economy. However, for the country to optimize its potential benefits, it is important that the government exercise fiscal discipline and control measures in its pattern of borrowing and spending. Borrowed funds should be invested in productive economic activities that will further enhance investment opportunities that could guarantee the attraction of more foreign investors. Most importantly the monetary authorities should devise more effective strategies in the control and management of the exchange and inflation rates by developing effective monetary policies that will encourage price stability, full employment, income equality and trade liberalization. This will culminate to the provision of a suitable and sustainable macroeconomic environment that will enhance the attraction and retention of foreign investors and also encourage local investors in the economy. Foreign Direct Investment has been pivotal to economic growth in Nigeria; justifying the effort of successive governments in the country at using FDI as a tool for economic growth. Governments direct involvement in the provision of goods and services by establishing and controlling corporations, for example, has contributed little to economic growth in Nigeria. This justifies the privatization policy of the past administration of President Olusegun Obasanjo, Musa Yar'Adua as well as Goodluck Jonathan to allow for the possible takeover by investors (both foreign and domestic) of the government corporations.

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Socio-Economic Adjustment among Retired Civil Servants of Kwara and Lagos States: A Theoretical Analysis

Christiana O. Adetunde,
Department of Sociology, Covenant University,
Ota, Ogun State, Nigeria.
adetundesunday@yahoo.co.uk

David Imhonopi,
Department of Sociology, Covenant University,
Ota, Ogun State, Nigeria.
davidimhonopi@gmail.com

C. Nana Derby,
Sociology and Criminal Justice, Virginia State
University, Virginia, USA.
CDerby@vsu.edu

Tayo Ola George,
Department of Sociology, Covenant University,
Ota, Ogun State,
Nigeria.Tayo.george@covenantuniversity.edu.ng

Abstract- **This presentation is the theoretical framework of a proposed dissertation on the transitional experience and adjustment of retired public servants in Kwara and Lagos. Yearly, several workers around the world retire from service voluntarily, compulsorily or mandatorily. In Nigeria public sector, workers are expected to quit service at the statutory age of 60 or 35 years of service; whichever comes first and begin to receive monthly pensions. In addition, most of these retirees are in their old ages. Usually, this transitional phase of life is characterized by several changes which include age, health, strength, income, social status, living condition and environment. However and in most cases, this phase calls for adjustments that are crucial to living a happy and fulfilling post-retirement life. Some of these changes could be difficult to easily adjust to (Ali, 2014; Garba and Mamman, 2014; Quadagno, 2005). Using secondary data, the study explored the actual actions taken by retirees at this transitional phase for proper adjustment to post-retirement and subsequently, old age using Activity, Multiple Modes of Livelihood and Conservation of Resources perspectives. The study concluded that (i) due to Nigerian economic instability and irregularity in pension payment, several retirees seek out for alternative means of income to augment their meagre pension, (i) retirees engage in such activities to deal with boredom and as survival strategies in the mist of economic crises.**

Keywords: Activity theory, Multiple Modes of Livelihood, Conservation of Resources.

I. INTRODUCTION

Background to the Study

In Nigeria, the statutory retirement age is 60 years or 35 years of unbroken active service, whichever comes first. The retirement ages for lecturers of tertiary institutions and judges are 65 and 70 respectively. Age is said to connote expertise and wealth of experience in these sectors (Garba & Mamman, 2014), hence the extended age for retirement. Whichever form retirement takes within the Nigerian statutory requirements, the retiree is entitled to benefits including gratuity and pension as rewards for the years put into serving the nation and also for the purpose of meeting their financial needs at old age (Ali, 2014; BusinessToday, 2015; Garba & Mamman, 2014). With the leverage arrangement and all other things being equal, Nigerian retirees ought to look forward to quitting service with relative enthusiastic relieve and spend the rest of their lives in leisure. However, Nigerian retirees according to Fapohunda (2013) have to struggle and suffer significantly before they could collect their meagre benefits. Corruption and the depth of

embezzlement of pensioners' gratuities and monthly pension benefits in the past decades are outrageous (Ali, 2014; Fapohunda, 2013; Garba & Mamman, 2014). Due to these challenges, there is fear of the unknown future in the minds of workers as they perceive or witness the plights and challenges facing retirees.

Coupled with this well-known financial problem among retirees is the problem of severance from the life that the worker is used to and has lived for decades. Study have shown that many retirees will spend up to two decades of their lives in retirement due to the increase in life expectancy in many parts of the world today (Asonibare & Oniye,2008; Lloyd -Sherlock, 2004; Moody & Sasser, 2012; Quadagno, 2005). Hence, adjusting to the live after years of service to the nation and humanity remains a core problem of the average retiree, not only in Nigeria, but some other parts of the world. How this set of people adjusts to their new status should not be overlooked. It is to this end that this paper endeavours to apply applicable theories to the transitional phase experience of civil-service retirees in Kwara and Lagos, by analysing what retirees do to adjust to their new status.

A. **Statement of the Problem**

Retirement from both public and private service comes with obvious changes in lifestyles, daily routine, income, social status, age, strength, environment and most times, health. Making transition from the former to the latter could be more difficult than imagined. This was established by Adewuyi (2008) who asserts that retirement is stressful. She analysed this statement by making reference to a 2006 New York research that confirmed that about 1.5 million workers due for retirement expressed their feelings of depression and stress as they envisage their retirement. In another study carried out on retirement stress and counselling in Kwara State, Oniye (2015) maintains that retirees go through stress that demands pre-retirement counselling. In yet another study by Bosser-Aldwin, Lavenson and Darces (2005) in Adewuyi (2005), up to seventeen percent of the participants who were retirees said they felt lonely; while fifty-five percent expressed a drop in their social life.

Studies have also shown that two-third of retirees did not seek financial advice while in service. Seventy-five percent of retired women were not satisfied with their retired status (Szinovacy & Davey, 2005 in Adewuyi, 2008). In Nigeria, many employees of federal and state governments do not have adequate understanding of the new pension scheme as enacted by the Pension Reform Act of 2004 (Adewuyi, 2006 in Adewuyi, 2008). Worse still is the irregularity and non-payment of gratuity and pension as and when due in the Nigerian civil-service. This is a negative critical factor in retirees' everyday living (Fapohunda, 2013; Garba & Mamman, 2014). Many retirees are therefore left at the mercy of their children and relatives, while some live as destitute (Ali, 2014; Asonibare & Oniye, 2008; Fapohunda, 2013). The depth of people's immersion in their work is another crucial issue which might not readily be noticed to the worker until work ceases (Fisher, 2015). Scholarship on what retirees do to adjust to their new status is sparse in Nigeria. To address this aspect of retirement in Nigeria, secondary source of data is employed. Specifically, three theories are analysed in an attempt to explain the ways civil service retirees in the study areas adjust to their new status in the postretirement years.

B. **Research Questions**

This paper will attempt to answer the following research questions:

i. What factors promote fulfilling life after retirement from public service?
ii. What forms of challenges are retired civil servants faced with?
iii. What steps do retirees take in their effort to adjust to the retired status?

C. **Objectives of the Study**

The objectives of the paper are to:

i. Investigate the factors that promote fulfilling life after retirement.
ii. Examine the challenges faced by retired civil servants in the study areas.

iii.   Analyse the steps taken by retirees in adjusting to the retired life.

II.   LITERATURE REVIEW

Retirement in Nigeria is usually welcomed with a sense of uncertainty (Iyortsuun & Akpusugh, 2013). It is often associated with risk and stress, especially among the civil servants. This is occasioned by the tension and strain retirees go through during screenings before they are able to access their benefits and entitlement (Inaja & Chima, 2013; Olatunde & Awosusi, 2011). Occasionally, media reports do have news of how pensioners collapse and die at screening venues (Adedokun, 2010; Olatunde & Onyinye, 2013). At the end of the exercise, they might not still be paid their pension for months. Under the former pension scheme, it is a well-known fact that many pensioners were not paid their gratuity for years (Garba & Mamman, 2014; Olatunde & Awosusi, 2011).

A.   Problems facing Retirees in Nigeria

Many retired civil servants in Nigeria are experiencing negative and difficult changes that come as the result of cessation of work. Citing Oniye (2001), Eremie (2015) highlight the challenges facing retirees to include lack of insufficient finance, health challenge, empathy, lack of social relevance and more. In a study carried out in Rivers state by Eremie (2015), retirees ranked financial problems as the most threatening challenge they are experiencing. This was followed closely by health challenges for both male and female respondents. Lack of finance to carter for health at old age could be the bedrock of their ailing health.

According to Garba and Mamman (2014), and Fapohunda (2015), many retired civil servants enter retirement phase without any financial or assets savings to fall back on. Also, many workers in the country do not own personal houses as and when due for retirement because of their lack of planning, heavy family responsibilities and the meagre salaries they lived on. Paying for residence in postretirement does lead to worries. Mallum cited in Ali (2014) argues that due to this challenges, several retirees experience one or more emotional trauma such as frustration, boredom, unsatisfactory life, fear of uncertainty and low social affinity. Retirement planning has been identified as one singular prerequisite to satisfying postretirement years, especially in a country like Nigeria (Adewuyi, 2008; Ali, 2014; Akpanmkpuk, 2011; Fapohunda, 2015; Garba & Mamman, 2014).

B.   Theoretical Framework

As no one theory is capable of explaining any social scenario, this paper adopted three theories that are relevant to the subject matter of the study. These theories attempt to explain the socio economic adjustment strategies employed by civil service retirees in their bid to adjusting to their new status. The theories are:

i.   Activity theory
ii.   Conservation of resources model
iii.   Multiple modes of livelihood approach

C.   Activity theory

Activity theory was propounded by Robert Havighurst in 1961 in reaction to disengagement theory. This theory stands on the premise that elderly individuals experience utmost happiness and fulfilment when they actively engage in meaningful social interaction and activities. In this way, older people substitute new activities or roles for those lost to retirement. Activity theory is focused on the social life of older people, without emphasis on the economic aspect of life. It aims at keeping people agile, healthy and with a satisfying self-image in their later lives.

It is not surprising for instance to see a retired teacher could be seen taking up a new job in a private school as school administrator or head teacher, a retired lecturer can take up appointment in another university, a retired banker could work as a consultant to firm and so on. Some other retired individuals take to private activities like owning a poultry or fishery farm, running laundry services etc. Some run charity organizations. Such activities as these are encouraged among older folks (Ali, 2013; Quadagno, 2005). Rather than retiring to fate, the involvement of elderly people in active lifestyle after retirement could also help to prolong their lives and produce satisfaction with and in life. The purpose is

not always for them to earn income only but also to remain active participants in the society. This theory is in agreement with the argument put forward by Moody and Sasser (2012) that retirement should not be abrupt and room should be given to elderly ones who desire to work longer than usual. Akpanmkpuk (2011) maintains that retirees must be engaged in activities that could keep them fit and healthy. Quadagno (2005) advocates phased or bridged retirement so as to eliminate the feeling of rolelessness. She also argues for labour participation of retirees either in the form of re-entrance into the labour market or community services through voluntary services. Although most of the scholars who argued for the participation of older people in work activities did so for the economic undertone, such activities no doubt could help retirees to remain active, relevant and satisfied as activity theory posits.

III.   CONSERVATION OF RESOURCES MODEL

This model was developed by Stevan Hobfoll in 1989. The Conservation of Resources Model (COR) argues that human beings work towards acquiring and retaining resources. These resources refer to anything people perceive as valuable. They could be in the form of objects such as food, clothes, house and investments; conditions like employment status, reputation, good health and leadership position; personal characteristics like self-confidence, self-esteem and skills; and, energies which include money, acquired knowledge, time and so on.

The purpose for the acquisition and retention of these resources is to be able to counter threats, especially in the near future. In order words, these resources serve as leverage (Moss, 2008). These resources are valued as either avenue for gaining access to means of survival or they are in themselves the actual survival needs. Effort is intensified to protect the resources in hand while at the same time, seeking ways of acquiring more resources.

Alvaro, Lyons, Warner, Hobfoll, Martens and Labonte (2010) identify three themes in COR for the purpose of their study on health system change in areas with limited or inadequate resources. Two of the themes are also relevant to this study. The first theme argues that resources are needed for adjustment to changes that occur in any system. This implies that the resources, as highlighted above, that are available to each retiree, determine the ease or otherwise of transition from work roles to retirement and old age status. Therefore as a social group, retirees' socio-economic adjustment is directly proportional to the resources at their disposal. This theory, however, did not prioritize the resources in order of importance.

The second theme posits that perceived threat to resource loss triggers protective actions in the direction of assets. Hobfoll (1989) argues that people experience stress when there is a perceived danger of resource or asset loss and when they actually experience the loss. The fear brought by either of these scenarios prompts people into effort to acquire more, thereby, shielding their resources from potential and actual loss. This premise is in line with advocacy for pre-retirement and postretirement planning and education. It also helps to buttress the efficacy of role substitution in postretirement years as advocated by Havingurt's theory. To eliminate potential or actual loss of finance (which are objects and energy resources), retirees have been advised to save as much as possible and invest in certain income-generating assets while in service (Adewuyi, 2008; Adams and Beehr, 2003; Akpanmkpuk, 2011; Ali, 2014; Garba and Mamman, 2014; Quadagno, 2005). Also, to guard against loss of personal characteristics and conditions resources, retirees have been counselled in addition to financial planning, to imbibe healthy habits like moderate regular exercise and eat balanced diet (Ali, 2014), keep their spirit high at all times, join religious and social groups in their communities (Garba and Mamman, 2014), carry out routine medical check-ups (Ali, 2014) and possibly opt for phased or bridged retirement and extend their services by remaining in paid employment beyond the normative retirement age, where it is allowed (Moody and Sasser, 2012; Quadagno, 2005).

Multiple Modes of Livelihood Approach

Multiple Modes of Livelihood as put forward by Abdul Raufu Mustapha in 1991 is typically meant to explain micro-economic condition as it is today especially in Nigeria.

According to Mustapha (1991), multiple modes of livelihood refer to survival strategies and activities people engage in to alleviate financial insufficiency, pressure and hardship. They are means employed by people to gain additional earnings through getting involved in additional jobs or ventures.

The basic tenets of this approach are:

i. They are means of generating additional earnings to argument for inadequate income.
ii. The multiple modes may not all be legal; it could include criminal and quasi – illegal practices. Examples include, prostitution, drug trafficking, smuggling of goods, avoidance of taxation by business owners and others.
iii. The pervasiveness of technological changes and economic crunch around the world has intensified the need for multiple modes of earning as people struggle for relevance and survival.

According to Mustapha (1991) and Owusu (2001), salaries (and by extension, pension) are grossly inadequate to offset people's bills due to low income and inflation. Thus, every avenue available to individuals and groups are harnessed to gain more earnings. Some of the opportunities available to retirees for added income according to them include farming (eg. food crops, fishery, poultry, goat faming and others), establishment of schools, vocations trainings like sewing, knitting, baking, events planning and more; consultancy services, investment in landed property, opening supermarkets or a shop, laundry services and others. Even in the United States, Quadagno (2005) explains that since the elimination of the earning test for social security recipients, retirees and elderly people have been able to earn their social security benefits and at the same time, engage in some other jobs to earn more income.

IV. CONCLUSION: Points of Congruence between the Theories

As earlier pointed out, the three theories: activity, conservation of resource and multiple modes outline actions (activities) carried out by people under certain socioeconomic circumstances. They are all action–based theories. They all spur people to action under changes that seem worrisome. Therefore, the three theories are activity theories. Conservation of resources encourages activities geared towards the accumulation, retention and protection of valued resources to eliminated threats capable of producing stress now or in the future. In the same vein, Multiple Modes of Livelihood approach identifies economics threats and consequent losses, which people initiate means to tackle by engaging in others jobs and businesses (apart from the regular normative employment) to avoid the depletion of resources on the other hand, and restore losses on the other hand. It means therefore that the two theories are sensitive to resources loss and go all out sourcing for means to prevent it. By implication, activity theory is also sensitive to loss; this is explained in the substitution of new roles for the lost old roles by way of active involvement in other spheres of life. The three theories are therefore having the same aim and objective, which is, the sustenance of valued statuses and survival strategies.

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Effect of Nitrogen on the Nutritional Quality and Microbial Load of Roselle (Hibiscus sabdariffa L)

B. K. Olopade, S. U. Oranusi
Biological Sciences Dept.,
Covenant University,
Ota, Ogun State, Nigeria

F.E. Babatunde
Crop Production Programme,
Abubakar Tafawa Balewa University
Bauchi, Nigeria

O. M. Oyawoye
Biological Sciences Programme,
Adeleke University
Ede, Osun State, Nigeria

Abstract—**The effect of nitrogen concentration on the nutritional quality and microbial load of samples of Hibiscus sabdariffa were studied. Samples of calyces harvested from three different nitrogen levels viz; 0 kg N / ha, 30 kg N / ha and 60 kg N / ha were used. Nutritional composition and the microbial counts of the calyces were determined. Highest significantly (P = 0.01) different crude protein and nitrogen value of 12.06% and 1.93 % were obtained from calyces fertilized with 60 kg N / ha. Ascorbic acid content of the calyces increased with increase in nitrogen levels. For the microbial load analysis, there was no significant influence of nitrogen on the microbial load. However, the least bacteria (2.6 x 10^4 cfu / ml) and fungi (5.68 x 10^5 cfu / ml) counts were obtained from calyces fertilized with 30 kg N / ha. Therefore, inorganic nitrogen fertilizer of up to 60 kg N / ha can be applied to Roselle plant in order to increase some of the nutritional constituents but should not exceed 30 kg N / ha for the purpose of reduced microbial load.**

Keywords—Nitrogen, nutritional quality, microbial load, roselle

I. Introduction

Roselle also known as Jamaican sorrel (Hibiscus sabdariffa) is a unique species cultivated in many tropical regions for its leaves, stem, seeds and especially calyces which are dried and used to prepare tea, jams, syrup, jellies and beverages [9]. The calyx has gained attention as well as acceptance because of its use in the preparation of a sour, with appealing flavour and wine-red coloured drink, popularly known as "Zoborodo" in the northern part of Nigeria. Roselle is important to the food, beverage and pharmaceutical industry because of its commercial potential as a natural food and colouring agent which can replace some synthetic products [9]. Ethnobotanical information of Roselle plant revealed its diaphoretic, diuretic, uricosuric, antifungal, antibacterial, sedative, mild laxative, antihypertensive, antitussive, hypercholesterolemia treatment, gastrointestinal disorder treatment, liver damage treatment and kidney stone treatment abilities and it also serves as an agent for decreasing the viscosity of the blood, and for treating the after-effects of drunkenness [1]. Roselle is consumed as hot and cold drinks to its uses in folk medicine. The drinks are widely used as diuretic, for treating gastrointestinal disorders, liver diseases, fever, hypercholesterolemia and hypertension [16]. The ripe calyces are used for hot and cold beverages and medicinally it is used as antispasmodic, hypotensive and antimicrobial agent and for relaxation of the uterine muscle [12]. Effect of several agronomic factors on the productivity of Roselle has been reported [6,8]. Also, the influence of nitrogen on the quality of Roselle fibre was reported by Babatunde et al. [7]. Nitrogen (N) is of special importance to plants as it is one of the major elements that are essential for plant growth and development [18]. Roselle reacts favourably to N application by growing more vigorously. When roselle is grown for its calyces only half of the recommended amount of fertilizer for vegetable is applied because excessive nitrogen encourages vegetative growth and reduces fruit production [11]. However, Okosun [12] reported a positive response of calyx yield to nitrogen application.

This study was done considering that not much work has been done on the relationship between pH, titratable acidity, microbial load and nutritional constituents as it relates to nitrogen application. The objective of this study was to evaluate the effect of increasing nitrogen levels as it affects these attributes in roselle calyces.

II. Materials and Methods

Sample collection, Preparation and Processing

The Roselle plants were grown in 1999 and 2000 at the Abubakar Tafawa Balewa University research farm site. Details of site, soil, climate, experimental design, agronomic practices involved are contained in Babatunde [6]. Pooled samples of calyxes used were obtained from three nitrogen levels: 0 kg N / ha, 30 kg N / ha and 60 kg N / ha. The samples were hand-picked separately to remove sticks and extraneous materials. The cleaned samples were packed in polythene bags and stored at ambient temperature throughout the period of study.

The samples were dried under a shade and separately pulverized. 4g of each sample were weighed into a beaker and 200ml of distilled water was added and allowed to stand for 30 mins and then filtered through a funnel using a filter muslin paper cloth.

Nutritional Analysis

The percentage total nitrogen and crude protein contents were obtained based on principles and procedure described by AOAC [3] and [5] respectively. Perchloric Acid Digestion (Wet Oxidation) of plant materials was used in the determination of the concentration of K, Na, Ca and Mg [4]. The ascorbic acid content of Roselle calyx was determined based on principles and procedures outlined by Moor (1957).

Microbial Load Analysis

The microbial analysis was carried on the 4th diluents of each sample for bacterial and yeast count and the results obtained expressed as colony forming units (cfu/ml).

Statistical Analysis:

Analysis of variance of data obtained was carried out with the aid of MINITAB computer software and the significant means were separated using the Duncan's Multiple Range Test.

Table 1: Some nutritional constituents and elements of Roselle calyx treated with different nitrogen levels.

Nutritional Content	O kg N/ha	30 kg N/ha	(60kg/ha)	S.E
% Dry matter	96.84a	96.43a	96.04a	0.098
% Moisture	3.16a	3.57a	3.96b	0.050
% Ash	7.97a	8.20a	7.94b	0.035
% Nitrogen	0.91c	1.38b	1.93a	0.126
% Crude Protein	5.68c	8.686b	12.06a	0.786
Minerals				
Ca	81.70a	88.90a	79.80a	1.180
K	67.60b	103.70a	65.30c	5.300
Na	1.70a	1.50a	2.00a	0.062
Mg	54.10a	43.10a	45.60a	1.420

Table 2: Total Aerobic bacterial counts and yeast counts of Roselle calyces treated with different nitrogen levels

Microbial load	Nitrogen levels 0kgN1/ha	30kgN2/ha	60kgN3/ha
Total aerobic bacterial Count(cfu/ml)	2.81×10^4a	2.61×10^4a	3.67×10^4a
Yeast counts(cfu/ml)	6.52×10^5a	5.68×10^5a	7.56×10^5a

III. RESULTS AND DISCUSSION

There were no significant differences in % dry matter and % ash content among nitrogen fertilizer levels. However, application of nitrogen fertilizer significantly affected % N, % crude protein, and concentration of Ca, K, Na and Mg (Table 1). Application of nitrogen fertilizer increased the ascorbic acid content in Roselle calyx but the increase was not significant as presented in Figure 1. The increase in ascorbic acid follows a trend from 0 to 60 kg N/ ha accordingly. Also not affected significantly with increasing levels of nitrogen treatment was pH and titratable acidity. The results in Figure 2 show 60 kg N / ha with the highest count for bacterial and yeast count (3.67×10^4 cfu/ml) and (7.56×10^5 cfu/ml) respectively and the least bacterial count in 0 kg N / ha for bacterial (2.81×10^4 cfu/ml) and yeast count in 30 kg N / ha (5.68×10^5 cfu/ml). However, there was no significant difference in microbial load at all the levels of treatment.

Increasing Nitrogen fertilizer application did not influence % dry matter and % ash content. Ca and K content increased with increasing nitrogen fertilizer application up to 30 kg N / ha after which further addition resulted to no significant differences in content of these elements. Results similar to this was obtained by Makus [13] who reported increase in the K, Fe, Mn and Zn content of the vegetable amaranth

(Amaranthus tricolor L). However, Nitrogen fertilizer did not have any consistent effect on the concentration of Na and Mg. Nitrogen content of Roselle calyx increased with increasing level of nitrogen fertilizer from 0 to 60 kg N/ ha. This is expected since nitrogen is known to be one of the essential macronutrients from the soil that is required by most plants [18]. This agreed with the findings of Musa and Ogbadoyi [15] who reported that application of Nitrogen fertilizer increases protein content, carotene, total N and nitrate content of leafy vegetables. The results obtained showed that with increasing level of nitrogen treatment, the crude protein and potassium contents significantly increased. This correlates with the findings of Olaniyi and Ojetayo [17] who showed that nitrogen application increased the protein content of leafy vegetables such as Celosia argentea. The microbial analysis showed no significant difference with increasing levels of nitrogen treatment which is relevant, since the problem of proliferation of microorganism, with increasing nitrogen treatment will not be a problem, unless of course by recontamination from harvesting implements, environment or farmer. The % Moisture obtained from this study is relevant since it comes short of the Standards (12%) required for dried vegetables especially that adopted by importers world over for importation of dried calyx. The low moisture obtained could be responsible for the low yeast count observed. Therefore, it meets possible international standards for export. The ascorbic acid content of Roselle calyx increased but not significantly with increased level of nitrogen fertilizer from 0 – 60 kg / ha. This agreed with the findings of Musa and Ogbadoyi [15] who reported that increase in nitrogen level increased β – carotene content of leafy vegetables.

IV. SUMMARY

Increasing nitrogen levels had statistical significance on the crude protein quality of Roselle. However, it had no significant difference on the microbial load. Considering that "Zobo" drink can become an alternative beverage in Nigeria and a possible export food, it is recommended that nitrogen fertilizers should be applied to Roselle plant to increase both plant yield and protein content.

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Threshold Effects between Longevity, Labour Productivity and Economic Growth in sub-Saharan Africa (SSA): a Non-dynamic Panel Data Analysis

Adedayo Oluseun Adedeji,
Department of Economics, Accounting and Finance,
Bells University of Technology, P.M.B 1015,
Ota, Nigeria
dayose2002@gmail.com

Anthony Enisan Akinlo,
Department of Economics,
Obafemi Awolowo University,
Ile-Ife, Nigeria
aakinlo@oauife.edu.ng

Abstract — **The theoretical demographic distribution stated that averagely the age group of the labour force is 15 to 64 years. Data showed that the highest longevity value of sub-Saharan Africans is approximately 54 years in the year 2010; 10 years less than the age of exit from the labour force, not to even compare with the developed countries. This study investigated the threshold effects in the relationship between longevity and labour productivity, and between longevity and economic growth in sub-Saharan Africa (SSA). Panel data spanning from 1990 to 2012 for 38 SSA countries were used and Hansen (1999) non-dynamic panel data test and estimation methods were adopted. The results revealed that, longevity was an increasing function of labour productivity and economic growth, with the significant threshold effects at ages 46.7 years on labour productivity and 67.5 years on economic growth. Among other things, food availability and capital accumulation were significantly required. Thus, policies that could accommodate people of age 67.5 years who are still fit to work, and provide entrepreneurial training and funds for the unemployed people in the ages 46 to 47 years are worthwhile in SSA countries. In addition, improvement in the provision of quality healthcare services at an affordable rate to the very poor sub-Sahara Africans is necessary to improve the quality of longevity in SSA.**

Keywords—longevity; threshold; panel; Hansen; labour; productivity; economic growth; SSA

1. INTRODUCTION

As most of the developed countries are concerned with aging population, the developing countries are battling with the challenge of short life span. Longevity, as an indicator of the extent of life span, is a variable of interest to economists in recent times. Longevity; an average number of years an individual is expected to live, given the prevailing and expected health condition over the life time, is an issue of concern, especially, in sub-Saharan Africa (SSA) countries.

Longevity in SSA region compares unfavourably low with most of other regions of the world. For instance, in East Asia and Pacific, longevity measured in years was 73 in 2004, and 74 in both 2008 and 2010, while in Europe and Central Asia, longevity was 74, 75 and 76 years in 2004, 2008 and 2010 respectively. Also, in Latin America and Caribbean, longevity in years was 73 in 2004, and 74 in 2008 and 2010, while in the Middle East and North Africa the longevity was 71 years in 2004 and 2008, and 73 years in 2010. All these are much higher than that of SSA region. A new child born in SSA countries in 2004 was expected to live for 52years, while

those born in 2008 and 2010 were of 54 life-years [15]. Whereas, if the same child was born in any of the other regions cited, he/she would have an average of additional 20 years to live.

The theoretical demographic distribution stated that the age group of the labour force is 15 to 64 years. Reference [15] data showed that the highest longevity value of sub-Saharan Africans is approximately 54 years in the year 2010; 10 years less than the age of exit from the labour force, not to even compare with the developed countries. This means an absolute loss to productivity, if longevity is an increasing function of productivity.

Another look at this issue is to investigate if there exist threshold point estimates value of longevity in SSA countries for which productivity is optimized significantly. Considering the few available empirical work on threshold and effects, [13] studied Denmark and Italy annual data and found that health in the first 20 years of people had a significant and positive effect on labour productivity, while [4] concluded, after studying the OECD countries, that reduction in mortality below age 40 years generated productivity gains. Although, this imply the existence of a threshold effect in the relationship between longevity and productivity, these studies tend to be limited by proxies and methodology, thereby unable to obtain the precise most productive age values. Besides, none of the studies focused on SSA region.

Longevity, as human health variable, is a component of human capital. Thus, its influence on productivity of labour and productivity per capita (that is, economic growth), may be vital for policy and increase in the stock of knowledge. With the adaption of [11] threshold test using fixed-effect model and bootstrapping, this study determined the significant threshold point estimates of longevity in the longevity – labour productivity and longevity – economic growth planes, for which both labour productivity and economic growth were significantly optimized in SSA

2. MODEL SPECIFICATION

To obtain the threshold effects in the relationship between longevity (*LONG*) and labour productivity (*LPROD*), and between longevity (*LONG*) and economic growth (*EGROW*) for countries in SSA, nonlinear relationships are assumed between the two pairs of variables. Adapting from [11] similar

to the adaption by [8], the models relating longevity and labour productivity, and longevity with economic growth after taking the natural logarithm of the variables are implicitly specified as follows;

$$\ln LPROD_{it} = \mu_i \, \beta_1 \ln (G_{it}) * I(LONG_{it} \leq \gamma_1) + \beta_2 \ln (G_{it}) * I(LONG_{it} > \gamma) + \epsilon_{it} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots .2.1$$

Alternatively,

$$\ln LPROD_{it} = \begin{cases} \mu_i \, \beta_1 \ln (G_{it}) + \epsilon_{it} & LONG_{it} \leq \gamma_1 \\ \mu_i \, \beta_2 \ln (G_{it}) + \epsilon_{it} & LONG_{it} > \gamma_1 \end{cases} \dots \dots .2.2$$

Similarly,

$$\ln EGROW_{it} = \mu_i \, \varphi_1 \ln (X_{it}) * I(LONG_{it} \leq \gamma_2) + \varphi_2 \ln (X_{it}) * I(LONG_{it} > \gamma) + U_{it} \dots \dots \dots \dots \dots \dots \dots .2.3$$

Alternatively,

$$\ln EGROW_{it} = \begin{cases} \mu_i \, \varphi_1 \ln (X_{it}) + U_{it} & LONG_{it} \leq \gamma_2 \\ \mu_i \, \varphi_2 \ln (X_{it}) + U_{it} & LONG_{it} > \gamma_2 \end{cases} \dots \dots 2.4$$

Where $\ln LPROD_{it}$ and $\ln EGROW_{it}$ are the dependent variables in equations 2.1 and 2.2, and 2.3 and 2.4 respectively. $LONG_{it}$ is the threshold variable for i individual country in time period t. G_{it} and X_{it} are vectors of other covariates, μ_i represents the level of country-i's fixed-effect, u_t is the level of time-t's fixed-effect.

According to [5], the traditional cross-sectional analyses usually focus on conditional convergence neglecting the nonlinear alternatives. However, if the aim of the model is not to study cross-country convergence but to determine whether or not nonlinearity exists between the two variables of interest, this can be done once the cross-country heterogeneity is taken care of.

Equations 2.2 and 2.4 indicate clearly that, the observations are divided into two regimes depending on whether the threshold variable ($LONG_{it}$) is smaller or larger than the threshold point (γ). The regimes or periods of longevity are distinguished by deferring regression slopes; $\beta_1 \, and \, \beta_2$ for labour productivity function and $\varphi_1 \, and \, \varphi_2$ for economic growth function. According to [11], for the identification of the parameters $\beta_1 \, and \, \beta_2$ and parameters $\varphi_1 \, and \, \varphi_2$, it is required that we assume the element of G_{it} and X_{it}, and the threshold variable are not time invariant and that $\epsilon_{it} and \, U_{it}$ are assumed to be independently and identically distributed (iid) with zero mean and finite variance σ^2. The iid assumption excluded the lagged dependent variables from G_{it} and X_{it}. By eliminating the individual effect μ_i through the removal of individual-specific means, the models 2.1 and 2.3 can be explicitly specified as follows;

$$\begin{aligned} lnLPROD = {}& C + \alpha_1 \, lnCAPITAPL_{it-1} + \alpha_2 lnCAPITAPL_{it-1}{}^2 \\ & + \alpha_3 \, lnCAPITAPL_{it-1}{}^3 \\ & + \alpha_4 \, [lnCAPITAPL_{it-1} * LONG_{it-1}] \\ & + \alpha_5 \, LONG_{it-1} + \alpha_6 \, LONG_{it-1}{}^2 \\ & + \alpha_7 LONG_{it-1}{}^3 + \varphi_1 \, lnFOOD_{it-1} \\ & * (LONG_{it-1} \leq \gamma) + \varphi_2 \, lnFOOD_{it-1} \\ & * (LONG_{it-1} > \gamma) \dots \dots \dots \dots \dots \dots \dots . \dots .2.5 \end{aligned}$$

$$\begin{aligned} lnEGROW = {}& C + \alpha_1 \, lnCAPITAPC_{it-1} + \alpha_2 lnCAPITAPC_{it-1}{}^2 \\ & + \alpha_3 \, lnCAPITAPC_{it-1}{}^3 \\ & + \alpha_4 \, [lnCAPITAPC_{it-1} * LONG_{it-1}] \\ & + \alpha_5 \, LONG_{it-1} + \alpha_6 \, LONG_{it-1}{}^2 \\ & + \alpha_7 LONG_{it-1}{}^3 + \beta_1 \, lnFOOD_{it-1} \\ & * (LONG_{it-1} \leq \gamma) + \beta_2 \, lnFOOD_{it-1} \\ & * (LONG_{it-1} > \gamma) \dots \dots \dots \dots \dots \dots \dots \dots \dots .2.6 \end{aligned}$$

The inclusion of the non-linear terms $LnCAPITAPL_{it-1}^2$, $LnCAPITAPL_{it-1}^3$, $(LnCAPITAPL_{it-1}) * (LONG_{i,t-1})$, $LONG^2{}_{i,t-1}$ and $LONG^3{}_{i,t-1}$, in the equation 2.5 and $LnCAPITAPC_{it-1}^2$, $LnCAPITAPC_{it-1}^3$, $(LnCAPITAPC_{it-1}) * (LONG_{i,t-1})$, $LONG^2{}_{i,t-1}$ and $LONG^3{}_{i,t-1}$, in equation 2.6 are to reduce the possibility of spurious correlations due to omitted variable bias.

Where G_{it} = Capital stock per labour ($lnCAPITAPL$) and food availability ($lnFOOD$) $and \, X_{it}$ = Capital stock per capita ($lnCAPITAPC$) and food availability ($lnFOOD$). Studies have shown that food availability [3, 6 and 10] and capital [14] are some of the variables important in explaining the variation in labour productivity and growth of the economy [1].

3. METHOD OF ANALYSIS

The threshold effects of longevity on labour productivity and economic growth were obtained from the estimation of equations 2.5 and 2.6 respectively. These equations are non-dynamic fixed-effects panel-data model. They take-off with the assumption of absence of any unmeasured time invariant heterogeneity across countries [9], then, the bootstrap procedure proposed by [11] is applied to test for the existence of thresholds and obtain the threshold point estimates. Thereafter, the panel least squares estimation method is conducted as suggested by Hansen to determine the threshold effects (see [11]).

4. DATA MEASUREMENT AND SOURCES

For this study, panel data covering the periods 1990 to 2012 were used. Thirty-eight (38) of the forty-eight (48) SSA countries formed the sample[1]. The choice of this sample size was informed by the extent of data availability and the choice was carefully made to maximize the available observations. The data were sourced from World Development Indicators online database published by World Bank Organization and Penn World Table version 7.1 and 8.0 published by University of Pennsylvania. Few data were extrapolated. Table 4.1 presents information on the description, measurement and sources of data for the variables in this work.

Table 4.1: Sources of Data, Description and Measurement of Variables

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[1] The sampled countries included Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo Rep., Cote d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia The, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

5. EMPIRICAL RESULTS

Variable	Description	Measurement	Source(s) of Data
LONG	Longevity	This is life expectancy at birth which is the number of years a new born infant would live if prevailing patterns of mortality at the time of its birth are to stay the same throughout its life. It is an overall indicator of mortality and an important indicator of health status in a country (WDI, 2007)	World Development Indicators (WDI) online database published by World Bank Organization
LPROD	Labour productivity	This is real Gross Domestic Product (GDP) per worker. It is the purchasing power parity converted GDP chain per worker at 2005 constant prices in US dollars(WDI, 2007)	Penn World Table versions 7.1 and 8.0 [7] and [12]
EGROW	Economic growth	This is real Gross Domestic Product (GDP) per capita. It is the purchasing power parity converted GDP chain per capital at 2005 constant prices in US dollars(WDI, 2007)	WDI
FOOD	Food availability	This is food production index (2004 - 2006 = 100). Food production index covered food crops that are considered edible and that contained nutrients (WDI, 2007).	WDI
CAPITAPL	Capital stock per labour	This is the stock of capital at constant 2005 national prices (in million 2005 US $) taken as the ratio of employment(WDI, 2007)	Penn World Table version 8 [7].
CAPITAPC	Capital stock per capita	This is the stock of capital at constant 2005 national prices (in million 2005 US $) taken as the ratio of total population (WDI, 2007)	Penn World Table version 8 [7].

5.1 Descriptive Summary of the Data

The summary of sample statistics of the series for the variables examined is presented in Table 5.1. All the variables except longevity are transformed into the logarithms of their levels. The longevity series is retained at levels as the threshold variable. The series in each variable are described using minimum, median and maximum. For longevity, the minimum value is as low as 26.8 years while the maximum value is 74.2 years.

Table 5.1: Sample Summary Statistics

Variables	Min.	25% quant	Median	75% quant	Max.
lnEGROW	4.717	5.758	6.224	6.816	9.609
lnLPROD	6.271	07.383	7.912	8.368	10.480
lnCAPITAPC	6.111	7.554	8.002	8.659	10.913
lnCAPITAPL	6.734	8.399	8.941	9.638	11.907
lnFOOD	3.078	4.264	4.562	4.709	5.150
LONGEVITY	26.76	47.743	52.726	57.487	74.207

5.2 Threshold Point Estimates between Longevity, Labour Productivity and Economic Growth in SSA

Adopting [11] threshold test in determining the threshold point estimates and estimating threshold effects in non-dynamic panels with individual specific fixed effects transformations, this study obtained six threshold values of longevity at which labour productivity is optimized and six threshold values of longevity at which economic growth is optimized. Table 5.2 presents the threshold point estimates results.

From table 5.2, six threshold point estimates are obtained and bootstrap[2] p-values of F-statistic tests are reported in parenthesis, while the corresponding asymptotic 95% confidence intervals are shown in the table. Out of the six threshold points estimated, only one threshold point ($\hat{\gamma}_2^r = 67.5\ years$) has statistically significant effect on economic growth at p=0.05. Therefore, 67.5 years is the threshold point of longevity for which the economic growth is significantly optimized. Also, the asymptotic confidence intervals for this threshold are very tight as shown in table 5.2. This is an indication of little uncertainty about the nature of this decision.

Also, for labour productivity, out of the six threshold points estimated, only one threshold value ($\hat{\gamma}_1^r = 46.7\ years$) had statistically significant effect on labour productivity at p<0.01. Thus, 46.7 years is the threshold point estimate of longevity for which labour productivity is optimized. The asymptotic confidence intervals for this threshold are very tight. This is indicating little uncertainty about this choice.

Table 5.2: Threshold Point Estimates between Longevity, Labour Productivity and Economic Growth

Threshold Variable: Longevity	Dependent Variables			
	Labour Productivity		Economic Growth	
	Estimates	95% Confidence Interval	Estimates	95% Confidence Interval
$\hat{\gamma}_1^r$	46.71*** (0.000)	[46.24, 47.13]	67.50** (0.053)	[67.50, 68.29]
$\hat{\gamma}_2^r$	56.14 (0.373)	[43.25, 56.84]	70.96 (0.813)	[46.28, 71.77
$\hat{\gamma}_3^r$	52.61 (0.637)	[40.49, 53.69]	52.08 (0.340)	[46.22, 55.30]
$\hat{\gamma}_4^r$	61.19 (0.717)	[35.79, 70.96]	47.76 (0.350)	[35.79, 56.76]
$\hat{\gamma}_5^r$	35.79 (0.637)	[35.79, 70.51]	35.79 (0.847)	[35.79, 61.22]
$\hat{\gamma}_6^r$	50.89 (0.290)	[49.49, 51.02]	54.92 (0.247)	[46.35, 57.06]

*Note: ** and *** in the results indicate 5% and 1 % levels of significance and figures in the parenthesis, ( ), are Bootstrap P-values of F-statistic tests and [ ] are the confidence intervals*

The *Effective-Labour-Productivity-Age* of 46.7 years is simply a unique threshold point estimate among series of

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[2] Taking after the work of [11], 300 bootstrap replications were carried out in each of the bootstrap test.

possible threshold point estimates in the longevity – labour productivity plane, for which labour productivity is significantly optimized. However, it should be noted that this does not suggest the age of exit from labour force or employment, but rather the age point in longevity function at which longevity is most impactful on productivity per unit of labour in SSA.

Similarly, the *Growth-Effective-Longevity-Age* of 67.5 years is the unique threshold point estimate, among series of possible thresholds, in the longevity – economic growth plane, for which economic growth is significantly optimized. This age does not suggest the only age impacting on economic growth, but rather the age point in longevity function at which longevity is significantly impactful on the growth of the economy in sub – Saharan Africa.

Furthermore, the locus of movement in the series of estimated threshold points in the longevity – labour productivity plane, is termed the *Longevity–Labour Productivity Threshold Path* (LPTP), while the locus of movement in the series of estimated threshold points in the longevity – economic growth plane is termed the *Longevity– Economic Growth Threshold Path* (LETP). The economic importance of LPTP and LETP is traceable to the fact that in analysing the working age distribution of population, LPTP and LETP show the various values of longevity that benefit the productivity per unit of labour and the growth of the economy respectively. LPTP signals to the employer of labour and the government in that, more productive efforts are extractible from longevity at these various threshold point estimates, while the most impactful ages of longevity in SSA are 46.7 and 67.5 years.

Based on the existence of a single significant threshold point estimate of longevity relative to labour productivity, and another single significant threshold point estimate relative to economic growth, thus, two longevity periods could be identified.

5.3 Threshold Effects between Longevity, Labour Productivity and Economic Growth in SSA

The regression slope estimates of the threshold point estimates are presented in tables 5.4 and 5.5. Yearly dummies are also included in all the models estimated in this section. From table 5.4, the approximate R^2 value of 0.98 suggests that, 98% of the variation in labour productivity is explained by the independent variables put together. The statistically significant F-statistic at $P<0.01$ imply that all the independent variables, put together, significantly explain the behaviour of labour productivity in SSA. It is, further, revealed that capital per unit of labour ($LnCAPITAPL_{it-1}$) is statistically significant in all the models estimated. The importance of capital per unit of labour for effective productivity of labour is also revealed. The inclusion of the non-linear terms $LnCAPITAPL_{it-1}^2$, $LnCAPITAPL_{it-1}^3$, $(LnCAPITAPL_{it-1})*$ $(LONG_{i,t-1})$, $LONG^2_{i,t-1}$ and $LONG^3_{i,t-1}$, in the regression was to reduce the possibility of spurious correlations due to omitted variable bias.

From column 1 of table 5.4, longevity has a positive and statistically significant effect on labour productivity at $p < 0.01$. When the average longevity of a country in SSA is at the threshold of 46.7 years, any health related improvement that raises longevity by 1 year will significantly increase labour productivity by 26.1%. The coefficient of the interactive effect between food availability and the point estimates of longevity revealed that food availability matter for longevity to have a significant positive effect on labour productivity.

From table 5.4 columns 2 and 3, both the longevity period before the threshold, and the period greater than or equal to the threshold point estimate, have positive and statistically significant effects on labour productivity. As expected, the coefficient of the point estimate before 46.7 years; $\beta_1 = 0.460$, (say, period 1) is less than the coefficient of the threshold point estimate and beyond; $\beta_2 = 1.692$ (say, period 2). On comparing the coefficients further, period 2's coefficient is almost 4 times the period 1 ($\beta_2 = 1.692/0.460\ \beta_1 = 3.6\ \beta_1$).

Table 5.4: Panel Least Square Estimates for Threshold Effect of Longevity on labour Productivity

Independent Variables	Dependent Variable: Labour Productivity		
	1	2	3
$LnCAPITAPL_{it-1}$	12.099*** (6.935)	14.910*** (8.092)	11.523*** (6.302)
$LnCAPITAPL_{it-1}^2$	-1.194*** (-6.196)	-1.542*** (-7.594)	-1.142*** (-5.654)
$LnCAPITAPL_{it-1}^3$	0.041*** (5.894)	0.054*** (7.391)	0.0395*** (5.379)
$(LnCAPITAPL_{it-1})*$ $(LONG_{i,t-1})$	-0.001 (-0.779)	0.0028* (1.873)	0.0005 (0.344)
$LONG_{i,t-1}$	0.261*** (5.392)	-----	------
$LONG^2_{i,t-1}/10^3$	-4.944*** (-5.175)	0.0834 (0.392)	0.0425 (0.206)
$LONG^3_{i,t-1}/10^6$	0.317*** (4.856)	-3.52** (-2.183)	-0.364 (-0.230)
$LONG_{i,t-1} < 46.7$	-----	0.460*** (2.797)	-----
$LONG_{i,t-1} \geq 46.7$	-----	-----	1.692*** (8.083)
$LnFOOD_{it-1}$ $*(LONG_{it-1} < 46.7)$	0.348*** (9.956)	-----	0.3676*** (7.808)
$LnFOOD_{it-1}$ $*(LONG_{it-1} \geq 46.7)$	0.369*** (10.43)	0.1196*** (3.212)	-----
C	-40.063*** (-7.653)	-42.483*** (-7.676)	-33.878*** (-6.233)
	Effects Specification		
	Cross-section fixed (dummy variables)		
R-squared	0.9846	0.9825	0.9836
F-statistic	733.101	655.351	698.695
Prob(F-statistic)	0.0000	0.0000	0.0000

Note: *,**,*** *in the results indicate 10%, 5% and 1% level of significance and figures in the parenthesis are t-statistic test. The F-statistic test reports the joint significance of the independent variables to the dependent variable. R^2 values give information the goodness-of-fit of the estimated model.*

Similarly, in the results of panel least square estimate for threshold effect of longevity on economic growth in table 5.5,

for all the estimated models, the approximate R^2 value of 0.99 imply that 99% of variation in economic growth is explained by the exogenous variables put together. Also, the statistically significant F-statistic at P<0.01 means that all the exogenous variables, put together, significantly explained the behaviour of economic growth of SSA.

Table 5.5: Panel Least Square Estimate for Threshold Effect of Longevity on Economic Growth

Independent Variables	Dependent Variable: Economic Growth		
	1	2	3
$LnCAPITAPC_{it-1}$	4.334*** (2.829)	6.074*** (3.767)	5.763*** (3.731)
$LnCAPITAPC_{it-1}^2$	-0.453*** (-2.459)	-0.667*** (-3.440)	-0.651*** (-3.513)
$LnCAPITAPC_{it-1}^3$	0.0186*** (2.573)	0.0266*** (3.501)	0.027*** (3.683)
$(LnCAPITAPC_{it-1}) * (LONG_{i,t-1})$	-0.001839 (-1.307)	-2.50E-05 (-0.018)	0.0012 (0.919)
$LONG_{i,t-1}$	0.165*** (3.366)	-----	-----
$LONG^2{}_{i,t-1}/10^3$	-3.182*** (-3.245)	0.394** (1.990)	-0.0259 (-0.149)
$LONG^3{}_{i,t-1}/10^6$	22.4*** (3.258)	-3.73** (-2.324)	0.132 (0.095)
$LONG_{i,t-1} \leq 67.5$	-----	1.766** (2.364)	-----
$LONG_{i,t-1} > 67.5$	-----	-----	1.691*** (11.300)
$LnFOOD_{it-1} * (LONG_{it-1} \leq 46.7)$	-0.016*** (-4.234)	-----	----
$LnFOOD_{it-1} * (46.7 < LONG_{it-1} \leq 67.5)$	0.3303*** (10.519)	-----	----
$LnFOOD_{it-1} * (LONG_{i,t-1} > 67.5)$	0.082*** (5.870)	0.497*** (3.006)	----
$LnFOOD_{it-1} * (LONG_{it-1} \leq 67.5)$	-----	-----	0.274*** (8.865)
C	-12.718*** (-3.014)	-15.447*** (-3.452)	-13.525*** (-3.187)
	Effects Specification		
	Cross-section fixed (dummy variables)		
R-squared	0.9829	0.9892	0.9901
F-statistic	658.018	1071.373	1168.197
Prob(F-statistic)	0.0000	0.0000	0.0000

Note: *** and *** in the results indicate 5% and 1% levels of significance and figures in the parenthesis are t-statistic test. The F-statistic test reports the joint significance of the independent variables to the dependent variable. R^2 values give information the goodness-of-fit of the estimated model.*

In addition, it is shown that capital per capita ($LnCAPITAPC_{it-1}$) and its powers are statistically significant in all the models estimated and reported in table 5.5. This is an indication of the existence of non-linear relationship between longevity ($LONG_{i,t-1}$) and economic growth ($lnEGROW$). These results also buttressed the importance of capital stock for the growth of the economies of the SSA countries. Furthermore, the inclusion of the non-linear terms $LnCAPITAPC_{it-1}^2$, $LnCAPITAPC_{it-1}^3$, $(LnCAPITAPC_{it-1}) *$

($LONG_{i,t-1}$), $LONG^2{}_{i,t-1}$ and $LONG^3{}_{i,t-1}$, in the regression was to reduce the possibility of obtaining spurious results due to omitted variable bias.

Considering the results in column 1 of table 5.5, longevity has a positive and statistically significant effect on economic growth at p < 0.01. When the average longevity of a country in SSA is at the threshold of 67.5 years, any health related improvement that raises longevity by 1 year will significantly raise economic growth by 16.5%. The coefficient of the interactive effect between food availability and the point estimate of longevity revealed that food availability matter for longevity to have a significant positive effect on economic growth.

It could be noted that at the longevity period of less than or equal to 46.7 years, the interactive effect between food availability and longevity is statistically significant but has negative effect. This may be an implication of unproductive longevity period among ages between 26.8 years (that is, the minimum longevity age in this study; see table 5.1) and the 46.7 years. Thus, unlike other periods shown in columns 1 to 3; food consumed at the period between ages 26.8 years and 46.7 years, may not be positively feeding back on economic growth. This could be an indication of high rate of youth unemployment in SSA countries.

The role of food availability and the accumulation of capital are very important for longevity to impact positively on both labour productivity and the growth of the economy. This results buttressed the findings of [2], and [3] that increase in food availability is vital for longevity. Even, the threshold point estimates of longevity made significant impact on labour productivity and economic growth, with the availability of substantial food production, and capital stock per labour and per capita. This implies that longevity may not be 'total' in itself.

6. CONCLUSION AND POLICY RECOMMENDATION

The focus of this study was to determine the threshold point estimates of longevity for which labour productivity and economic growth were significantly optimized. It was also to analyse the threshold effects of longevity on labour productivity and economic growth. Using panel data from 38 SSA countries and [11] threshold effects test for determining the threshold points and their effects, this study found that longevity was an increasing function of labour productivity and economic growth, with the significant positive threshold effects at ages 46.7 years on labour productivity and 67.5 years on economic growth, for which both were significantly optimized. Comparing the recent average longevity of 55 years of sub-Sahara Africans with the economic growth maximizing longevity of 67.5 years (longevity gap of 12.5 years) revealed that the economies of the SSA countries can grow through improved longevity. Among other things, food availability and capital accumulation were significantly capable to spur labour productivity and economic growth in the region.

Thus, this study recommended that the governments in SSA countries need to review the working age bracket and enact a planned policy that will accommodate people of age 67.5 years who are still fit to work. Also, they could provide entrepreneurial training and funds for the unemployed but physically fit people in the ages 46 to 47 years, to engage in productive activities. Besides, there is the need to improve on the provision of quality healthcare services at an affordable rate to the sub-Sahara Africans with a view to maintain and improve on the quality of longevity in SSA. This will lead to significant increase in labour productivity and economic growth. Also, policies that will promote food production and capital accumulation are vital to spur labour productivity and economic growth through longevity in SSA region.

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Microgrids For Sustainable Electricity Supply In African Countries

Oluwadamilola Soyoye
Electrical and Computer Engineering Department
Illinois Institute of Technology
Chicago, USA

Abiola Ayinla
Energy Studies Specialist
Lagos, Nigeria

Abstract— **Africa is blessed with renewable energy resources. It is becoming increasingly needful to take advantage of these resources, especially as it relates to electricity supply. Electricity availability has been closely linked with economic growth in many countries. Yet, many rural communities do not even have electricity supply of any form and many urban areas do not have a reliable electricity supply.**

A number of solutions have been proposed to solve the energy crisis in Africa. One common observation is the abundance of renewable energy sources. Microgrids provide a platform to integrate several Distributed Energy Resources (DERs) using centralized control. African Communities can take advantage of their abundant resources by using Distributed Generation which can be fuelled by locally available materials. Solar energy, wind energy and biomass abound in many communities for localized electricity generation; backup systems from fossil fuel generation are readily available in form of diesel and petrol generators. Energy Storage Systems facilitate the integration of variable renewable energy sources by storing energy at low-demand periods for later use during high-demand periods. Microgrids also incorporate Energy Management Systems to promote energy efficiency.

Microgrids have been installed in many parts of the world with high success rates. Governments can take advantage of Microgrids for Rural Electrification projects without incurring significant Transmission and Distribution costs associated with large scale power systems. The benefits of Microgrids are numerous and they can be designed to meet specific community needs.

This paper explores Microgrid applicability in African countries and the use of renewable resources for electricity generation to facilitate a sustainable energy future.

Keywords—Microgrids; Renewable Energy Sources; Africa; Distributed Generatiion; Energy Storage Systems

I. INTRODUCTION

Electric Power is an important resource for development. In the US, the Electric power system accounts for 4% of the Gross Domestic Product (GDP). [1] Many African countries have low GDPs, and although this is multifaceted, electricity (or insufficiency of it) plays a significant role. Therefore, an improved electricity sector could boost the economy and facilitate the achievement of sustainability goals. Of the 850 Million people in Africa, 10% are grid-connected and 90% are disconnected from the grid. Africa accounts for 13.4% of the world's population but only uses about 3% of the world's electricity consumption. [7] This disparity is saddening and indicates the need for strategic improvement.

Generally, the traditional Electric Power System is subdivided into generation, transmission and distribution. Electricity has always been produced in large quantities due to economy of scales. The electric energy generated is not intended to be utilized only at the generation region. It is transferred at high voltages to other regions for consumption. This transfer over large distances is term electricity transmission. Finally, substations step down high voltage electricity received, to make it safe for distribution. Electricity is distributed at lower voltages to industrial, commercial and residential consumers.

Microgrids alter this traditional arrangement. They incorporate generation into the distribution system, closer to the consumer. This eliminates the need for a transmission system and the losses associated with it

The Microgrid concept can be very useful in political propaganda. Governments can set up microgrids in fulfillment of rural electrification promises. This can be particularly beneficial to rural farmers, for storage of farm produce and can facilitate the use of Information Technology in Agriculture.

II. Microgrid Definition

A Microgrid is a cluster of interconnected loads and microsources with electrical boundaries operating as a single controllable entity. [2] [6] These microsources, in recent times, are commonly referred to as Distributed Generation. Microgrids can be operated in the Grid-connected or Islanded mode where the Microgrid is connected to the main utility grid in the Grid-connected mode, and disconnected in the Islanded mode.

The traditional Generation-Transmission-Distribution system has been challenged due to concerns about the reliability, resiliency and economic operation of power systems. Reliability issues are high frequency, low impact occurrences. Resiliency issues are low frequency, high impact occurrence, such as natural disasters and terrorist attacks. With clusters of Distributed Energy Resources scattered in many areas, it is more difficult to have a total collapse of the power system. The large generating units are like the proverbial "eggs in a basket".

III. MICROGRID COMPONENTS

A typical Microgrid consists of Distributed Energy Resources, Loads. A Microgrid is different from a regular backup system. Microgrids need to have the following distinct characteristics: clearly defined electrical boundaries, a master controller, and critical loads that do not exceed the generation capacity. [3]

Distributed Energy Resources consist of Distributed Generation and Energy Storage Systems. Distributed Generation (DGs) are small-scale energy resources used to locally supply electricity. Energy Storage Systems store energy during a certain period for use at a later period. There is a need for ESSs because of the intermittence of certain Distributed Generation, especially those from renewable energy sources.

A. Loads

Loads play a major part in determining the needs of the system. Loads can be residential, commercial or industrial. Also, very importantly, loads are classified as critical or non-critical loads. Critical loads need to be supplied at all time while non-critical loads can be modified during load shedding, demand response, etc. They are also referred to as fixed and flexible loads.

B. Master Controller

The master controller provides Centralized Control. It controls and operates the other components of the Microgrid. It ensures the economic and reliable operation of the system. It is integral to the Microgrid.

C. Point of Common Coupling (PCC)

This serves as the interface between the Microgrid and the utility grid. When the PCC is closed, the microgrid is connected to the utility grid. The microgrid is disconnected from the utility grid when the PCC is open.

D. Ancillary Components

These components facilitate the reliable and economic operation of the Microgrid. They include smart switches, protective devices, and communication, control and automation systems. [3]

IV. BENEFITS OF MICROGRIDS

Some of the benefits of implementing microgrids are as follows:

➢ Reliability: For microgrids connected to the utility grid, blackouts can be eliminated when there are disturbances in the system because of the availability of local generation and energy storage. [5] These create redundancy because of the different available electricity sources. Reliability is further improved in smart microgrids. [5]

➢ Integration of Renewable Sources: Due to certain factors (such as the variability of renewable energy - sources), it is challenging to directly integrate them into the utility system. Since there is an electrical boundary between the microgrid and the utility grid, it is easier to integrate the renewable energy sources for electricity generation.

➢ Demand Response: These are strategies implemented on the demand side of the power system to control the load. Demand response is easier to implement in Microgrids as the system is seen as a single entity to be controlled.

➢ Power Quality: With the availability of Distributed Generation, Energy storage, and an efficient Master controller, electricity can be supplied at best frequency and voltage quality.

➢ Energy Arbitrage: The Microgrid can supply electricity back to the grid or bilateral contracts at higher costs than the cost of obtaining the electrical energy

➢ Cost Savings: Microgrids provide significant cost savings in both the initial installation and operation in power systems. The cost savings in installation are gotten from the elimination of transmission and distribution infrastructure. In operating a Microgrid with renewable energy sources, the cost of fuel is also drastically reduced.

V. RENEWABLE RESOURCES

With growing concerns about the emission of Greenhouse gases, more environment-friendly alternatives are being sought. Most electricity generation is from fossil fuels, and fossil fuels significantly pollute the environment. The increased use of renewable energy sources for electricity generation would reduce these harmful emissions.
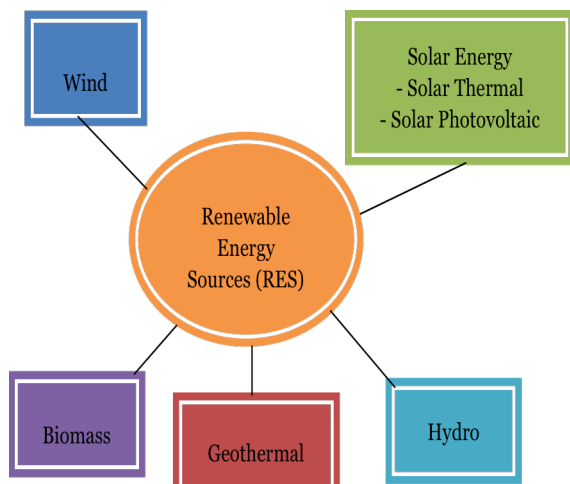
Fig. 1. Some Viable Renewable Energy Sources for Microgrids

Renewable energy sources have low operating costs. Therefore, they are more economical to operate on the long term; although initial capital costs may be high.

Renewable Energy Sources for Electricity generation in microgrids include:

a) Solar

Solar Energy can be used for electricity generation by Solar Thermal and Solar Photovoltaic (PV) means. Solar Thermal generation is obtained by concentrating energy from the Sun to produce steam and generate electricity. Photovoltaic Cells convert light energy into electrical energy.

b) Wind

Wind turbines generate electricity from wind energy. The wind rotates the blades which are connected to the turbine. The turbine generates electricity.

c) Biomass

The most viable sources for electricity generation using biomass are organic sources of food, forest production, fiber and animal manure. A steam cycle can be used to convert the biomass into steam, which is used to turn a turbine that generates electricity. Another method is to convert the solid biomass into fuel gas. [4]

d) Geothermal

This involves using the heat in the earth's crust to generate electricity.

e) Hydro

Hydro power generation is a popular renewable energy source that has been available for several years. The force of water is used to drive a turbine which generates electricity

VI. RENEWABLE RESOURCE AVAILABILITY IN SOME AFRICAN COUNTRIES AND MICROGRIDS IN DEVELOPING COUNTRIES

Many African countries have great potential for Renewable Energy electricity generation. Most African countries have abundant solar energy. Also, wind energy is a viable energy source. Rural communities can utilize biological waste for biomass generation. Biomass can also be used to generate electricity in urban regions.

Although these resources are abundant, there are challenges with the adoption and integration of these resources. The advantages of RES electricity generation include:

- Reduction of operation costs. Fossil fuel Power Plants require fuel to run continuously. With RES generation, the cost of fuel is eradicated, which significantly reduces operation costs. In the long run, the initial high capital cost of installation is offset but by low operation costs

- RES are environmentally friendly as there is little or no emission of Greenhouse gases.

Incorporating these Renewable energy sources into Microgrids is highly beneficial. As improvements are being made on the Electric Power systems, a major challenge is that many of these systems have been fully built and have been operational for years in more developed countries.

Many developing countries do not have adequate electricity infrastructure for reliable electricity supply. Therefore, the improvements on the electric power system can be applied to these countries without having to remove already established infrastructure. One of such improvements is the Microgrid Concept.

VII. MICROGRIDS FOR RURAL ELECTRIFICATION

One of the benefits of Microgrids mentioned earlier is the deferral of transmission and distribution upgrades. In rural areas that have never had electricity supply, it may be more cost efficient to build Microgrids. Many of these areas are in obscure regions with challenging terrains that make implementation of transmission systems problematic. Also, locally available and naturally occurring resources can be considered in planning the Microgrid system. The systems can be designed and tailored to meet the specific needs of the community.

VIII.   SOME CASE STUDIES

a.   *Rural Migrogrids: Ololailumtia Microgrids*

A Microgrid was installed at Ololailumtia village in Kenya 75km from the nearest power lines. The village has a population of about a thousand people, a few of which had 1-3kW gasoline generators. Two microgrids were installed with a capacity of 2.1kW of PV with Energy storage provided by a 9.6kWh sealed lead-acid bank. The microgrids cost about $15,000. Energy-efficient LED lighting was also added to the microgrid. [9]

b.   *A Campus Microgrid: The Illinois Institute of Technology, Chicago Microgrid*

The Microgrid consists of 300kW of Solar Generation, 8,000kW of Natural Gas Turbines, 8kW of Wind Generation, and 4034kW backup generation. There also Energy Storage devices such as the 500kWh battery and other small size energy storage devices. It is connected via two substations to the utility grid. The Master-Controller operates a three-level hierarchical control. [8]
The improvements are remarkable. Energy efficiency has been improved by 6.51%, CO_2 emissions have been reduced by 6.58% and significant cost savings. [8]

IX.   CONCLUSION

Microgrids have been found to have so much potential in many regions. African communities are not left behind. In fact, it may be easier to implement Microgrids in some parts because the power systems in these areas need to be freshly built. Hopefully, the concept of Microgrids in African countries will be explored more as a solution to Africa's Electricity inadequacy.

ACKNOWLEDGMENT

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Socio-economic Factors Influencing Health Behavior of Women and Immunization Status of Children in Nigeria

Temitope, O. ILUSANYA, Muyiwa, OLADOSUN.
Department of Demography and Social Statistics,
Covenant University,
Ota Ogun State, Nigeria.
Email: ilusanyatemitope@gmail.com

Abstract- Women's health behavior is a major barrier to the immunization status of children in Nigeria. Despite the intervention and progress over the years on childhood immunization in Nigeria four out of five children still do not see their fifth birthday due to preventable diseases. Women's health behavior has been recognized as a major barrier to the immunization status of children in Nigeria. The purpose of this study is to examine the Socio-economic factors influencing the health behavior of women and immunization status of children in Nigeria. Nigeria Demographic and Health Survey (NDHS) that included the women 15-49 years. The result of the analysis shows that 69.5% of the respondents have ever had vaccination. This study revealed that mothers' level of education, type of occupation, place of residence, wealth quintile, religion and region were significantly associated with health behavior of women (p-value = 0.000).Region, residence, level of education varied significantly by respondents' check-up after delivery (p-value = 0.000), respondent checked health status before delivery (pvalue= 0.000), and number of antenatal visits during pregnancy (p-value = 0.000). Future policy geared to increase immunization coverage will have to consider these factors.

Key Words: Socio economic factors, Health Behavior of women, immunization status, Nigeria, NDHS 2013.

INTRODUCTION

Vaccines are among the most effective preventive health measures in reducing child mortality, morbidity, and disability (Nyarko, 2001). Immunization is described as a form of health technology that is central on child health care practice that is aiming at reducing preventing or protecting an individual against epidemic (Jegede 2005). In 2011 alone, statistics reveal that, about seven million under-5 mortality occurred globally, out of which about 41% occurred in sub-Saharan Africa and vast majority of the deaths are preventable through universal immunization coverage in the region (Rutherford, Mulholland, & Hill, 2010; UNICEF, 2012). In fact, about 30 million out of the 130 million children born every year worldwide are not receiving vaccination of any kind (WHO, 2000).

Child mortality has fallen significantly in many low-income countries; however, sub-Saharan Africa continues to experience the slowest fall in mortality rate among children (Ahmad, 2000). Studies in Africa have shown that about 3 million children in developing countries still die and many more are crippled, blinded, or otherwise disabled from six major diseases that are preventable through immunization (World Health Organization (WHO)/United Nations Children's Fund (UNICEF), 2010). While coverage was estimated to be less than 80% in 36 countries, 6 countries (Chad, Equatorial Guinea, Gabon, Nigeria, Palau and Somalia) failed to achieve 50% coverage level (WHO/UNICEF, 2010).

Nigeria is among the countries with vaccine coverage rate below 50% (Hersh 2005). In Nigeria, an estimated 10.8 million children die worldwide each year, of which 41% of these deaths occur in sub-Saharan Africa and 34% in South Asia (Maduabum, 2005). Nigeria is among the countries which has a very low coverage rate of childhood vaccines in

the world (Babalola, Aina, 2004). Nigeria's immunization coverage rates are among the worst in the world (UNICEF, 2001). Measles was responsible for 5 percent of the child deaths in Africa (Bryce, Boschi, Shibuya, Black, 2005). It has been documented that children from parents who live below the poverty level have lower immunization coverage than those who live above poverty level (CDCP, 2012). Parents of higher socio-economical background with non-minority children were far more likely to have complete immunization (Bundt, Hu. 2004).

Ojikutu (2012), observed that many factors such as poor knowledge of immunization, lack of suitable venues, long waiting, transportation difficulties, non-medical facilities and poor motivation impede smooth realization of the objectives of immunization programmes. Mothers who have poor health, their children are likely to also suffer poor health either because of inheritance or because of the type of place where they grew up (propper, Rigg 2007). Even though several other factors are responsible for low immunization coverage in Nigeria which is yet to be explored. Hence the need for this present study which seeks to examine the impact of socio economic factors

(Mother's Educational attainment, employment status, marital status, wealth quantile, Religion and place of residence) influencing women's health behavior and immunization status.

LITERATURE REVIEW

In immunization coverage, widespread inequalities persist to the disadvantage of parents in the lowest socio economic quintile, including parents in rural areas and no education which affects a child's immunization status (NPC 2004).

SOCIO ECONOMIC FACTORS

Child health is significantly related to maternal health as health status of the mother impact the health of the child prior to delivery and after (UNICEF 2007). Mothers below 30 years were 2.26 times more likely to be fully immunized (Odusanya et al., 2008). To reduce under-five (5) mortality rate mother's

education is an important independent factor (Breiman et al., 2004). Mothers who completed primary education were less likely to have their children fully immunized compared to women who have no education at all. (Jamil et al.,1999). A woman is empowered through education to access relevant health care services such as prenatal care, antenatal care and childhood immunization (Becker et al., 1993). Mothers who are educated have three times more chances to immunize their children than the uneducated mothers; therefore there is a significant relationship between mother's education status and child immunization status (Patra, 2006). In another study, uneducated mothers are less concerned about their children's immunization status compared to highly educated mothers (Odunsanya et al., 2007). Immunization status of children can be increased through the increase in education of women on health care services (Munthali, (2007). Educational qualification does not influence parents to immunize their children when due and education qualification does not significantly influence the belief of people about the causes of the diseases (Jibowo, 1992), Another highly significant factor that influences parents to be willing to immunize their children is marital status (Rasheed, 2012).

In 2003, some leaders from three states in Nigeria who are religious and also into politics shunned a polio campaign organized by WHO with an assertion that vaccines are causes of AIDS and infertility in the country (Jegede, 2007). The choice of health practice women adopt is a function of their beliefs (Yomi, Alfred, 2012). Religion, social and religion are not barriers to routine immunization. (Christopher, 2009). Vaccination is believed by some respondents to be a form of family planning which is targeted towards the Muslims (Mitcher, 1995).

There is a positive association between religion, marital status, household size, and age with their knowledge of expanded programme immunization (Yomi, Alfred, 2012). Education and wealth status of women has a strong hold on their health seeking behavior and also on child survival (Becker et al., 1993). Mothers who are wealthier are more likely to attend a

first visit than poorer mothers (Ortiz, 2007). Mothers' age is an influencing factor on utilization of prenatal care services (Kroeger 1983). The level of child health and infant mortality is a function of traditional mores, condition including health literacy or awareness as well as community development (Aigbe and Zannu 2012). Children born to mothers educated have a lower mortality risks because educated women tend to marry and have their first child during their reproductive ages than uneducated women who give birth before and after their reproductive age which leads to lower birth weight and poor health status of the child (Darlene 2002).

Children in wealthier families have access to high quality health care and living conditions (Case 2002). It is reported that children in urban area have consistency higher immunization rates than those in rural areas (Doctor et al. 2011).

HEALTH BEHAVIOR OF WOMEN

Other factors also associated with the immunization status of children are place of delivery, access to health facilities (Funmilayo 2013). Two studies have indicated that antenatal visit and birth in health facility give children a more likely chance to be fully vaccinated since mothers will be exposed to health information on immunization (Mutua et al., 2011). According to Odiit and Amuge (2003), children who are born in the health facilities are more likely to be vaccinated with BCG since it is given immediately after birth and up to date with their vaccination unlike children who were not given birth to at home. Prenatal care increases the chances of a child having access to health care services such as immunization and institutional delivery (Lee, 2005). Almost 40 percent of women with no education gave birth without receiving any antenatal care compared with 60 percent of women who with secondary education (UNESCO 2010).

The Data Source

This study used the 2013 Nigeria Demographic Health Survey (NDHS) women data. According to the study report, data on immunization status was collected from vaccination cards and in cases where not available or a vaccination was not recorded, the mother's recall of vaccination was accepted. This study includes a sample of 26,046 women aged 15-49 who had children aged five years or younger in household at the time of survey.

Sample Design

The sample survey uses as sampling frame the list of enumeration areas (EAs) prepared before 2006 population census of the Federal Republic of Nigeria, provided by the National Population Commission. The NDHS sample was selected using a stratified three stage cluster design consisting of 904 clusters, 372 in urban areas and 532 in rural areas. A representative sample of 40,680 households was selected for the survey. A fixed sample take of 45 households were selected for cluster. All women age 15-49 who were either permanent residents of the household in the 2013 NDHS sample or visitors present in the households were interviewed.

Data Collection

Unlike the previous NDHS surveys, data collection was carried out in six zones (rather than the states). NDHS 2013 was carried out by 37 interviewing teams, one for each of the 36 states of the country and the Federal Capital Territory (FCT). Data was collected from February 15th to the end of May 2013 (with the exception of two states Kano and Lagos who completed the data collected in June 2013).

Limitations of the study.

Due to the security situation at the time this data collection was conducted, the survey could not be accomplished in eight clusters (four in Borno, two in Yobe, one in Nasarawa, one in Plateau).

Table 1: Frequency Distribution of Socio Economic Factors, Women Health behavior and Children Immunization

Variables	Frequency N=(26,046)	Percentage %	Variables	Frequency N=(26,046)	Percentage %
Women age in groups			No antenatal visits during pregnancy		
15-19	4153	15.9	None-don't know	6808	35.1
20-24	4571	17.5	1-3	2407	12.4
25-29	5596	21.5	4-6	4390	22.6
30-34	4442	17.1	7-9	2078	10.7
35-39	3553	13.6	10+	3704	19.1
40+	3731	14.3	Place of delivery by major types of facility		
Region			Home based facility	11501	59.5
North-Central	4035	15.5	Public health facility	5159	26.7
North-East	5167	19.8	Private health facility	2685	13.9
North-West	7696	29.5			
South-East	2403	9.2	Respondents Professional checkup- all first six children		
South-South	3347	12.9	None prof	169	2.0
South-West	3398	13.0	Low level prof	2036	23.9
Place of Residence			Medium level prof	3556	41.7
Rural	16754	64.3	High level prof	2768	32.5
Urban	9292	35.7			
			Respondents health checked after discharge – delivery –all first six children		
Highest Education level			No-don't know	10432	79.0
No education	10925	41.9	Yes	2769	21.0
Primary	5027	19.3			
Secondary	8375	32.2	Child ever been Vaccinated - all first six Children		
Higher	1719	6.6	No	3924	26.5
Marital Status			Yes	10857	73.5
Never in union	4134	15.9			
Married-living together	20984	80.6	Received BCG – all first six children		
No longer living together-widowed-divorced-separated	928	3.6	No	8522	44.8
Religion of respondent			Yes	10512	55.2
Islam-Trad.	14693	56.7	Received Measles Vaccination –all first six children		
Catholic	2285	8.8	No	10569	55.6
Other Christian	8939	34.5	Yes	8438	44.4
Wealth Index					
Poorest	5304	20.4	Received Polio 0 Vaccination- all six children		
Poorer	5699	21.9	No	9684	50.9
Middle	5332	20.5	Yes	9358	49.1
Richer	5126	19.7			
Richest	4585	17.6			
Number of Living Children and pregnancy			Received Polio 3 Vaccination- all six children		
None	4116	15.8	No	8473	45.0
1-2	7547	29.0	Yes	10370	55.0
3-4	7133	27.4			
5+	7250	27.8			
Employment Status					
No working	9418	36.4			
Working	16487	63.6			
Visited Health Facility					
No	19151	73.9			
Yes	6771	26.1			

RESULTS

Basic Description of Respondents

The majority of women (72%) were aged 34 or younger, and were from the North Central (15%), North East (19%), North West (29%), South East (9%), South South (12%), and South West (13%). Most of the respondents were from the rural areas (64%) and most were working (64%) at the time of survey. Most of the women had no education/Primary education (61%), and the m over half (55%) had three or more children., Results shows that the majority of women were married or living together (80%), and considerable proportion (58%) were of the middle/rich socioeconomic status. Over half of the respondents were either Moslems or Traditionalist. With respect to health behavior, close to 60% used home based facility during delivery, 27% used public health facility, and 14% used private health facility. Only 26% of women visited health facility, and of these, about half (52%) reported having had at least four antenatal visits, 21% reported health check after discharge, and 74% of these were checked by medium or high level professional.

Findings show that 73% of children aged five or younger had been vaccinated as at the time of the survey. Of those vaccinated, 44% had measles vaccination, 49% received polio 0, 55% polio 3, and 55% BCG.

Table 2: Logistics Regression: Socio economic factors, Health behavior of women and children immunization.

Variables	Child ever received Immunization	Child Received BCG	Child Received Measles	Child Received 0 Polio	Child Received 3 Polio
Women age in groups					
15-19 (Ref)	1.00	1.00	1.00	1.00	1.00
20-24	1.461*	1.617***	1.546***	1.037	1.508***
25-29	1.614**	1.699***	2.117***	1.233	1.913***
30-34	1.657**	1.973***	2.292***	1.160	2.005***
35-39	1.864**	2.127***	2.290***	1.381*	1.746***
40+	1.929**	1.683**	2.373***	0.966	1.732***
Region					
North-Central (Ref)	1.00	1.00	1.00	1.00	1.00
North East	0.817	0.802*	0.878	0.569***	1.310**
North-West	2.091***	0.459***	0.934	0.483***	1.501***
South -East	0.781	1.369	0.933	1.182	1.092
South -South	1.486**	1.573***	1.286**	0.654***	1.314***
South -West	1.083	0.836	0.750***	0.600***	0.811**
Place of residence					
Rural (Ref)	1.00	1.00	1.00	1.00	1.00
Urban	0.827	1.159	1.014	1.231**	1.035
Highest education level					
No Education (Ref)	1.00	1.00	1.00	1.00	1.00
Primary	1.685***	1.812***	1.598***	1.463***	1.349***
Secondary	1.975***	2.717***	2.142***	1.862***	1.580***
Higher	3.170***	3.681***	2.568***	2.361***	1.763***
Marital Status					
Never in union (Ref)	1.00	1.00	1.00	1.00	1.00
Married-living together	0.573	0.720	0.864	0.732	0.868
No longer living together-widowed-divorced-separated	0.967	0.681	0.912	0.706	0.946
Religion					
Islam-trad (Ref).	1.00	1.00	1.00	1.00	1.00
Catholic	1.593**	1.515**	1.775***	1.436**	1.184
Other Christian	1.360**	1.571***	1.506***	1.477***	1.274***
Wealth Index					
Poorest (Ref)	1.00	1.00	1.00	1.00	1.00
Poorer	0.924	1.142	1.466**	1.192	1.032
Middle	1.056	1.495**	1.883***	1.548***	1.043
Richer	1.039	1.798***	2.118***	1.915***	1.085
Richest	1.620**	2.839***	2.807***	2.858***	1.401**
Number of living children					
1-2 (Ref)	1.00	1.00	1.00	1.00	1.00
3-4	1.046	1.029	1.623***	1.035	0.993
5+	0.950	0.986	1.503***	1.035	0.953
Employment Status					
No working (Ref)	1.00	1.00	1.00	1.00	1.00
Working	1.564***	1.210**	1.298***	1.164*	1.102
Visited health facility					
No (Ref)	1.00	1.00	1.00	1.00	1.00
Yes	1.335***	1.613***	0.994	1.374***	1.390***
No of antenatal visits during pregnancy					
None-don't know (Ref)	1.00	1.00	1.00	1.00	1.00
1-3	1.746***	1.996***	1.518***	1.696***	1.633***
4-6	1.723***	2.273***	1.546***	2.489***	1.429***
7-9	2.286***	3.041***	1.856***	2.711***	1.469***
10+	2.415***	3.828***	2.043***	2.831***	1.728***
Place of delivery by major types of facility					
Home based facility (Ref)	1.00	1.00	1.00	1.00	1.00
Public health facility	1.157	1.557***	1.351***	2.055***	0.977
Private health facility	1.024	1.116	1.185	1.684***	0.902
Respondent Professional Checkup- all first six children					
None prof (Ref)	1.00	1.00	1.00	1.00	1.00
Low level prof	0.490**	1.256	1.215	1.079	0.684*
Medium level prof	0.591**	1.600**	1.363	1.513*	0.727
High level prof	0.643	2.106***	1.538*	1.733**	0.694*
Wald: (Model chi square)	1934.355	2719.154	660.343	1434.301	231.013
-2 Log likelihood	4280.921	5692.891	9246.166	7598.838	10747.086
Nagelkerke R Square	0.178	0.394	0.234	0.350	0.074

Multivariate Results

Child ever received immunization vs. background factors and health behavior

Women's health behavior was measured as; (1) visited health facility, (2) number of antenatal visits during pregnancy, (3), place of delivery of child, and (4) respondents professional check-up after delivery. Results in Table 2 show that the odds women immunized their children increased with age, education, and wealthiest women, and the odds varied significantly by region, religion, and work status.

The odds that women would have their children immunized varied significantly by whether they visited health facility, and the odds increased by number of antenatal visits during

pregnancy, and level of professionals that checked them during visits.

Child received BCG immunization vs. background factors and health behavior

Results show that the odds that children received BCG increased by age, education, and wealth status index, and it varied significantly by regions (in some), religion, and employment status. The odds that children received BCG varied significantly by whether their mothers visited health facility, especially public health facility, and the odds increased by number of antenatal visits and level of professional that did checkup for them during visits

Child received measles immunization vs. background factors and health behavior

Findings in Table 2 show that the odds that children received measles immunization increased with age, level of education, wealth index, and number of living children, and it varied significantly by region (some), religion, and employment status. The odds that children received measles immunization increased by number of antenatal visits, and varied significantly by whether they had check-up at public health facilities with high level health professionals.

Child received polio 0 & 3 immunization vs. background factors and health behavior

Results in Table 2 suggest that the odds for children immunization on polio 0 and 3 increased with age (mostly for polio 3), level of education, and wealth index (mostly for polio 0), and the odds varied significantly by region, religion, employment status and residence (only for polio 0). The odds that children received polio 0 and polio 3 immunization varied significantly by whether women visited health facility, place of delivery (public or private), and the odds increased significantly by number of antenatal visits, and level of professional that checked the woman during visits.

DISCUSSIONS & CONCLUSIONS

The results of this study is a pointer to the fact that background characteristics of women and their health behavior have significant effects on whether they would immunize their children or not. Key characteristics of women that are consistent in the data analysis and should be consider in designing programs to increase children immunization intakes in Nigeria are; age, region, education, religion, and wealth or socioeconomic status of women. These key background factors were consistently significant all through the five key immunization indicators examined in this study.

The number of visits women make to the health facility, whether they were attended to by high or medium level professional at a public or a private health facility have positive effects on immunization of children. These health behavioral factors should be factored into policies and programs geared to increase immunization intake in the country.

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Exposure to Health Information and Women's Behavioral Response to Immunization of Children in Nigeria.

Temitope, O. ILUSANYA, Muyiwa, OLADOSUN.
Department of Demography and Social Statistics,
Covenant University,
Ota Ogun State, Nigeria.
Email: ilusanyatemitope@gmail.com

Abstract- According to the 2013 Nigeria Demographic and Health Survey (NDHS) data immunization coverage for children aged 0-5 was 69.5% the literature show that exposure to health information and services is associated with Women's behavioral response on children's immunization. The purpose of this study is to examine key sources of women's health information and behavior of children's immunization in Nigeria. This study uses the NDHS data of 2013. Preliminary results show that exposure to TV and radio were significantly associated with respondent check-up after delivery (p-value = 0.000), number of antenatal visit (p-value = 0.000), baby post natal two monthly checks (p-value = 0000). Also, access to radio was significantly associated with children's immunization status with respect to (1) BCG injection (p-value = .0000), Polio injection (p-value = 0.000), and measles (p-value = 0.000). Future programming geared to increase immunization coverage in Nigeria will find these results useful for planning.

Key Words: Exposure to Health information, Women's Behavior, Childhood immunization, Nigeria, NDHS 2013.

INTRODUCTION

Immunization is a proven tool for controlling and eliminating life-threatening infectious diseases (WHO, 2010). The Global immunization and strategy goal of 2006-2015 was for every country to reach at least 90% coverage nationally and for every district 80% by 2015 (WHO 2010). Out of the 14 million deaths of children under 5 years of age globally, 95% of the deaths occurred in developing countries and 70% of this deaths are attributed to vaccine preventable diseases (Shann and Steinhoff, 1999). Globally, 23% (30 million) of (130 million) children born every year do not take vaccine of any kind (WHO, 2000). An estimated 2.1 million people around the world died in 2002 of diseases preventable by widely used vaccines, including 1.4 million children (WHO, 2010). In African countries, studies show that about 3 million children still die and considerable number are crippled, blinded, or otherwise disabled from six major diseases that are preventable through immunization (World Health Organization (WHO)/United Nations Children's Fund (UNICEF, 2010). Nigeria National immunization coverage

has plateaued at about 70% for several years with variations cutting across states. (National Bureau of Statistics, 2013). Nigeria ranks 15th highest in the world among countries with high under-five mortality (UNICEF, 2001). The first five years of life are the most crucial to the physical and intellectual development of a child. This time of life can affect potential to learn and thrive thought life (Policy Project/Nigeria, 2002). (The mothers' poor knowledge of immunization against targeted diseases has been identified as the cause for low coverage rate (Yihunie, lemayhu, Sibhatu 2015). Most common reasons for non-immunization were lack of knowledge about childhood immunization schedule, where to source for it and a lack of awareness about the benefits of immunization (Babalola, 2011). In order for mothers and teachers to promote best health practices, they must have good knowledge of health information (Schultz, 1984). According to Kahane, Watt, Newell, Kellam, Wight, Smith, et al., (2000), there are many explanations as to low or partial immunization among children; they classified the reasons for this into three main groups: causes due to health care system, causes relating to parents and causes due to the health providers.

Previous studies revealed that factors associated with immunization coverage of children in developing countries is over the first year of life of a child include lack of mothers' health literacy (Rup 2009). The exposure to mass communication channels such as television, radio, and newspaper have important influence for creating awareness and reproductive health behavior (John Hopkins University, 1997). This study provides empirical evidence on how exposure to health information affects women's health seeking behavior immunization status of their children.

LITERATURE REVIEW

Despite impressive achievements each year approximately 9.7 million of the world's children die under the age of five from largely preventable diseases (UNICEF 2007). It is estimated that immunization saves lives of 3 million children per year but 2 million more lives could be saved by existing vaccination (Andre 2003). Full and continuing access to health information requires active participation, and responsibility for our health is an important aspect of our daily lives

(Bamise, Sofowora, 2012). Effective information is relevant for promoting and encouraging preventive as well as effective treatment practices (Kadira et al., 2014). Access to reliable health information is the cornerstone for improved and sustainable health outcomes (Godlee, Pakenham, Ncayiyana, Cohen, Packer, 2004).

MASS MEDIA CAMPAIGN

The role of mass media in fostering behavior change with respect to immunization is tackled in this study. Mass media health communication on immunization has contributed greatly to the success of immunization in Nigeria (Akpobo, 2015). The main source of health information worldwide and most especially in low-medium income countries is mass media (Collins, et al., 2016). In Nigeria, a major source of information on women's health, family planning and HIV/AIDS is the mass media (Nwagwu, Ajama, 2011). Public health attitudes, beliefs, behaviors and knowledge are largely impacted by the mass media (Naugle, Hornik, 2014). Mass media has led to positive health behaviors and health changes among individuals. (Wakefield, Laken, Hornik, 2010). The combination of other forms of communication and mass media campaigns, will increase knowledge and reduce possibility of negative health outcomes through the use of effective strategy (Ugwu, 2013, FAO, 2004). An Individual's behavior can be influenced by the effective and efficient use of mass media (Bankole 1994). Mass media is a strong tool for most especially creating awareness but also to motivate the desires of people for more information and to help people put the information to their own behavior (Piotrow et al., (1990), cited in Bankole 1994). Education enlightens people as to the availability of health facilities and treatment options, and so places them in positions of making more informed decision on health (John, 2014). In Low-and- Middle-Income countries (LMIC) like Nigeria, poor access to health information, especially among rural women is a major public health problem (Meekers, Van, Silva, Koleros 2007, Nwagwu and Ajama 2011). Health behavior of women has untoward implications on immunization of children. About 35 percent of women in developing countries have no access to or contact with health personnel before delivery and only 54 percent gave birth with a skilled attendant present (UNEPA 2007). The basis of child health revolves around the knowledge and experience of mothers who are the first custodians of the child's health (Ekanayake, Weerahewa and Ariya waradana, 2003). Health Literacy is the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions (Healthy People 2010). Mothers who are more educated have healthier behavior and provide more sanitary and safer environments for their children (Behrman and Deolaliker 1998; Currie and Moretti 2003).

THE DATA SOURCE

This study used the 2013 Nigeria Demographic Health Survey (NDHS) women data. According to the study report, data on immunization status was collected from vaccination cards and in cases where not available or a vaccination was not recorded, the mother's recall of vaccination was accepted. This study includes a sample of 26,046 women aged 15-49 who had children aged five years or younger in household at the time of survey.

Sample Design

The sample survey uses as sampling frame the list of enumeration areas (EAs) prepared before 2006 population census of the Federal Republic of Nigeria, provided by the National Population Commission. The NDHS sample was selected using a stratified three stage cluster design consisting of 904 clusters, 372 in urban areas and 532 in rural areas. A representative sample of 40,680 households was selected for the survey. A fixed sample take of 45 households were selected for cluster. All women age 15-49 who were either permanent residents of the household in the 2013 NDHS sample or visitors present in the households were interviewed.

Data Collection

Unlike the previous NDHS surveys, data collection was carried out in six zones (rather than the states). NDHS 2013 was carried out by 37 interviewing teams, one for each of the 36 states of the country and the Federal Capital Territory (FCT). Data was collected from February 15th to the end of May 2013 (with the exception of two states Kano and Lagos who completed the data collected in June 2013).

Limitations of the study.

Due to the security situation at the time this data collection was conducted, the survey could not be accomplished in eight clusters (four in Borno, two in Yobe, one in Nasarawa, one in Plateau).

Table 1 Showing percentage of women according to background characteristics, exposure to health information and immunization status of children.

Variables	Total N=(26,046)	Percentage %	Variables	Total N=(26,046)	Percentage %
Women age in groups			**Heard Family Planning on TV last few Months**		
15-19	4153	15.9	No	21654	83.2
20-24	4571	17.5	Yes	4358	16.8
25-29	5596	21.5			
30-34	4442	17.1			
35-39	3553	13.6	**Read about Family Planning in**		
40+	3731	14.3	**New spapers last few months**		
Region			No	24610	94.7
North-Central	4035	15.5	Yes	1369	5.3
North-East	5167	19.8			
North-West	7696	29.5			
South-East	2403	9.2	**At Health Facility told about Family Planning**		
South-South	3347	12.9			
South-West	3398	13.0	No	3865	57.9
Place of Residence			Yes	2810	42.1
Rural	16754	64.3			
Urban	9292	35.7	**Multiple Exposure to Family Planning Information**		
Highest Education level			None	16724	64.2
No education	10925	41.9	One	4496	17.3
Primary	5027	19.3	2 or more	4826	18.5
Secondary	8375	32.2			
Higher	1719	6.6	**Child ever been Vaccinated- all first six Children**		
Marital Status			No	3924	26.5
Never in union	4134	15.9	Yes	10857	73.5
Married-living together	20984	80.6			
No longer living together-widowed-divorced-separated	928	3.6	**Received BCG – all first six children**		
Religion of respondent			No	8522	44.8
Islam -Traditional	14693	56.7	Yes	10312	55.2
Catholic	2285	8.8			
Other Christian	8939	34.5	**Received Measles Vaccination –all first six children**		
Wealth Index			No	10569	55.6
Poorest	5304	20.4	Yes	8438	44.4
Poorer	5699	21.9			
Middle	5332	20.5	**Received Polio 0 Vaccination- all six children**		
Richer	5126	19.7	No	9684	50.9
Richest	4585	17.6	Yes	9358	49.1
Number of Living Children					
None	4116	15.8	**Received Polio 3 Vaccination- all six children**		
1-2	7547	29.0	No	8473	45.0
3-4	7133	27.4	Yes	10370	55.0
5+	7250	27.8			
Employment Status					
No working	9418	36.4			
Working	16487	63.6			
Heard Family Planning on Radio last few months					
No	18223	70.0			
Yes	7803	30.0			

RESULTS

Basic Descriptive Statistics of Respondents The majority of women (72%) were aged 34 or younger, and were from the North Central (15%), North East (19%), North West (29%), South East (9%), South South (12%), and South West (13%).

Most of the respondents were from the rural areas (64%) and most were working (64%) at the time of survey. Most of the women had no education/Primary education (61%), and the over half (55%) had at three or more children., Results shows that the majority of women were married or living together (80%), and considerable proportion (58%) were of the middle/rich socioeconomic status. Over half of the respondents were either Moslems or Traditionalist. On exposure to health information, results show that 30% of respondents had family planning (FP) information on radio, 17% on TV, 42% from a health facility, 5% from newspapers, and 18% heard from two or more of these sources. Findings show that 73% of children aged five or younger had been vaccinated as at the time of the survey. Of those vaccinated, 44% had measles vaccination, 49% received polio 0, 55% polio 3, and 55% BCG.

Table 2: Showing odds of children vaccination by women's background characteristics, and exposure to health information.

Variables	Ever had Vaccination	Received BCG	Received Measles	Received Polio 0	Received Polio 3
Women age in groups					
15-19 (Ref)	1.00	1.00	1.00	1.00	1.00
20-24	1.351	1.625**	1.508***	1.084	1.727***
25-29	1.647*	1.725**	1.941***	1.260	2.170***
30-34	1.777**	2.338***	2.157***	1.332	2.172***
35-39	1.784*	1.771**	1.753**	1.133	1.762***
40+	1.685*	1.698	1.835**	1.007	2.127***
Region					
North-Central (Ref)	1.00	1.00	1.00	1.00	1.00
North East	0.808	0.926	0.870	0.645***	1.301**
North-West	1.304	0.458***	0.698***	0.409***	1.639***
South-East	0.776	2.564***	1.116	1.683**	1.295*
South-South	1.487	1.221	0.994	0.517***	1.150
South-West	0.978	1.184	0.766**	0.696**	0.836
Place of residence					
Rural (Ref)	1.00	1.00	1.00	1.00	1.00
Urban	0.722**	0.947	0.963	1.094	1.031
Highest education level					
No Education (Ref)	1.00	1.00	1.00	1.00	1.00
Primary	1.683***	2.015***	1.777***	1.533***	1.199*
Secondary	1.945***	2.810***	2.460***	2.093***	1.563***
Higher	3.110***	4.390***	2.622***	2.950***	1.624***
Marital Status					
Never in union (Ref)	1.00	1.00	1.00	1.00	1.00
Married-living together	1.369	1.049	1.219	0.785	1.159
No longer living together-widowed-divorced-separated	2.421*	0.979	1.460	0.996	1.278
Religion					
Islam-trad. (Ref)	1.00	1.00	1.00	1.00	1.00
Catholic	1.406	1.874***	1.692***	1.810***	1.202
Other Christian	1.340*	1.645***	1.551***	1.345***	1.249**
Wealth Index					
Poorest (Ref)	1.00	1.00	1.00	1.00	1.00
Poorer	1.054	1.520**	1.599***	1.611***	1.222
Middle	1.036	1.995***	2.030***	2.025***	1.116
Richer	1.006	2.948***	2.420***	3.126***	0.957
Richest	1.540	5.009***	2.930***	4.877***	1.348*
Number of living children					
1-2 (Ref)	1.00	1.00	1.00	1.00	1.00
3-4	1.106	1.028	1.675***	1.063	1.099
5+	0.979	0.787	1.574***	0.969	1.100
Employment Status					
No working (Ref)	1.00	1.00	1.00	1.00	1.00
Working	1.775***	1.400***	1.322***	1.355***	1.124
Read of Family planning in Radio					
No (Ref)	1.00	1.00	1.00	1.00	1.00
Yes	1.252*	1.141	1.089	1.051	1.057
Heard of family planning on TV last few months					
No (Ref)	1.00	1.00	1.00	1.00	1.00
Yes	0.892	1.039	1.270**	1.110	1.058
Heard family planning on Newspaper last few months					
No (Ref)	1.00	1.00	1.00	1.00	1.00
Yes	1.349	1.403	1.206	1.196	1.034
At health facility told about family planning					
No (Ref)	1.00	1.00	1.00	1.00	1.00
Yes	1.608***	1.888***	1.190**	1.593***	1.310***
Wald (Model Chi-Square)	1337.512	1600.370	237.092	836.737	398.843
-2 Log likelihood	3001.507	4299.725	6684.279	5647.716	7313.352
Nagelkerke R Square	0.128	0.405	0.229	0.314	0.054

Multivariate Results

The results in this section are interpreted based on dummy reference category represented as 1 in Table 2.

Dependent Variable I: Child ever had Vaccination:

Ever had vaccination for children in household is one of the key dependent variables in this study. Results in Table 2 show that age of women is positively related to whether a child ever had vaccination. Women aged 40 or older were 1.7 times as likely as those aged 19 or younger to have vaccinated their children, women aged 35-39 were 1.8 times as likely as those in the youngest age group to have vaccinated their children, and for women aged 30-34, and 25-29, the odds were 1.7 and 1.6 respectively. Education of women is also positively related to child vaccination. The odds were three times more for

women with higher education than those with no education to have vaccinated their children, and for women with secondary school education, and those with primary education, the odds were 1.9 times, and 1.7 times as likely as those with no education respectively. Other background variables with some significant odds in expected directions are marital status, religion, and employment status. Results of this study showed that women in the urban areas were less likely than their counterparts in rural areas to have vaccinated their children.

The intervening variable exposure to health information was measured with respect to ever heard family planning on; radio, tv, at the health facility, or read in the newspapers. Results shows that women who heard family planning in the radio were 1.2 times as likely as those who did not to report that they ever had vaccination for their children, and those who heard about family planning from health facility were 1.6 as likely as those who did not to have ever vaccinated their children.

Dependent Variable II: Child Received BCG

As Table 2 showed the odds that women reported that their children had BCG vaccination increased with age, wealth status, and education, and the odds varied by region, religion and employment status as well. Also, women who heard FP from health facility were 1.6 times as likely as those who did not to report that they received BCG for their children.

Dependent Variable III: Child Received Measles Vaccination

Results in Table 2 show significant relationships between background characteristics of women and measles vaccination for their children. The odds that women reported receiving measles vaccination for their children increased with age, wealth status, education, and number of living children. While the odds that the same women reported measles vaccination for their children varied significantly in some regions, by religion, and employment status. Exposure to health information is also significantly related to a child receiving measles vaccination. Women who heard family planning on TV were 1.3 times as likely as their counterpart who did not to have vaccinated their children, and those who heard family planning at the health facility were 1.6 times as likely as those who did not to have vaccinated their children.

Dependent Variable IV & V: Child Received Polio 0 and Polio 3 Vaccination

According to standard health requirements, children under five years are expected to receive five polio vaccinations, one right after birth, and other taken at intervals before age five (Ubajaka, Ukegbu, Okafor, Ejiofor 2012). This study included polio vaccination at birth, and the last polio vaccination requirement just to have insights on women's adherence to children's polio vaccination. Results in Table 2 show that the odds that women obtained vaccination for their children increased by wealth status, education, and age (for polio 3), and it varied significantly by religion, and employment (for polio 0). The odds that women obtained polio 0 and polio 3 vaccinations for their children were more for those who heard family planning at the health facility compared to their counterparts who did not.

DISCUSSIONS AND CONCLUSION

Results of this study corroborate vaccination coverage of about 73% in Nigeria which had been stagnant over the years. This figure drops to about 50% or less when specific types of vaccination are considered, and is a major concern for policy makers, health professionals, and other stakeholders working to achieve the new sustainable development goals of 100% vaccination by 2030 (Endurance, Musa, Azuka, Rachel, Precious 2014). In order to improve vaccination intake in the country, it will be necessary that programs be implemented taking considerations of significant variations of this study results on vaccination intake by women's age, region, wealth status, educational levels, religion, employment status, and number of children depending on the type of vaccination.

Results of this study suggest that although radio, and TV are important tools for exposing women to health information, many women were not exposed to vaccination information through this channels of communication. Also, radio and tv may not be effective enough to ginger more women to obtain the range of vaccinations needed for their children. The most effective channel of information reported by women who participated in this study is from professionals at the health facilities. Therefore, future program would need to encourage women to visit health facilities in their localities and not rely only on what they get from the radio or TV which may not be enough to motive them to obtain vaccination for their children or wards. In addition, the strategy may be to use radio, and TV to encourage women to visit health facilities to obtain information on the importance of vaccination for their children.

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The Role of ECOWAS in Fostering Nigeria's Cocoa Beans Value Chain

OBASAJU Barnabas Olusegun
Landmark University: dept. of Economics
Omu-Aran, Kwara State, Nigeria
obasaju.barnabas@lmu.edu.ng

OKODUA Henry
Covenant University: dept. of Economics
Ota, Ogun State, Nigeria
henry.okodua@covenantuniversity.edu.ng

OLAYIWOLA Kolawole Wumi
ECOWAS Commission: Principal Program Officer,
Economic Policy Analysis Unit,
Abuja, Ogun State, Nigeria
kolayiwola@gmail.com

Abstract

Despite the huge potentials of the cocoa beans value chain in Nigeria, the performance of this sector is hampered, *inter alia*, by low productivity which is not unconnected to low value addition along the product's value chain. The regional platforms put in place by the Economic Community of West African States are supposed to be able to proffer solutions to some of the challenges of this sector. In economic literature, inter-linkages amongst related or same industries are important for value addition which in turn is essential for maximising income gains and improving general living standards accruing from engaging in production and trade. The New Trade Theory explicates how intra-industry/intraregional trade can give rise to the fragmentation of production processes that characterise value chains and how intra-regional trade can foster the needed value addition in a value chain. This current study is motivated by the need to assess the extent to which the Economic Community of West African States (ECOWAS) has fostered intraregional cocoa beans value chain between Nigeria and other members of ECOWAS by creating the necessary forward and backward linkages between actors in the cocoa beans value chain in Nigeria and the rest of ECOWAS. Findings from descriptive statistics seem to suggest a weak performance on the part of ECOWAS thus calling for the need for intensified regional efforts to sufficiently bolster the performance of Nigeria's cocoa beans value chain.

Keywords—Economic Integration; Cocoa Beans Value Chain; ECOWAS; Nigeria

1.0 INTRODUCTION

Economic Integration (EI), an embodiment of custom unions, trade blocs and free trade, has an ultimate aim of fostering trade participation of Member countries and enhance economic performance and welfare of their citizenry in the long-run [1]. Reference [2] noted that discriminatory trade policy is the defining characteristic of a regional integration arrangement. EI instruments could be in form of tariff or non-tariff measures. EI entails the partial or full removal of trade tariffs across national boundaries with the aim of lowering prices and fostering the welfare of citizens in the Member States [3].

In the bid to transform the agricultural sector – a sector crucial to the economy of Nigeria - and use it to foster its economic growth, Nigeria embarked on an Agricultural Transformation Agenda - ATA in 2010. Some agricultural products were earmarked as priority commodities in order to achieve the objectives of the Transformation Agenda. One of the prioritised commodities is cocoa beans. However, recent literature such as [4], [5] and [6] harped on the importance of paying attention to the entire value chain to deliver the income and other welfare gains to all actors rather than laying emphasis on only increases in production. The Agricultural Transformation Agenda noted cocoa beans value chain as a strategic commodity value chain that is expected to generate over 350,000 jobs in primary production, plantation establishment and across its value chain in 2015. In the context of a regional economic community, cocoa beans value chain would imply that the production processes are fragmented across national borders within the region. For example, within ECOWAS, production of cocoa beans may be done in Nigeria, processing done in Togo and marketing and selling to final consumers done in Benin Republic.

Nigeria is one of the leading exporters of this commodity after Cote d'Ivoire, Indonesia and Ghana respectively. Yet, notwithstanding the huge potentials of this commodity, it is characterised by low value addition and productivity which retard the gains of actors along its value chain [7] and [8]. However, on the positive end, [9] reported that notwithstanding the drop in production and yield, Nigeria remains the world's fourth largest exporter of cocoa beans.

The platforms created by ECOWAS are expected to be able to proffer solutions to some of the challenges of this sector. These platforms include the ECOWAS Trade Liberalisation Scheme (ETLS) meant to allow for free movement of goods, people and services and removal of trade barriers within this region and the ECOWAS Agricultural Policy (ECOWAP) meant to improve productivity and competitiveness of the agricultural sector of Member states. *Inter alia,* other platforms include the Regional Agricultural Investment Programme (RAIP) and the ECOWAS Bank for Investment and Development (EBID) and are meant to provide the needed funds for agriculture. These platforms are also expected to enhance the value chain in agriculture [4] including the cocoa beans value chain thus bringing about value addition and productivity increase. But to guarantee substantive value addition, there is the need for inter-linkages (forward and backward) amongst the cocoa beans industries within the region; a forward linkage of Nigeria with the rest ECOWAS members would imply that Nigeria supplies the rest of ECOWAS with cocoa beans as inputs while a backward linkage of Nigeria with the rest of ECOWAS implies that Nigeria demands for cocoa beans from the rest of ECOWAS.

The primary question this study raises is "to what extent is ECOWAS bringing about these inter-linkages (necessary for value addition) between Nigeria and the rest of ECOWAS?" In Other words, to what extent has ECOWAS fostered intraregional cocoa beans value chain between Nigeria and the rest members of ECOWAS? And consistent with economic literature on economic integration, the null hypothesis is that ECOWAS has not played a significant role in fostering intraregional cocoa beans value chain between Nigeria and the other countries in the ECOWAS region. This is an area, which to the best of our knowledge, is yet to be reasonably explored in West Africa. Similar studies are those of [10] and [11] which focus respectively on: China's regional economies and value chains using an interregional I-O analysis; and Measuring global value chains and regional integration using an international I-O approach. The work of [12] on "value chain improvement for cocoa industry in Indonesia by input-output analysis" appears to be the most similar to this current study.

2.0   CONCEPTUAL FRAMEWORK

According to (13), full economic integration suggests the unification of monetary, fiscal, social and countercyclical policies and needs that a supra-national authority whose decisions are binding for member countries be set up.

Reference [14] defined a value chain as the full range of activities which are needed to bring a product or service from conception, through the various phases of production, transformation and delivery to end consumers, and eventual disposal after use. Their value chain approach aims at characterizing how chain activities are carried out and to appreciate the way value is created and distributed amongst the participants in a chain. There are also other variants of the definition given by [14]. Reference [15] noted that although

the terms value chain and supply chain are often used interchangeably and describe the relationships of firms and processes required to deliver products to end consumers and both aim to identify the opportunities for and challenges to increasing productivity, there are slight differences between them. He remarked that the basic goals of value chains are value creation, innovation, development of products and marketing and so value chains are basically about net value added (rather than overall size and gross output), while supply chains focus on cost and supply efficiencies. Reference [15] opined further that supply chain analysts focus on measures that reduce costs and marginal inefficiencies in supply which may be to the detriment of focusing on measures capable of generating bigger value additions.This study adopts the definition of [14] of value chain

2.1   REVIEW OF SOME RELEVANT THEORIES

2.1.1 Comparative Cost Advantage

The comparative cost advantage principle opines that countries trade in goods for which they have the comparative not absolute advantage in producing. Reference [16] while reviewing the comparative advantage theory opined that a country has a comparative advantage in the production of a good provided the opportunity cost of producing that good in terms of other goods is lower in that country relative to other countries. With respect to terms of trade and gains from trade, this theory asserts that there is no need for trade between two countries with the same terms of trade as this will result in zero gains from trade. To guarantee mutual gains from trade, terms of trade has to be within the range of the comparative costs.

The comparative advantage theory is somewhat comparable with the value chain approach as countries specialize in the activities or stage (not necessarily goods) that they have the comparative advantage in undertaking. For instance, within ECOWAS, suppose Ghana has a comparative advantage in producing cocoa beans rather than in processing while Nigeria has a comparative advantage in providing storage facilities and processing it and Benin has a comparative advantage in branding and distributing the product to end consumers, then individual countries ought to specialize in the stage(s) for which they have the comparative advantage in performing. The theory's support of free trade rather than imposing restrictions such as tariffs, transportation costs and quota on trade is also in line with the purpose of economic integration arrangements such as ECOWAS Agricultural Policy (ECOWAP) in partnership with the New Partnership for African Development (NEPAD) which has as one of its objectives the enhancement of value chains in agriculture within the sub-region [4].

Notwithstanding, due to other assumptions of this theory, its applicability to this current study is questionable. For instance, among others, it assumes perfect competition in all economy, constant technology and existence of full employment. In reality, there exists imperfect competition, changing technology and less than full employment. Moreover, the

theory has no suggestion concerning the now common trend in which production processes are fragmented across national borders and the implication this has for the gains derivable for countries and their citizens from international trade. Nevertheless, the Ricardian model contributed greatly to the development of international trade by the use of relative prices in explaining the patterns of trade.

2.1.2 New Trade Theories

The 'New Trade Theories': New Trade Theory, Neotechnology Trade Theories and New-New Trade Theory emerged in the late 1970s and 1980s by Paul Krugman and built on the neoclassical framework by relaxing the assumptions of the existence of constant returns-to-scale and perfect competition and laid emphasis on the economies of scale and differentiation of products. The neotechnological theories emphasised the role of technology like the classical theories and departed from the neoclassical framework. With respect to economies of scale, in the presence of increasing returns to scale, when the inputs to an industry are doubled, the production of such industry more than doubles. In a situation in which there are many goods subject to economies of scale, rather than each country struggling to produce all goods, if each country produces just a few goods, the world will be able to produce so much of each good. The role of international trade then in this respect is that it offers the possibility of each country producing limited goods while taking the advantage of economies of scale and also giving the opportunity for increasing the consumption of all goods via trade [17].

Rather than the constant returns to scale assumed by the neoclassicals and the standard trade theories, the new trade theories assume increasing returns to scale which points to the existence of imperfect competition in as much as economies of scale are not external to the individual firms. For an industry with purely external economies of scale (that is an industry without any advantage to large firms), there will be many small firms that will be perfectly competitive [17]. At the level of the industry, economies of scale may arise due to the existence of a larger industry which provides a wider variety of specialised services that support the operation of the industry or provides a bigger and more flexible market for various specialised labour. However, with significant external economies of scale, a country that starts with production on a large basis in a specific industry will have an advantage of cost in that industry thereby inducing further specialisation in that industry and leading to inter-industry trade. In addition, it is possible for countries to lose from trade given that they have relatively small or low external economies of scale or income elasticity in their pattern of specialisation [17].

On the other hand, with the assumption of internal economies of scale which lead to imperfect competition, there are two possible dimensions. The first dimension models mainly economies of scale and considers imperfections in market and as such assumes monopolistic competition [17]. The second characterises market structure as being oligopolistic or models

Cournot or Betrand competition [17]. For monopolistic competition, an industry is made up of reasonably large number of similar firms that produce differentiated/unique products. Here, equilibrium in the market ensures that all firms have zero profits with the number of firms determined by the size of the market. The relevance of this to trade is that trade increases the size of the market which may enlarge its scale of production and provide more varied products to consumers.

The basic trade mechanism here is internal economies of scale and differentiation of product – this causes the production of each varied product to be concentrated in that given country and each country produces different sets of varieties of a particular product. Due to consumers' love for varieties, each country imports the varieties produced by other countries and exports its own varieties, thus an intra-industry trade is created. In the case of an oligopolistic market, the decision of each firm mutually depends on that of the other. An open trade makes a firm to be a part of a bigger and more competitive market and each firm faces a higher demand elasticity which leads to an expanded output and expanded industry's output and consequently a fall in price. This is what is called the 'pro-competitive' effect. However, given the possibility of market segmentation and price discrimination, trade can occur without economies of scale and comparative advantage [17]. Trade takes place because oligopolists sense higher demand elasticity on exports more than on domestic sales – their foreign market share is smaller than domestic market. This makes them to penetrate each other's market (reciprocal dumping).

Here, differences and gaps in technology amongst countries are outcomes endogenous to firm-level product and process innovation that lowers the costs of production and creates new products. It is assumed that the flow of technology in a firm/country is neither free nor instantaneous meaning that a firm/country possesses a temporary comparative advantage in production and exports. The neotechnology trade theories' treatments of the effect of technology on trade are different from the Ricardian's in that in the former, trade is due to the innovating country's creation of some new products that other countries cannot produce at least on a temporary basis while in the latter, it is the technological (productivity) differences for some goods that cause trade.

In a situation in which consumers demand for varieties of goods (love for varieties) thus promoting the need for product differentiation in the presence of monopolistic competition, the new trade theory is able to account for this (18). However, recent studies reveal that intra-industry trade (or trade between countries or firms with similar technology, factor endowments and products) is more common with intermediate goods than with final goods and new trade theory accounts for this [19]. Just like the way consumers can maximize their utility under the 'love for variety' approach, firms, through trade in intermediate products should also be able to attain reduced costs and produce more output [18].

In addition, a priori, trade in intermediate products should also give room for firms to specialize narrowly along better defined comparative advantages. It also tends to be capable of promoting technological diffusion or provide producers with wider options of purchasing a given input that they may be incapable of producing themselves (18). Thus, if Nigeria or ECOWAS in general for instance engages in a global agricultural value chain, then trade in agricultural intermediate products would be the emphasis and gains from this pattern of trade is explainable within the new trade theory rather than the traditional trade theory. On the part of the New-New Trade theory, it maintains that global trade takes place between firms in a given country rather than between countries themselves. The proponents of global value chains also affirm the same. Yet, the applicability of the new-new trade theory to Nigeria and ECOWAS is limited because of the difficulties in obtaining microdata on plants and firms within this sub-region.

Some insights with regards the theory-objective nexus could also be garnered from other relevant theories such as the comparative advantage theory, heterogeneous firm theories and new economic geography/location theory.

2.2 REVIEW OF EMPIRICAL STUDIES

Some studies such as (1) and (20) relate economic integration, trade facilitation and agricultural export performance in ECOWAS countries using descriptive, statistical and econometric techniques. They used a descriptive analysis to assess the level of economic integration in ECOWAS countries. To examine the impact of economic integration process on agricultural exports in ECOWAS, they adopted a statistical analysis (correlation analysis) and employed an econometric method (Generalized Method of Moment) in examining the effect of economic integration on trade facilitation. Their findings suggested that in ECOWAS, on the average, the level of trade facilitation is below world average. The study also observed a sustained growth in agricultural production and a close relationship between agricultural production and agricultural exports in ECOWAS. They also found out that economic integration and trade facilitation influenced agricultural exports significantly in the region.

Reference [10] studied "China's regional economies and value chains using an interregional I-O analysis." The paper focused on the measure of domestic value chains (DVCs) across regions and their linkages with global markets. They used the Input-Output tables of China for 1997 and 2007 and concluded, *inter alia,* that the increase in interregional trade characterised by high trade in intermediate products is the primary cause of a flat creation and distribution of value added across regions. They also observed that the final demand for goods and services at the regional level, produced in other regions, has played a major role in the development of value added trade trans-regionally.

Reference [11] studied "Measuring global value chains and regional integration using an international I-O approach." Using Trade in Value Added (TiVA) as a new concept to estimate the evolution of GVCs and regional economic integration, their primary findings, *inter alia,* are that: intraregional Trade in Value Added in Europe is high thus revealing this continent as a high-level integrated region; the increasing interaction between EU15 and the rest of Europe is the main feature of the ongoing regional integration of the European region; contrarily, Asia as a whole witnessed a slight decrease in the presence of regional integration in the aspect of intraregional TiVA, and: trade in intermediate goods amounted to 66% of the total international TiVA in 2005 pointing to the fact that the deepening regional integration is basically driven by the increase in intraregional trade in intermediate goods in terms of value creation and distribution.

The work of [12] is also very similar to this current study. They however did not consider the role of economic integration. Their work was based on "value chain improvement for cocoa industry in Indonesia by input-output analysis'. Their objective was to access the contributions of relevant sectors to value added and the extent of the forward and backward linkages of the cocoa beans industry in Indonesia. Using the input-output technique, they found out that the cocoa beans industry in Indonesia has weak forward and backward linkages with other sectors of the economy.

3.0 STYLISED FACTS AND TREND ANALYSES: REGIONAL ECONOMIC INTEGRATION AND COCOA BEANS VALUE CHAIN

Some indicators of the performance of a regional economic community (REC) – intra-regional trade flows and the extent of trade facilitation are used to measure the performance of ECOWAS as a REC. In specific terms, the intra-regional trade flows in cocoa beans between Nigeria and the rest of ECOWAS (Nigeria-ECOWAS cocoa beans trade flows) and infrastructure (mobile cellular subscriptions, regulatory quality) are used as indicators of the performance of ECOWAS. With respect to the cocoa beans value chain in Nigeria, the performance of this value chain is benchmarked against those of the other leading producers of cocoa beans in the world – Cote d'Ivoire, Indonesia and Ghana – by comparing the productivities of cocoa beans of these countries with that of Nigeria. Trend analyses is used to shed more light on the relationship between regional economic integration in West Africa and cocoa beans value chain in Nigeria which is the interest of this study.

A) Regional Economic Integration in ECOWAS

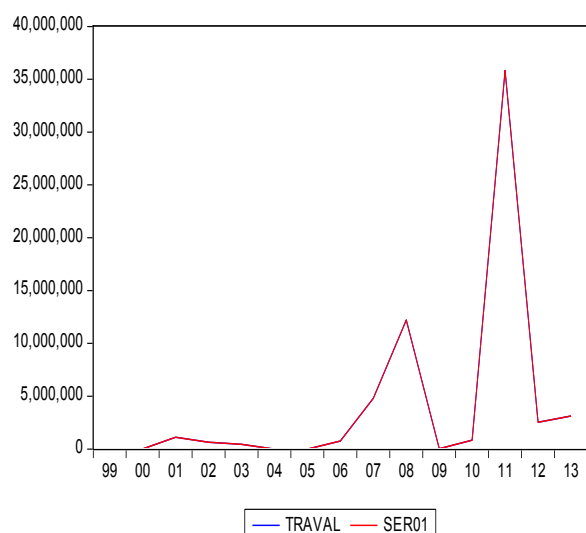Intraregional trade flows: This is shown in fig. 1 below

a)

Fig. 1: Trend in the value of Nigeria-ECOWAS cocoa beans
trade flows (TRAVAL) from 2000 to 2013.
Source: Charted from the statistics contained in (21)

Fig. 1 shows the trend in the Nigeria-ECOWAS cocoa beans trade flows (TRAVAL). The growth rates between 2000 and 2004 fluctuated between positive and negative values with zero growth in 2005 and 2006 because there was no trade for those years.

b) Indicators of Trade Facilitation: 1) infrastructure and 2) regulation. They are now considered as shown in table 1.

The mobile cellular subscriptions (per 100 people) indicator as shown in table 1 refers to mobile cellular telephone subscriptions to the service of a public mobile telephone that offers access to the Public Switched Telephone Network (PSTN). This indicator includes (and is divided into) the number of postpaid subscriptions and the number of active prepaid accounts (that is, those that have been used during the last three months). Subscriptions via data cards or USB modems, mobile data services, private trunked mobile radio, radio paging and telemetry are not included. This indicator reveals that Indonesia has thehighest mobile cellular subscriptions up to recent times while Nigeria has the least consistently since the late 90s to recent times. Given that actors in the cocoa beans value chain in Nigeria need to communicate with other actors within the ECOWAS region in order to get information about the cocoa beans market in ECOWAS, the relatively low mobile cellular subscription suggests the possibility of actors inNigeria not having necessary information thusinhibiting their opportunities to derive maximum gains from their activities.

TABLE 1: INDICATORS OF TRADE FACILITATION

	Mobile Cellular Subscriptions (per 100 people)				Year		Regulatory Quality				Year
	Cote	Ghana	Indonesia	Nigeria			Cote	Ghana	Indonesia	Nigeria	
	1	0	1	0	1998		-0.26	-0.25	-0.26	-0.93	1998
	3	1	2	0	2000		-0.54	-0.10	-0.18	-0.74	2000
	6	2	5	1	2002		-0.45	-0.47	-0.64	-1.23	2002
	10	8	14	7	2004		-0.96	-0.35	-0.67	-1.32	2004
	23	24	28	23	2006		-0.85	-0.08	-0.34	-0.89	2006
	57	50	60	42	2008		-0.89	-0.04	-0.32	-0.78	2008
	82	72	88	55	2010		-0.91	0.12	-0.39	-0.71	2010
	91	101	114	67	2012		-0.77	0.12	-0.28	-0.72	2012
	106	115	126	78	2014						

Source: (22) and (23)

With respect to the indicator of regulation which relates to the policies and regulations that permit and promote private sector development, Ghana was the highest performer in this indicator with statistics ranging between -0.47 and 0.12 from 1998 to 2012 while Nigeria had the poorest performance (worstregulatory quality) with statistics ranging between -1.32 and -0.71. Hence, the two indicators of infrastructure are

pointers to the possibility of actors in the Nigerian cocoa beans value chain being the most adversely affected by the level of the availability of mobile cellular subscriptions and quality of the regulatory environment.

B) Cocoa Beans Value Chain in Nigeria

a) Mapping as suggested by (14)
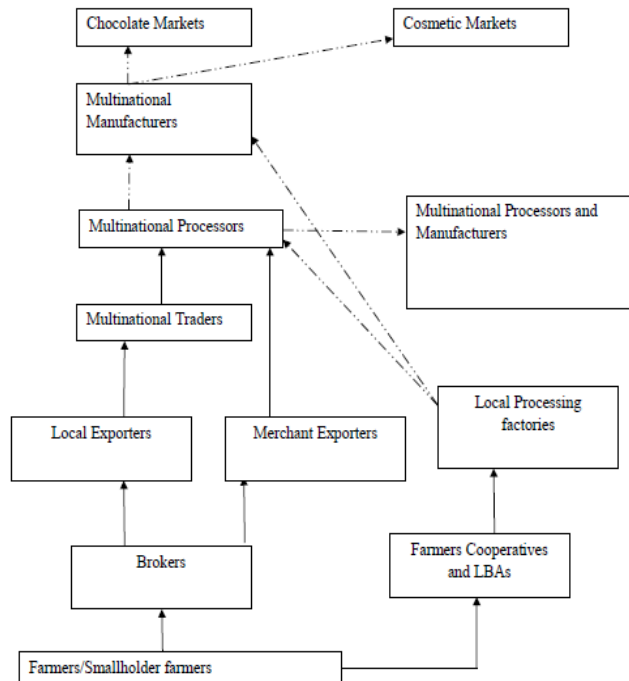
Fig. 2. The Nigeria's Cocoa Beans Global Value Chain
Source: Adapted from (24)

b) Comparative Performance Assessment Using Benchmark Data

Reference [14] opined that one of the ways to assess the performance of a product's value chain is to benchmark the production efficiency/productivity against leading firms/countries in that given value chain. In this respect, given that Cote d'Ivoire, Ghana and Indonesia are the leaders in terms of exports, the productivity of Nigeria (proxy by productivity per hectare/yield of cocoa beans) is compared with those of these countries using trend analysis. This is shown by fig. 3
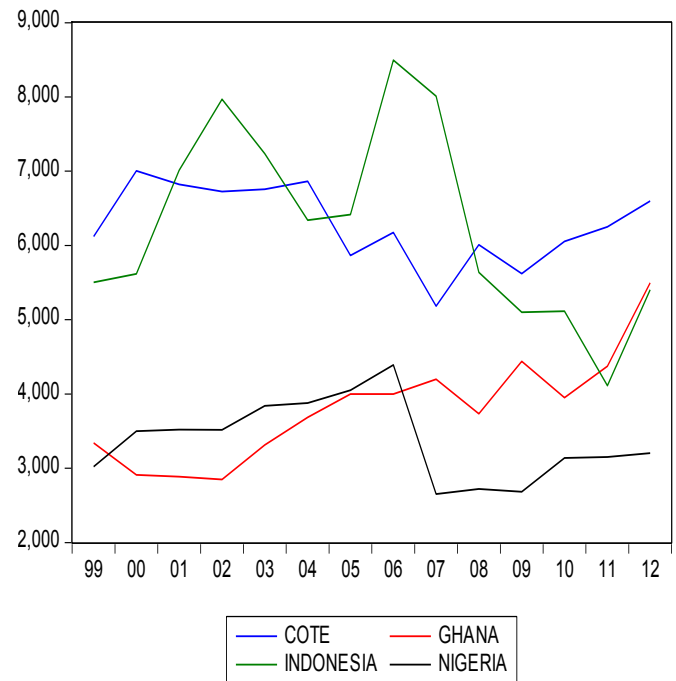
Fig. 3. Trend in Value Chain Productivity
Source: Authors' computation from (25)

Fig. 3 shows that in the early/first half of the 2000s, Indonesia and Cote d'Ivoire had much higher cocoa beans productivities than Nigeria but Nigeria had higher productivities than Ghana within the same periods. However, in the second half of the 2000s, Ghana's productivities became much higher than those of Nigeria. Cote d'Ivoire and Indonesia also had much higher productivities than Nigeria. Thus, in the second half of the 2000s till 2012, out of the four leading exporters of cocoa beans in the world, Nigeria's productivities lag much behind those of the others.

Relating the Nigeria-ECOWAS trade flows (an indicator of regional economic integration) and the productivity of the cocoa beans value chain in Nigeria, in the first half of the 2000s, the trends showed a gradual and steady increase in the trade flows and productivity thus suggesting a positive relationship between them. However, in the second half of the2000s up to 2013, the trend in the former fluctuated while that of the latter decreased sharply after 2007 thus showing an ambiguous relationship between the two. To corroborate the descriptive analysis done here, an empirical analysis using the input-output analysis is suggested to estimate the extent of forward and backward linkages brought about by regional economic integration.

CONCLUSION AND POLICY RECOMMENDATION

From the stylised facts and trend analyses, some insights into the performance of ECOWAS and the cocoa beans value chain between Nigeria and the relationship between the two concepts have been garnered. The indicators of regional economic integration considered show that on the average,Nigeria lags behind other leading exporters. On theother hand, the indicator of the intraregional cocoa beans value chain between Nigeria and the rest of ECOWAS (Nigeria's cocoa beans value chain productivity) also shows a

relatively low performance when compared to the productivities of other leading exporters of cocoa beans. Thus, it can be inferred that the platforms put in place by ECOWAS tend not to be sufficient to significantly bolster intraregional cocoa beans value chain between Nigeria and the rest of ECOWAS.

Thus, with special focus on the cocoa beans value chain in Nigeria, ECOWAS Commission still has to play better roles in increasing the access to telecommunication and encouraging better regulatory environment in order to create the necessary inter-linkages between the cocoa beans value chain actors in Nigeria and the actors in the rest of ECOWAS.

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Socio-Demographic Factors, Contraceptive Use and Fertility Preference among Married Women in South-South Region of Nigeria

Iheyinwa Chidinma Salami
Department of Economics and Development Studies,
Covenant University, Canaan Land
Ota, Nigeria.
E-mail: milasaify2014@gmail.com

Muyiwa Oladosu,
Department of Economics and Development Studies,
Covenant University, Canaan Land,
Ota,Nigeria.
E-mail: muyiwa.oladosun@cu.edu.ng

Abstract - **Nigeria is among a few countries in sub-Saharan Africa with consistently low contraceptive use of 15% among married women whose average fertility rate is 5.5 from the 2013 Nigeria Demographic and Health Survey (NDHS) report. The [21], report showed that while fertility rate of 5.5 in 2013 was a slight drop from previous years of 5.7 in 2003 and 2008, contraceptive use has experienced only a gradual increase of 2% from 2003 figures. This study examines the relationships between socio-demographic factors influencing contraceptive use of married women and how this affects their fertility preferences now and in the future. The study used the 2013 Nigeria Demographic and Health Survey [21] data sets. Analysis employed univariate, bivariate, and multivariate analytical techniques. Results show that some women background factors like state of residence, education, wealth index, and number of other wives have both direct and indirect relationship with contraceptive use. The odds that women used contraceptive method increased significantly by level of education, wealth status, and number of living children, and the odds varied significantly by state of residence, number of other wives, and fertility preference. Effective programming focused on contraceptive increase will need to consider state variations, educational levels, and wealth differences across sub-groups in this region. Other important factors that should be factored into programming are number of co-wives, number of living children per woman, and whether women are favorable or not to having another child.**
Key words: socio-demographic factors, contraceptive use, fertility preference, married women.

I. INTRODUCTION AND STATEMENT OF PROBLEM

In the year 2000, it was estimated that the population of the world was growing by about 78 million per year at the rate of 1.4%, and was projected to rise to over 8 billion in 2025, [27]. A survey carried out in 1990 among the developing countries, revealed that total fertility rate was highest in the Sub – Saharan Africa at an average of 5.3 children per woman [3].

Among the black nations in the world today, Nigeria is the most populous and recent estimates indicate a total population of 177 million people [31], with a growth rate of 3.2% and a TFR of 5.5, [21].These statistics are obviously indicators of an impending population explosion if measures for checks are not considered. In Nigeria today, according to [20], population explosion with the resultant effect of food production not being sufficient for the growing population is already being experienced. In Nigeria, the more children a woman is able to procreate, the matrimonially fulfilled the culture considers her. This attitude is the bane of Nigeria's economic growth and development, [10] confirmed this assertion with an opinion that less developed countries like Nigeria could only grow economically if population growth is held in check.

In the olden days, world over, it was hard for women to decide when next to have a child, the actual number of children and when to stop childbearing, except for women who were highly educated career women [10]. They concluded that the number of children a woman bore reflected the desired fertility of her husband and his relatives. However, in the modern society, women's status is gradually changing. At present, women's traditional household activities are changing due to the influence of various socio- economic and demographic conditions, especially with more women engaging in income generating activities, higher educational status and high decision power in the household especially as it relates to her reproductive health.

Despite this progress made in the status of women world over, Nigeria is still among the few countries in Sub- Sahara Africa with consistently low contraceptives use of 15% among married women whose average rate is 5.5 from the 2013 Nigeria Demographic and Health Survey (NDHS) report. The [21] report showed that while fertility rate of 5.5 in 2013 was a slight drop from previous years of 5.7 in 2003 and 2008, contraceptive use has experienced only a gradual increase of 2% from 2003 figures.

Although efforts to control fertility in Sub-Saharan Africa are being vigorously pursued, little results have been recorded. This could be attributed to the fact that the economy in the region continues to be agricultural based, with most of the population being predominantly rural. According to [7], marrying early and low levels of contraceptive use continue to be normative in the sub- region. In Nigeria, Contraceptive Prevalence Rate (CPR) is low and according to the report released by the International Women's Health Coalition in 2007, the Contraceptive Prevalent Rate among the cohort of married women aged 15-49 years indicated an all time low of 8% for modern methods and 12% for all methods [1]. In Nigeria, as revealed by [13], adopting modern contraceptive use is a rather difficult and complex issue that is highly influenced by sociological factors, cultural affiliations and religious convictions.

Authors, [2,9, and 25], all reiterated the fact that socio-economic status of women, notably educational levels, cultural and religious values have been argued to explain differences in reproductive behavior and contraceptive choices. In recent times, much research have been undertaken to investigate the socio-demographic characteristics and their association with contraceptive use among women of reproductive age. These socio-demographic characteristics include women age, state of residence, residence (whether urban or rural), educational attainment of the woman, wealth index, marital status, work status of the woman. However, studies on the relationships between socio- demographic factors influencing contraceptive use of married women and how it affects their fertility preferences now and in the future in South – South Region of Nigeria is sparse. This study is designed to address this knowledge gap

Nigeria and Fertility
In Africa as well as Nigeria, fertility preference is affected by social norms and biological behaviour. These influences include a high level of mortality among the infants and children, early marriage, early child bearing as well as child bearing within much of the reproductive life span, low use of contraception and high social values placed on child bearing. The Total Fertility Rate (TFR) in Nigeria is 5.5. This means that at current fertility levels, the average Nigerian woman who is at the beginning of her child bearing years will give birth to 5.5 children by the end of her lifetime. Although the Nigerian government in its first population policy in 1988(revised in 2004), that called for a reduction in the birth rate through voluntary fertility regulation methods compatible with the nation's economic and social goals, pegged the number of children per woman at four, the country's Total Fertility Rate (TFR) is still high as 5.5; one of the highest fertility levels in the world. [22].

Nigeria and Contraceptive use
In developing countries like Nigeria, unplanned pregnancies abound and this usually results in abortions by untrained persons with resultant cases of diseases and death. In the world nearly 350,000 women die annually while another 50 million suffer from illness and disability from complications

as a result of pregnancy related issues and child birth and Nigeria is among the first six countries that contribute to about 50% of maternal death annually [24]. This is alarming, bearing in mind that Nigeria's contraceptive prevalence rate is still quite low even at 15% though it is an increment of about 2% from 2003 NDHS report, [21]. In industrialized countries, virtually all married women resort to contraceptives at sometime in their reproductive period [1], little wonder the fertility rates in those nations are very low. In contrast however, the percentage of people reporting such huge use of contraceptives in developing countries is extremely low. As earlier reported, adopting modern contraceptive use is a very complex sociological issue in Nigeria therefore a study of contraceptive usage in Nigeria is one of the ways for providing inquiry into the factors motivating reproductive behavior. At present, it could be argued that examination of the socio-economic cultural characteristics of contraceptive adopters will provide insights into the causes of observed levels and trends in the fertility differentials in the Nigerian context and that's what this study is set to achieve.

Family Planning In Nigeria
Fertility decline is a means of achieving demographic dividend, with the consequent potential of reducing poverty, boosting economic growth and contributing to the overall well-being of families and societies [11]. It has been estimated that in Nigeria, a reduction in fertility by one child per woman would lead to 13% increase in GDP per capita within 20 years and it is important to note that while family planning impacts all the MDG goals, it is most directly associated with MDG 5, improving maternal health [29].

Family planning- the ability of individuals and couples to attain their desired number and spacing of their children through contraceptive use- is one of the most cost-effective public health interventions and is pivotal to reducing the country's fertility [18]. Nigeria's family planning program began in 1964 with the National Family Planning Council of Nigeria. Before the 1980's, however, family planning programs were not a priority for the government of Nigeria and consequently were driven by development partners and non-governmental organizations. Following analysis of the consequences of unregulated population growth on health and development in Nigeria, starting in the late 1980's the country began formulating various policies aimed at improving reproductive health outcomes and reducing fertility levels through family planning [6].

Recently, following the 2012 London Summit on family planning, Nigeria developed a blue print for accelerating uptake of family planning with a target of increasing the national contraceptive prevalence rate to 36% by 2018 [8].

Currently, family planning services are provided by both the public and private sectors, with the commodities provided free in public sectors facilities. In spite of the various investments in family planning programs in the country, it is saddening to know that contraceptives prevalence has not shown any sign of increasing. According to the [21], while knowledge of contraceptives is generally high, uptake is low; only 15% of

married women of reproductive age are using any contraceptives method, only 10% are using modern family planning method, while unmet need for contraception is 16%. Therefore, the promotion of family planning in countries with high birth rates has the potential to reduce poverty and hunger and avert 32% of all maternal deaths and nearly 10% of childhood deaths.

Literature Review

Fertility is a complex phenomenon that is enormously affected by cultural conditions, preferences and family structures. More so, demand for children is affected by factors such as socio-economic status, and components of demography. The various socio-economic and demographic factors such as level of education, standard of living, working status, number of living children etc have a great impact on prevalence of contraception using and ultimately lower fertility. Contraception Use, which is one of the determinants of fertility [12], has a great impact on fertility, but this awareness has not been fully harnessed by some less developed countries. As a matter of fact modern contraceptives use persists to be low in most African countries, where fertility is high, population growth is escalating and unmet need for family planning is high. Therefore, an understanding of the factors that influence contraceptive use is critical to all the efforts being put in place to produce programmes that will increase prevalence [4].

Writers have different opinions on the exact factors that affect contraceptive use and fertility behavior but there is a general consensus that socio-economic, demographical factors and attitude of women are key, to the use of contraceptive in less developed countries where fertility rate is still high. In their work [6] explored the role of contextual factors in determining use of modern contraceptives in Nigeria. The study used Secondary data from the 2013 Nigeria Demographic and Health Survey (NDHS) among women aged 15-49. The result showed that, generally in Nigeria, individual and community level variables accounted for 82% of the variations in contraceptive use in Nigeria. The contextual factors found to be positively associated with use of modern contraceptives were female education, female autonomy and access of health facilities; while communities with higher proportions of Muslim and higher proportions of polygynous marriages negatively predicted use of modern contraceptives.

In an attempt to determine the prevalence and determinants of choice of contraceptive methods among rural women in Osun State Nigeria, [1] found that the most significant socio-demographic determinants of ever use of contraceptives were religion and family setting. Similarly, [16], studied the impact of religion on the decision to use contraception among Muslim families in India and found that, individual beliefs held by men and women about their religion and what it prescribes or proscribes concerning contraceptive use ultimately affects their demographic decisions.

According to [17], in their study "the variation and factors influencing modern contraceptives use among married women in Ethiopia; evidence from a national population survey", found that being wealthy, more educated, employed, having higher number of living children, being in a monogamous relationship, attending community conversation, being visited by health workers at home predicted use of modern contraception, while living in the rural areas, older age, being in polygamous relationship and witnessing one's own child's death were found to negatively influence modern contraceptive use. The findings indicate a significant socio-economic, urban, rural and regional variation in modern contraceptive use among reproductive age women in Ethiopia. Similarly, [19] studied the socio-economic and demographic factors affecting contraceptive use in Malawi using the 2000 and 2004 DHS Surveys. The study revealed that, the major determinants of contraceptive use are age, respondent's and partners' approval of family planning, family planning discussions with partner, number of living children, work status, education and visit to a health center.

Furthermore, [26] in his work, socio-economic and cultural differentials in contraception usage among Ghanaian women, found that the use or non-use of contraception in Ghana is affected by a multitude of demographic, socio-economic and cultural factors. The study reveals that high socio-economic development and modernizing influence on women help to promote contraception, thus, reduce fertility. The study made use of Secondary data from the Ghana Fertility Survey (GFS) 1979/80 under the auspices of the World Fertility Survey. Available evidence as gleaned from these studies explicitly portrays the enormous effect of socio-demographic factors on contraceptive use especially among married women in less developed countries, but studies on the relationships between these socio-demographic factors and their influence on contraceptive use of married women and how it affects their fertility preference now and in the future is scarce. Therefore, this paper is poised to address this gap as it relates to the married women aged 15-49 in South-South Region of Nigeria.

II. DATA & METHODS

The 2013 National Demographic and Health Survey (NDHS) is a national sample survey collected on fertility levels, marriage, fertility preferences, among other vital information. The 2013 NDHS sample was selected using a stratified three-stage cluster design consisting of 904 clusters, 372 in urban areas and 532 in rural areas. A representative sample of 40680 households was selected for the survey, with a minimum target of 943 completed interviews per state. A complete listing of households and a mapping exercise were carried out for each cluster from December 2012 to January 2013, with the resulting lists of households serving as the sampling frame for the selection of households. A fixed sample take of 45 households were selected per cluster. All women aged 15-49 who were either permanent residents of the households in the 2013 NDHS sample or visitors present in the households on the night before the survey were eligible to be interviewed. A total of 38,948 respondents were administered structured questionnaire (NDHS, 2013)

The study analysis focuses mainly on 6058 women in the south-south region of Nigeria.

VARIABLES DEFINITION

Dependent Variable
The main variable in this analysis is contraceptive use defined as; (1) using, or (2) not using. The analysis has been restricted to this category of women because of the expectation that fertility- related policies and contraceptive regulations are likely to be more meaningful to, and become more successful when adopted by women who are exposed to child bearing oriented sexual relations throughout their reproductive ages.

Independent Variables
The main predictor variables are the socio- demographic factors influencing women's employment status and they include; age, residence, education, religion, state of residence, marital status, number of co-wives, wealth status index, age at first sex, and living arrangement.
The intervening variables include:
No. of living children: It is categorized into; none and 1 or more.
Fertility Preference: It is categorized into; favourable to another child and not favourable to another child.

III. RESULTS

Study Sample Description
The majority of women were aged 29 or younger (57%), lived in the rural areas (66%), and had secondary/higher education (69%). Most women were Christians (97%), in a monogamous union (82%), had first sexual debut at age 19 or younger (80%), and lived with their husbands (84%). Respondents were fairly evenly distributed the six states in the region; Bayelsa (20%), Delta (19%), Edo (18%), Akwa Ibom (16%), Rivers (15%), and Cross River (12%). Majority of respondents were employed (65%), earned cash only (78%), and were in the rich/richest socioeconomic bracket (63%). About 25% of respondents had one or two children, 18% had three or four, and 19% had 5 or more, while 38% do not have any. Results show that only 26% of the women who participated in the survey reported using contraceptive methods.

Multivariate Results
The result of the binary logistic regression model is presented as relative odds in table 2. The reference category of each measured independent variable has a value of one and the values for other categories are compared to that of the reference category. Results of this study (Table 2), show that some women background factors like state of residence, education, wealth index, and number of other wives have both direct and indirect relationship with contraceptive use. The odds that women used contraceptive method increased significantly by level of education, wealth status, and number of living children, and the odds varied significantly by state of residence, number of other wives, and fertility preference.

Model 1: Contraceptive Use by background factors
Rivers State women were 1.5 times as likely as women from Edo State to use contraceptive. Women from Bayelsa State were 0.45 times as likely as women from Edo State to use contraceptive. With regards to educational level, respondents with primary education were 1.8 times as likely as women with no education to use contraceptive, while women with higher education were found to be 2.5 times as likely as women with no education to use contraceptives. Women in the richer wealth category were 1.7 times as likely as women in the "poorest/poorer" category to use contraceptives and respondents in the richest wealth category were 1.8 times as likely as women in the "poorest/poorer" category to use contraceptives. With respect to the number of co-wives, women with one or more co-wives were 0.62 times as likely as women with no other wife to use contraceptives.

Model 2: Contraceptive use by fertility behavior factor
Results in Table 2 show that women with one or more living children were 0.81 times as likely as women with no living children to use contraceptives. With regards to fertility preference, women who were not favorable to having other children were 1.3 times as likely as their counterparts favourable to another child to use contraceptives.

Model 3: Contraceptive use vs. background & fertility behavior factors
Results in Table 2 show that women in Delta State were 1.47 times as likely as women from Edo State to use contraceptive method. So also are women from Rivers State who were 1.62 times as likely as women from Edo State to use contraceptives. Also, respondents from Bayelsa State were 0.50 times as likely as respondents from Edo State to use contraceptives. In terms of education, women with secondary education were 2.6 times as likely as women without education to use contraceptives, while women with higher education were 2.9 times as likely as women without education to use contraceptives. In the wealth index category, the women in the richer categorized were 1.9 times as likely as women in the poorest/poorer category to use contraceptives. Women in the richest wealth index were 2.1 times as likely as women in the reference category to use contraceptive. Women who had co-wives were 0.62 times as likely as women with no co-wife to use contraceptives. Women with 1 or more living children were 3.3 times as likely as women with no living children to use contraceptives. As regards to fertility preference, women that are not favourable to having another child were 2.3 times as likely as women that favour another child to use contraceptives.

IV. DISCUSSIONS & CONCLUSIONS

This study was geared to examine the relationships between women's background factors and their fertility behavior with contraceptive use at the south-south region of Nigeria with a view to providing useful information for stakeholders to increase contraceptive use in the region. Results show that effective programming focused on contraceptive increase will need to consider state variations, educational levels, and wealth differences across sub-groups in this region, this was found to be consistent with several studies conducted in developing countries (C. L. Ejembi, T. Dahiru and A. A. Aliyu, (2015) and L. Yihunia, A. Ayalu, T. Habtamu, B. Susan and D. Kebede, 2013). Other important factors that

should be factored into programming are number of co-wives, number of living children per woman, and whether women are favorable or not to having another child, this is also consistent with previous studies [18,19]. Fertility preference may differ depending on the stage of a woman in her reproductive life cycle but a salient cultural factor that this study brings to bear is seeming competition among co-wives which may not be overt but may be a key reason for desire for another child among women in polygamous relationship in the region. This study confirms [6]. findings from Nigeria that higher proportions of polygynous marriages negatively predicted use of modern contraceptives.

Table 1: Background characteristics of the respondents

Variable	Frequency (N=6,058)	Percentage (%)	Variable	Frequency (N=6,058)	Perc (%)
Respondent age			**State of residence**		
15-19	1376	22.7	Edo	1079	17.8
20-24	1063	17.5	Cross River	727	12.0
25-29	1027	17.0	Akwa Ibom	979	16.2
30-34	803	13.3	Rivers	919	15.2
35-39	737	12.2	Bayelsa	1224	20.2
40+	1052	17.4	Delta	1130	18.7
Residence			**No of Co-wives**		
Rural	3996	66.0	No other wives	2696	82.3
Urban	2062	34.0	One or more	578	17.7
Educational level			**Marital Status**		
No education	336	5.5	Never in union	2344	38.7
Primary	1549	25.6	Married together	3308	54.6
Secondary	3483	57.5	Married not together	406	6.7
Higher	690	11.4	**Age at first Sex**		
Religion			15 or younger	1130	30.5
Islam-trad	171	2.8	16-19	1829	49.4
Catholic	555	9.2	20 or older	744	20.1
Other Christian	5302	88.0			
Wealth index			**Living arrangement**		
Poorest-poorer	620	10.2	wife living with husband	2773	84.2
Middle	1599	26.4	wife living elsewhere	521	15.8
Richer	2060	34.0	**Employment Status**		
Richest	1779	29.4	Not working	2131	35.4
			Working	3896	64.6
Earnings					
Not paid	474	13.3	**No. of Liv. Children**		
Cash only & in kind	3083	86.7	None	2285	37.7
			1 or more	3773	62.3
Fertility preference					
Favourable to another Child	4750	79.3	**Contraceptive use**		
Not favourable to Another Child	1243	20.7	Not using	4468	73.8
			using	1590	26.2

Table 2: Logistic Regression Analysis of Contraceptive Use and Fertility Behaviour, Background Factors.

Variable	Model 1 (Contraceptive use by Background Factors)	Model 2 (Contraceptive use by Fertility Behavior)	Model 3 (Contraceptive Use by Fertility Behavior by Background factors)
Age			
15-19	1.00		1.00
20-24	1.195		1.052
25-29	1.057		0.801
30-34	1.010		0.648
35-39	1.423		0.772
40+	1.061		0.449
State of Residence			
Edo	1.00		1.00
Cross river	1.374		1.235
Akwa Ibom	1.083		1.025
Rivers	1.530*		1.629**
Bayelsa	0.453***		0.502**
Delta	1.380		1.472*
Educational Level			
No Education	1.00		1.00
Primary	1.840*		1.934
Secondary	2.489**		2.625**
Higher	2.528**		2.971***
Wealth index			
Poorest-poorer	1.00		1.00
Middle	1.025		1.004
Richer	1.726**		1.904**
richest	1.808**		2.143**
Age at first Sex			
15 or younger	1.00		1.00
16-19	0.957		1.028
20 or older	0.809		0.966
Religion			
Islam-Trad	1.00		1.00
Catholic	1.861		1.973
Other Christian	1.166		1.259
No. of co-worker			
No other wife	1.00		1.00
One or more	0.622**		0.626**
Place of residence			
Rural	1.00		1.00
Urban	0.872		0.856
Living arrangement			
Wife with Husband	1.00		1.00
Wife living elsewhere	0.947		0.925
No. of Living Children			
None		1.00	1.00
1 or more		0.812**	3.370***
Fertility Preference			
Favourable to another child		1.00	1.00
Not favourable to another child		1.337***	2.337***
Model chi square	455.195	1271.190	472.313
Nagelkerke R Square	0.093	0.004	0.144
-2log likelihood	2146.110	6838.729	2002.575

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Factors Influencing Women Employment Status and Fertility Preferences Among Married Women in South-South Region of Nigeria

Iheyinwa Chidinma Salami (Corresponding author)
Department of Economics and Development Studies,
Covenant University, Canaan Land
Ota, Nigeria.
E-mail: milasaify2014@gmail.com
Muyiwa Oladosu, PhD
Senior Lecturer, Department of Economics and Development
Studies,
Covenant University, Canaan Land,
Ota,Nigeria.
E-mail: muyiwa.oladosun@cu.edu.ng

Abstract

Evidence from the literature show that in developed countries where considerable proportion of women participate in the labor force, total fertility and population growth rate are considerably low. This is in sharp contrast to most less developed countries like Nigeria where women's involvement in the labor force is low, and total fertility and growth rate are both consistently high. This study examines the relationships between factors influencing the relationships between women's involvement in the labour force and fertility preferences with focus on south-south region of Nigeria. The study employed the 2013 Nigeria Demographic and Health Survey (NDHS) data sets. Analysis applied univariate, bivariate, and multivariate analytical techniques. Preliminary results show that current working status of women in the region vary significantly by age, education, no of co-wives, state of residence, and age at first sex of the respondents (p-values = 0.000). Other factors with positive significant association with current work status are; religion (p-value = 0.034), and wealth index (p-value = 0.030). Earnings of women in the south-south region of the country were significantly associated with age, residence, education, religion, wealth index state of residence, and age at first sex (p-values = 0.000). These results have importance significance for policy and programmes geared to increase women's labour market involvement in Nigeria. The results from the multivariate analysis showed that policy makers and programmers need to consider variations and differences in state of residence, education, wealth status, and number of co-wives when designing tailor made programmes for these subgroups in the region.

Key words: women participation, labour force, current working status, and earning of women

INTRODUCTION AND PROBLEM STATEMENT

Evidence shows that high fertility has adversely influenced the socio- economic, demographic, and environmental development of developing countries such as Nigeria [4]. Given the country's total fertility rate (TFR) of 5.5%; one of the highest in the world, [17], there is no signal that a sustainable decline is visible soon. It is therefore imperative to further appreciate the forces underlying the fertility situation in the country. Labour Force Participation of women among other factors is identified as a significant predictor of fertility [14].The literature show that in developed countries considerable proportion of women participate in the labour force, with attendant low total fertility and population growth rate compared to most developing countries where low proportion of women participate in the labour force and fertility is high There are considerable untapped benefits of women labour force participation that Nigeria is yet to tap. into. S. P. Tsani, L. Paroussos, S. Fragiadakis, I. Charalambidis, and P. Capros, P, (2012) argues that women human capital is underutilized both at the national and global levels in many countries.

In Nigeria, female labour force participation increased from 36% in 1990 to 39% in 2009 [22]. Although the increase of 3% is small, it did not have any appreciable effect on total fertility in the country. In the more industrialized societies, an inverse association between various measures of fertility among economically active and inactive women appears to have been more consistent than in the less developed societies. In the less developed societies, the nature of the relationship tends to vary with conditions and sectors of employment and it might be sufficient to note that research findings from Nigeria and some other African countries indicate that the relationship between female work and fertility is far from being consistent, varying from positive to negative, and from significant to no-significant relationships [20]. Even in the face of modernization, many people in developing countries still hold on to the view that the woman's place should be in the kitchen and therefore it is non-traditional for women to engage in paid jobs outside the home. The implication of this is that the rate at which women participate in the labour force is dictated by societal norms and stereotypes [12]. Therefore, in this paper we attempt to show that critically examining the factors influencing women's employment status and not just

employment itself, provides a potentially better method of understanding and measuring the impact of female employment on fertility preference. This has become pertinent because it has been argued that it is not labour force participation *per se* which affects fertility but a series of other variables associated with labour force participation such as age, longer period of schooling, age at first sex, religion, residence, ethnicity etc. [5]. Hence, this paper attempts to examine the relationship between factors influencing women's involvement in the labour force and fertility preferences with focus on the south – south region of Nigeria.

2: LITERATURE REVIEW

2.1: Overview

Labour market decisions and fertility are two important aspects of the female life cycle. Greater female participation in the labour force has often been suggested as a means of reducing fertility. The relationship between female labor force participation and fertility behavior has been confirmed in the industrialized countries, previous research focusing on less developed countries points to no such uniform pattern, [5].

There are divergent views on the likely effect of employment on fertility. However there appears to be a general consensus that women who are employed outside the home tend to have fewer children than those who have familial employment and work inside the home [12]. The findings clearly support the notion that working can have the effect of depressing fertility through the mechanism of competition for a woman's personal resources; especially time [12]. In the more industrialized societies, an inverse association between various measures of fertility among economically active and inactive women appears to have been more consistent than in the less developed societies. Women in these countries have fewer children and also delay the births

A. R. Miller, (2006) [3], observed that fertility delay has been increasing with female education, labour force participation and earnings in the US since the post- war baby boom. However, In the less developed societies, the nature of the relationship tends to vary with conditions and sectors of employment, [20].

A. Bashieri, J. Cleland, C. Bailey and J. Falkingham. (2009)[1], re-assessed women "work- fertility" linkages in Africa with recent evidence. Result revealed that regions where women had a favourable work opportunity in the modern sector during the 1990s were those regions that experienced a larger increase in use of contraception and delayed the age at first birth during the subsequent decade.

In contrast to the above findings, [9] found that women's employment is positively related with demanding another child. This study used the desire for another child as an instrumental variable for number of children/ fertility. The positive relationship was attributed to the increase of the economic potential was attributed to the increase of the economic potential of women in employment and thus influence their fertility intention. More so, the study identified residential setting as a key determinant of fertility preference.

However, it is important to note at this point that research findings from Nigeria and some other African countries indicate that the relationship between female work and fertility is far from being consistent; varying from positive [16] to negative and from significant to non- significant relationships [20]. For instance, [15] re-tested the relationship between female labour force participation and fertility in Nigeria. The aim of the study was to empirically investigate the existing relationship between female labour force participation and fertility in Nigeria. The results show that female labour participation leads to increase in fertility and that labour force participation of the women has little or no effect on fertility. This they attributed to probably the bounding of some work to child bearing and the communal living nature of Africans which makes it easy to raise children. This study aims to examine the relationship between women's employment status and fertility status, and preferences with a view to understanding the dynamics at the regional level.

3: Data and Methods

The 2013 National Demographic and Health Survey (NDHS) is a national sample survey collected on fertility levels, marriage, fertility preferences, awareness and the use of family planning methods among other vital information. The 2013 NDHS is nationally representative covering the entire population residing in non- institutional dwelling units in the country. The survey list of enumeration areas (EAs) as primary sampling frame prepared used in the 2006 population census of the Federal Republic of Nigeria [13]. The 2013 NDHS sample was selected using a stratified three-stage cluster design consisting of 904 clusters, 372 in urban areas and 532 in rural areas. All women aged 15-49 who were either permanent residents of the households in the 2013 NDHS sample or visitors present in the households on the night before the survey were eligible to be interviewed. A total of 38,948 respondents were administered structured questionnaire [17]. The study analysis focuses mainly on 6058 women in the south-south region of Nigeria.

3.1: Variables

Dependent Variable

The main variables in this analysis are the level of fertility defined by *the number of living children* which is categorized into 0 if none and 1 if they reported otherwise and *the fertility preference* among the married women which is categorized into 1: Have another/undecided and 2: No more/ sterilized/declared infecund. The analysis has been restricted to this category of women and not the singles because of the expectation that fertility- related policies are likely to be more meaningful to, and become more successful when adopted by women who are exposed to child bearing oriented sexual relations throughout their reproductive ages.

Independent Variables

The main predictor variables are the socio- demographic factors influencing women's employment status and they include; age, residence, education, religion, state of residence, marital status, number of co-wives, wealth status index, age at first sex, and living arrangement.

The intervening variables include:

.1**(i) Work Status and fertility**: This is defined as the act of engaging in a form of economic activity. It is categorized into; currently working, and not working.

(ii)Respondents Earnings: This elicits information on whether respondents received wages for the economic activity that they are involved with. Respondents earnings were classified into; not paid, cash only, and cash and in- kind/ in-kind only. The Dependent Variable

2. Current use of Contraceptive: This is defined as whether a woman was using a form of contraception method at the time of survey. It is categorized into; not using, and using.

RESULTS

Sample Characteristics and Description

The majority of women were aged 29 or younger (57%), lived in the rural areas (66%), and had secondary/higher education (69%). Most women were Christians (97%), in a monogamous union (82%), had first sexual debut at age 19 or younger (80%), and lived with their husbands (84%). Respondents were fairly evenly distributed the six states in the region; Bayelsa (20%), Delta (19%), Edo (18%), Akwa Ibom (16%), Rivers (15%), and Cross River (12%).

Majority of the respondents were employed (65%), earned cash only (78%), and were in the rich/richest socioeconomic bracket (63%). About 25% of respondents had one or two children, 18% had three or four, and 19% had 5 or more, while 38% do not have any. Results show that only 26% of the women who participated in the survey reported using contraceptive methods.

Multivariate Results

Woman's Employment Status vs. Number of Living Children

Women's employment status was measured using two variables namely; whether respondent was currently working or not working, and the mode of remuneration, in cash or in-kind or both. Table 2 presents logistic regression results in three models; one examined direct relationships between independent variables (background factors) and fertility, model 2 captures the effects of only the intervening variables, while model 3 shows the full model including both independent and intervening variables to tease out the most crucial effects in the model.

Results show that although education had a significant positive effect on number of living children in the reduced model 1, the effect was attenuated in the full model 3. Women with higher education were 0.34 times as likely as their counterpart with no education to have children. Likewise, women with secondary education were 0.37 times as likely as those with no education to have children. But in the full model, only employment status i.e. whether working or not working has significant positive effect on number of children. The odds that women who reported that they were employed would have more living children were over three times (3.6 times) that of their contemporaries that were unemployed.

Women's Employment Status vs, Fertility Preferences

Results in Table 3 show that effects of independent variables like, state of residence, level of education, wealth status, and number of co-wives that were significant in Model 1 (reduced model) were not completely eliminated in Model 3 (full

model). Findings in Model 3 show that women in Cross River, Akwa Ibom, Rivers, and Bayelsa were less to be favorable to having another child. Likewise, the odds that women will be favorable to another child decreases with level of education, wealth status, and number of co-wives.

The relationship between employment variables and preference for additional child was in the reverse direction of what was expected. The odds that working women would be favorable to another child was 4.9 times that of their counterparts not working, and the odds for working women who reported that they received both cash and kind remuneration was 1.7 times that of their counterpart who were not paid/received in-kind remuneration.

DISCUSSION & CONCLUSION

This paper examined the effects of employment based factors on fertility in conjunction with background factors. This is with a view to providing policy makers and programmers with additional information that will help to reduce current high fertility in the country, and thus better quality of life for the region and respective states in the long-run.

The results showed that policy makers and programmers need to consider variations and differences in state of residence, education, wealth status, and number of co-wives when designing tailor made programmes for these subgroups in the region. This finding is consistent with the report of [1]. The study contributes to the body of literature suggesting positive effect of work status on fertility [15, 16]. The work of [9] fully supports this finding. In her findings, women's employment is positively related to the demand of another child. This she opined is due to their economic potentials. The reasons for these results might be due to weakness of the two variables employed. Whether a women is working or not working excludes the type of work, working condition and salary, and the position she holds which may have considerable effects on the value placed on the job and thus, decision to have another child. A measure of employment status that captures position, years of experience, salary scale, may be able to do a better job of explaining the relationships between women's employment and fertility in the south-south region of Nigeria.

Table 1: Background Characteristics of the Respondent

Variable	Frequency (N=6058)	Percentage (%)	Variable	Frequency (N=6058)	Percentage (%)
Respondent Age			**Number of Co-Wives**		
15-19	1376	22.7	No other Wives	2696	82.3
20-24	1063	17.5	One or More	578	17.7
25-29	1027	17.0			
30-34	803	13.3	**Age at First Sex**		
35-39	737	12.2	15 or Younger	1130	30.5
40-44	531	8.8	16-19	1829	49.4
45-49	521	8.6	20 or Older	744	20.1
State of Residence			**Living Arrangement**		
Edo	1079	17.8	Wife living with husband	2773	84.2
Cross River	727	12.0	Wife living elsewhere	521	15.8
Akwa Ibom	979	16.2	**Employment Status**		
Rivers	919	15.2	No working	2131	35.4
Bayelsa	1224	20.2	Working	3896	64.6
Delta	1130	18.7			
Place of Residence			**Earnings from Employment**		
Rural	3996	66.0	Not paid and in kind only	517	13.1
Urban	2062	34.0	Cash only	3083	78.2
			Cash and in kind	343	8.7
Highest Education Level			**Contraceptive Status**		
No Education	336	5.5	Not using	4468	73.8
Primary	1549	25.6	Using	1590	26.2
Secondary	3483	57.5			
Higher	690	11.4			

Source: Author's computation.2016.

TABLE 2: LOGISTIC REGRESSION ANALYSIS OF NUMBER OF LIVING CHILDREN AND BACKGROUND FACTORS, EMPLOYMENT CHARACTERISTICS

Variables	Model 1 (Number of living Children and background factors)	Model 2 (Number of Living Children by Employment)	Model 3 (Number of Living Children by Employment by Background factors)
State of Residence			
Edo	1.00		1.00
Cross River	1.361		1.289
Akwa Ibom	1.679**		1.591
Rivers	1.147		1.126
Bayelsa	1.424		1.371
Delta	0.798		1.109
Highest Educational Level			
No Education	1.00		1.00
Primary	0.710		0.772
Secondary	0.373*		0.449
Higher	0.344*		0.349
Wealth Index			
Poorest-Poorer	1.00		1.00
Middle	1.609		2.108
Richer	0.951		1.123
Richest	0.714		0.834
Religion of Respondent			
Islam-Trad	1.00		1.00
Catholic	0.734		1.009
Other Christian	0.704		1.049
Age at first Sex			
15 or younger	1.00		1.00
16-19	0.807		0.784
20 or older	0.682		0.741
Place of Residence			
Rural	1.00		1.00
Urban	0.794		0.705
Number of Co-wives			
Number of other wives	1.00		1.00
One or more	0.092(1.592)		1.216
Living arrangement			
Wife living with husband	1.00		1.00
Wife living elsewhere	1.200		1.098
Earnings from Employment			
Not paid and in-kind only		1.00	1.00
Cash only		2.099***	0.835
Cash and in-kind		2.105***	0.893
Employment Status			
No working		1.00	1.00
Working		2.730***	3.592**
-2 Log likelihood	1226.319	4011.568	901.965
Nagelkerke R Square	0.093	0.026	0.094
Wald (Model Chi Square)	878.132	1129.489	723.917

Source: Authors computation, 2016.

Table 3: Logistic regression analysis of Fertility Preference and Background factors, Employment Characteristics

Variables	Model 1 (Fertility Preference by background factors)	Model 2 (Fertility Preference by Employment)	Model 3 (Fertility Preference by Employment by Background Factors)
State of Residence			
Edo	1.00		1.00
Cross River	0.571**		0.571**
Akwa Ibom	0.803		0.639*
Rivers	0.722		0.637
Bayelsa	0.217***		0.183***
Delta	0.694*		0.694
Highest Educational Level			
No Education	1.00		1.00
Primary	0.833		0.765
Secondary	0.385***		0.398***
Higher	0.496**		0.538*
Wealth Index			
Poorest-poorer	1.00		1.00
Middle	1.277		1.393
Richer	1.337		1.313
Richest	1.584*		1.624
Religion of Respondents			
Islam-Trad	1.00		1.00
Catholic	0.793		0.747
Other Christian	0.668		0.646
Age of First Sex			
15 or Younger	1.00		1.00
16-19	0.889		0.878
20 or older	0.768		0.799
Place of Residence			
Rural	1.00		1.00
Urban	0.880		0.853
Number of Co-Wives			
No other wives	1.00		1.00
One or more	1.483**		1.409
Living Arrangement			
Wife living with husband	1.00		1.00
Wife living elsewhere	1.118		1.133
Employment Status			
No Working		1.00	1.00
Working		2.981*	4.966*
Earnings from Employment			
Not paid and in-kind only		1.00	1.00
Cash only		1.300*	1.115
Cash and in-kind		2.231***	1.690
Wald (Model of Chi-square)	457.874	640.544	308.828
2 log likelihood	2104.431	4649.959	1780.294
Nagelkerke R Square	0.087	0.014	0.108

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Drivers and Challenges of Sustainable Development in Africa

Ayodeji O. Ojo

Dept. of Agricultural Economics,
University of Ibadan
Ibadan, Nigeria
Ayodejiojo7591@gmail.com

Isaac B. Oluwatayo

Dept. of Agricultural Economics and Animal Production
University of Limpopo
Sovenga, South Africa
isaacoluwatayo@yahoo.com

Abstract— **Sustainable development is at the core of global policy discourse. This is because it emphasises environmental, economic and social considerations in the quest of countries to improve wellbeing. This paper therefore examined the drivers and challenges of sustainable development in Africa. The tale of Africa in terms of sustainable development is mixed-good and bad. The continent is one of the fastest growing economies in the world. Africa has a favourable weather and large landmass for agriculture. The resource endowments especially in terms of human and natural resources are high. However, poverty, inequality, malnutrition, youth unemployment are the highest in Africa. Therefore, it follows that Africa is a land of superlatives. Africa's sustainable development is constrained by corruption, infrastructure deficits, insecurity and reliance on primary products. The study recommends increased and monitored investments in infrastructure. Existing efforts on reducing insurgency and corruption should be intensified. There is also the need to promote value addition in African trade.**

Keywords—infrastructure; inequality; policy; economic; primary products.

I. INTRODUCTION

Sustainable development is complex, multidimensional and dynamic [1]. Sustainable development refers to the utilization of resources in order to achieve improvements in the economic outcomes of components of an economy without jeopardising access of future generations [1]. This implies intergenerational equity must be applied in all economic considerations for growth to be sustainable. Sustainable development is the core of global economic policy. Therefore, the reason United Nations developed 14 goals tagged Sustainable Development Goals [2] is not far-fetched. Africa is the second most populous continent in the world with a young population of 1.2 billion people. This is because youths account for more than half of the African population. The favourable weather and large landmass make Africa the ideal destination for agricultural production. The continent has huge mineral deposits. Africa is no doubt a land with great potentials. However, poverty,

inequality and youth unemployment levels in Africa is worrisome. Africa is home to the majority of the people living below the USD1.20 poverty line globally. In fact, 300 million people in sub-Saharan Africa subsist on less than USD1.0 per day [3]. The task of reducing poverty, maternal and child mortality and malnutrition remain a moving target in Africa. Poverty has been falling in all regions except sub-Saharan Africa (SSA) since 1990 [3].

Earlier developmental efforts was concentrated on raising physical wealth and capital stock within an economy. Sustainable Development paradigm investigates the nature of development from the environmental, economic and social perspectives [1]. According to OECD (2001) sustainable development is the development path along which the maximisation of wellbeing of human wellbeing does not compromise perpetual use by future generations. Therefore, Sustainable Development is a paradigm shift from the economic growth hinged on depletion of resources and environmental degradation. There are several sustainable development strategies in Africa. The strategies include the National Environmental Policy in Ghana, National Development Vision (NDV) 2025 in Tanzania, National Strategy for Solid Waste Management in Egypt [4]. Collectively, 28 African countries under the umbrella of African Union established New Partnership for Africa's Development (NEPAD) and the Regional Economic Council (RECs) in the sub-region [4, 5]. incorporating the applicable criteria that follow.

There are arguments in literature on the appropriateness of a single definition for sustainable development [1]. A school of thought opine that three approaches to sustainable development exist-social, ecological and economic dimensions. This emphasises social justice, economic prosperity and environmental protection. Another option is a dualistic approach that is based on the relationship between nature and humanity [4]. Meanwhile, the most cited definition of Sustainable development is provided in the 1987 Brundtland Commission's Report [1]. It defines sustainable development

as the kind of development which satisfies the current needs without endangering the future generations to satisfy their own. Whether dualistic approach or the three pillars of sustainable development are taken into consideration, there is a common denominator. The central message of sustainable development is economic, environmental and social sustainability achievable through rational management of physical, natural and human capital [1].

II. ECONOMIC GROWTH AND STATE OF POVERTY IN AFRICA

Sustainable development focuses on inclusive or broad-based growth sustained over time. Economic growth is the expansion in the production and marketing of goods and services within a nation as a result of improvements in technology or management. Africa's Gross Domestic Product (GDP) has been growing in the last one decade. The GDP grew by 4.5 percent in 2015 and it is projected to increase to 5 percent in 2016 [6]. Africa has almost recovered fully from the 2008/2009 global economic crisis [6]. Africa's growth is driven by agriculture, extractive industries, construction and services and manufacturing (however little) [6]. The average real GDP rose in Africa rose by 3.3 percent from 2003-2004. Africa's GDP increased from USD 600 billion in 2000 to USD 2.2 trillion (adjusted for inflation) in 2013 [4]. This implies Africa's GDP has doubled in a decade. Meanwhile the demographic dividends of Africa have not been harnessed. The high population is a vital domestic market for finished goods, if industrialisation is aggressively pursued. Also, the African population is young as people less than 25 years account for more than 50 percent of the population [4]. However, the performance of Africa in human development indices is very disturbing. About 230 million Africans are chronically malnourished [7] and 40 percent of under 5 children have stunted physical and mental development [8]. Again, an estimated 380 million people live on less than USD 1.25 in sub-Saharan Africa [8]. Poverty is more severe in Africa than any other developing regions. The fact that economic growth, poverty, inequality and youth unemployment co-move in Africa is an economist's nightmare [8, 9]. Socioeconomic indicators like per capita income, life expectancy at birth, access to health care, access to education and access to sanitation facilities further reveal the high level of poverty in Africa [10].

[1] In terms of expenditure in the health sector, African countries spend an average of 5 percent of GDP which is less than USD 10 per person annually compared to the required USD 27 [11]. Again, more than 50 percent of African population do not have access to modern health care facilities while 40 percent do not have access to safe drinking water and sanitation [11]. In fact, per capita income of Africa is 50 percent less than that of the next poorest region (South Asia) [12]. Africa and developing Oceania were noted for lowest life expectancies at birth since 1950-1955 [13]. The average age length of life in developing Oceania has since increased to 64 years while it remained low at 54 years in Africa [14]. Africa has the lowest number of physician per 1000 people in the world estimated at 2.3. This is compared to 14.0 in the world,

11.0 in Eastern Mediterranean and 33.3 in Europe. The under 5 mortality per 1000 live births and maternal mortality are the highest in the world at 107 in 2011 and 620 in 2008 respectively [14].

III CONSTRAINTS TO SUSTAINABLE DEVELOPMENT IN AFRICA

Corruption: Corruption is difficult to define, estimate and curb. This is because most corrupt acts are carried out "off-book". Corruption has been defined as the application of position of trust or authority for financial gains or other personal rewards. In corrupt climes, the rule of law, due process and equity are relaxed. Corruption is a global disease with more influence in Africa [15]. This is because Africa faces developmental challenges and the resources meant to liberate her from sub-human living conditions are unrepentantly misappropriated. The fact that Africa trails other continents in terms of social indicators can be explained by the high level of corruption, impunity and poor governance [16]. Corruption has an inverse relationship with GDP growth and consequently sustainable development. In fact, a rise in corruption by 1 index point reduces GDP by 0.13 percentage points and GDP per capita by USD 425 [16]. About USD 300 billion is lost to corruption annually. This is 25 percent of Africa's GDP which is significantly higher than donor and foreign aid flows [16]. Africa accounts for 12 out of the last 25 countries in the 2014 Corruption Perception Index (CPI) (See Table 1) [17].

Table 1: Last 25 countries on CPI

Serial No	Name of Country	Rank	Score
1	Paraguay	150	24
2	Congo Republic	152	23
3	Tajikistan	152	23
4	Chad	154	22
5	Democratic Republic of Congo	154	22
6	Cambodia	156	21
7	Myanmar	156	21
8	Zimbabwe	156	21
9	Burundi	159	20
10	Syria	159	20
11	Angola	161	19
12	Guinea-Bissau	161	19
13	Haiti	161	19
14	Venezuela	161	19
15	Yemen	161	19
16	Eritrea	166	18
17	Libya	166	18

Serial No	Name of Country	Rank	Score
18	Uzbekistan	166	18
19	Turkmenistan	169	17
20	Iraq	170	16
21	South Sudan	171	15
22	Afghanistan	172	12
23	Sudan	173	11
24	Korea (North)	174	8
25	Somalia	174	8

Source: [17].

About 92 percent of sub-Saharan African countries scored below 50 in the CPI. This is compared to 84 percent in MENA (Middle East and North African countries), 16 in European Union and Western Europe, 95 percent in Eastern Europe and Central Asia, 64 percent in Asia pacific and 68 percent in the Americas. Therefore, it follows that Africa ranks high in the global corruption perception index. The high level of corruption is a consequence of weak judicial system, poor leadership, lack of accountability and transparency, weak governance institutions and general exclusion of the public from governance. Corruption induces inefficient allocation of the resources of state into white elephant projects with insignificant effects on the people. Therefore, sustainable development is very difficult in an unfair, corrupt and unequal environment.

Infrastructure Deficits: Sustainable development is undermined by severe infrastructure deficits that stare African development in the eye. Infrastructure deficits explain the existence of untapped productive potentials of Africa [18]. Africa requires an annual investment of USD 93 billion annually until 2020 [19]. Infrastructure is critical to significant improvements in competitiveness, domestic and international trade and global integration. Currently in Africa, less than 40 percent of the population has access to electricity, 33 percent of rural population has access to roads and only 5 percent of agricultural lands are irrigated [20]. Africa loses about 12.5 percent of production to power outages compared to 7 percent in South Asia which is the next worst case [21]. There are disparities in the allocation of resources to infrastructure among African countries. For instance, while Lesotho, Cape Verde and Angola invest over 8 percent of their GDP on Infrastructure, Nigeria and South Sudan spend below 1 percent. Infrastructure deficit remains an undermining factor in Africa's quest for poverty reduction and sustainable development. Africa trails other developing countries in paved road density, telecommunication, electricity and water and sanitation [7, 8]. However, infrastructure has been responsible for more than 50 percent of Africa's recent improved growth performance and thus additional growth prospects [19]. In cases where infrastructure is available, it is too costly for businesses to make profit and grow. This has grave consequence on Africa's sustainable development. The annual per capita consumption of electricity of 124 kw/hr in

Africa is just 10 percent of the consumption in other developing regions. The loss of sales as a result of power outages is as high as 20 percent in informal sectors that are unable to afford generating sets [22].

Insecurity: Africa's development is currently threatened by insecurity ranging from "commercial violence", civil wars, terrorism and kidnapping. Currently, Nigeria, Somalia, Darfur and Kenya face security issues. However, terrorism remains the most significant security problem in Africa. There is no universally accepted definition of terrorism but the most popular definition is contained in the UN General Assembly Resolution [23, 24]. It states that criminal acts intended or calculated to provoke a state of terror in the general public, a group of persons or particular person for political purposes is terrorism [25]. Security has been a primary concern and value for all humans and nations from time immemorial [26]. Africa's sustainable development is constrained by insecurity because only "conflict entrepreneurs" make profit in environments that are insecure. Insecurity is one of the constraints to improvements in economic activities in Africa. Terrorism has been increasing in the last few decades. Boko Haram and ISIS both account for 51 percent of all recorded global fatalities in 2014 [27]. Nigeria recorded the biggest increase in terrorist activity with 7,512 deaths in 2014. This is about 300 percent increase on the 2013 value. The economic cost of terrorism in 2014 was USD52.9 billion [27]. Insecurity in Africa is characterised by deaths, collateral tortures, injuries, rapes and maiming [26].Ten African countries experience the highest impact of terrorism globally. The countries are Nigeria (3rd), Libya (9th), Egypt (13th), Central African Republic (14th), South Sudan (15th), Sudan (16th), Kenya (18th), and Democratic Republic of Congo (19th) and Cameroon (20th) position (IEP, 2015). The dominant terrorist groups in Africa are Bokoharam, Sudan People's Liberation Movement in Opposition (SPLM-IO), Al-Shabaab and Fulani herdsmen [27]. Africa is at the receiving end of communal clashes, electoral violence, "commercial" violence induced by high youth unemployment among others. Apart from the destruction of lives and properties that come with insecurity, businesses do not grow in unsafe environments.

Imports: The current state of importation in Africa is high. The continent imports commodities she should be producing. How else can one explain the importation of food items in a continent that accounts for 25 percent of global arable land? In 2012, sub-Saharan African countries spent USD 37.7 billion on food imports with trade mis-pricing and other illicit outflows valued at USD 63 billion [8]. Africa exports are mainly primary products and the continent imports finished goods with the balance of trade tilting towards developed countries. This implies Africa benefit less from trade as a result of reliance on primary products.

IV PROSPECTS OF SUSTAINABLE DEVELOPMENT IN AFRICA

Sustainable development is possible in Africa. This is especially so for resource-rich countries. The constraints to

sustainable development have been discussed earlier. Africa has a young population that can provide manpower in her quest for sustainable development. Africa has a wealth of resources sufficient to drive the economic growth and social development. The resources include land, minerals, biological diversity, wildlife, forests, fisheries and water [8].

Agriculture is the mainstay of the African economy accounting for 65 percent of labour employment and 34 percent of the GDP. Oil, minerals and agricultural commodities account for 80 percent of Africa's export [28]. The bulk of food production in Africa is carried out by smallholder farmers with about 70 percent being women [29]. Irrigation alone could raise agricultural productivity by 50 percent. It is estimated that for every increment in farm yield there has been 7 percent poverty reduction in Africa [30]. Agriculture accounts for about 24 percent of Africa's annual growth. Therefore, investment in basic infrastructure (water, electricity, and road), farm-level infrastructure (irrigation, storage facilities) and access to credit and extension services and farmers' driven policies is the way to go. The World Bank estimates that agriculture and agribusiness together could attract a whopping USD 1 trillion presence in Africa's regional economy in the next 15 years [7]. This implies agricultural development is critical to the achievement of sustainable development.

Oil and gas and minerals can also position Africa strategically for sustainable development. This involves the promotion of value addition in the mineral and oil and gas sector. Africa accounts for approximately 30 percent of mineral resources but less than 7 percent of global metal production and fourth largest oil reserves in the world [31].

V   CONCLUSION

The paper examined the drivers and challenges of sustainable development in Africa. The resource endowments in Africa is high coupled with presence of domestic market. Generally, Africa has the potential of growing sustainably despite prevailing economic realities. Currently, the continent battles with poverty, infrastructure deficits, youth unemployment, corruption, insecurity, negative balance of trade among others. Therefore, agriculture, entrepreneurship and mineral resources remain important ingredients for sustainable development in Africa. The study suggest the following:

(1)   Government should increase and monitor investments in infrastructure in Africa

(2)   There is the need to adopt public-private partnerships for infrastructure provision in Africa.

(3)   The fight against corruption and terrorism should be intensified while existing anticorruption and antiterrorism laws are implemented.

(4)   Africa should promote value addition in exports.

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Assessment of Dissolved Oxygen in Sewage Containing Camphor

Tenebe Imokhai Theophilus[1], Emenike Chidozie PraiseGod[2], Egbe-Etu Emmanuel Etu*[3], Olufemi Olamijulo[6], Oluwatoba Emmanuel Osoba[7]

Department of Civil Engineering,
Covenant University, Canaanland, Ota
Ogun State, Nigeria.
egbe-etu.etu@stu.cu.edu.ng*

Richard Afolabi[4]
Department of Petroleum Engineering,
Covenant University, Canaanland, Ota
Ogun State, Nigeria.

Emmanuel Osawe[5]
Department of Civil Engineering,
Ambrose Alli University, Ekpoma
Edo State, Nigeria.

Abstract—**Camphor is widely used for odor eradication in eateries and homes. The health of the sewage tank is paramount to the environmental engineer as bacteria aid in sewage degradation. This research is geared towards investigating the effects of camphor on aerobic and anaerobic sewage degradation due to its constant usage.**

Ten 4 liters clean containers having 2 liters sewage where prepared. To one set of four 4 liters containers which was not covered (Aerobic), crushed camphor weighing (7.38g, 14.25g, 21.91g, and 25.75g) were added and the other four 4 liters containers which was not covered (Anaerobic), camphor in solid form (2No., 4No., 6No., and 7No.) with the same weight as described above to check the effects of surface area and two control containers having sewage alone. The pH, Total Dissolved Solid (TDS), Dissolved oxygen (DO) and temperature was observed and compared with a control solution which had no camphor. From the research, dissolved oxygen level showed significant decrease as the weight and number of camphor increased. This could imply that the presence of camphor creates a film over sewage thereby reducing oxygen exchange rate as it was observed during the experimental process. This finding could emerge as one of the reasons for septic tank failures which may arise as a result of increased organic loadings over time. However, the physio-chemical properties which include pH, TDS and temperature obtained were within range and suitable for microbial growth.

Keywords—Sewage, Degradation, Camphor, Bacteria, Aerobic

INTRODUCTION

Any place where surface water advances into groundwater, organic chemicals and pathogens conceivably can enter [1]. Groundwater quality includes; the physical, chemical and biological characteristics [2]. Inorganic chemicals that occur naturally in soils, sediments and rocks – for instance; dissolve mineral matter can also degrade the quality of groundwater. Groundwater can be degraded by the entry of contaminants.Groundwater contamination is an undesirable change in groundwater quality resulting from anthropogenic activities [2]. Contaminants permeate the soil until they reach the groundwater. Contaminants can enter aquifers by several means which incorporates; infiltration of surface water through soil, direct flow through improperly built wells that become conduits for contamination, accidental spills, landfills, surface waste ponds, underground storage tanks, failed septic tanks, acid mine drainage, land application of waste and pesticides and injection wells [8][1][2]. A septic tank is a highly efficient, independent underground wastewater treatment system. A septic system is a sewage treatment, transfer and disposal system buried in the ground [3]. It comprises of two fundamental parts; a septic tank and a drain-field. The septic tank is a water-tight box, typically made of concrete with an inlet and outlet pipe. The drain-field is not of utmost importance to us during this research but it helps in the distribution of the wastewater to the soil, waste in form of solids and liquids flow from three layers inside the tank. The first layer (scum layer) consists of solids lighter than water and they float to the top while the second layer (sludge layer) which consists of solid sediments which are heavier than water, settle at the bottom of the tank [4]. Sludge is a layer composed of different sewage materials that are not homogenous [5]. The contaminants found in wastewater includes; phosphorus, nitrates, disease-causing bacteria and viruses, metals, and solvents [7][6][3]. The layers of sludge and scum are acted upon by micro-organisms (bacteria) which helps to break the solids down into smaller particles. Studies have shown that micro-organisms require oxygen to breakdown organic matter into smaller particles that would not be harmful to the environment. Improperly functioning and overloaded septic systems are major sources of pollution.However, with sufficient amount of oxygen, bacteria can be strengthened to break down this harmful pollutants. On the other hand, failing septic systems leak harmful pollutants like bacteria (micro-organisms), excess nutrients (Nitrates and Phosphorus) into the environment [3] as well as other contaminant found therein. The organisms and chemicals found in untreated septic waste can be dangerous and camphor may be one of them. Camphor is a volatile inorganic crystalline substance that is used in the production of explosives and pest deterrent [11].With a

chemical formula of $C_{10}H_{16}O$, it is soluble in water, acetone, acetic acid, diethyl ether, chloroform and ethanol. These chemicals may migrate through water and affect the groundwater if failure occurs in the septic tank system as poor degradation may lead to shock loading [9][10][3]. Therefore, this research is carried out to ascertain camphor effect on depletion of dissolve oxygen (DO) as it is consistently used in toilets. This is essential as the availability of microbes could also be predicted.

MATERIALS AND METHODS

A. Materials

Sewage for analysis was collected from Covenant University, Ota sewage treatment plant for laboratory analysis. Ten 4 liters containers having 2 liters sewage where prepared. To one set of Four liters containers which was not covered (Aerobic), crushed camphor weighing (7.38g, 14.25g, 21.91g and 25.75g) were added and the other Four 4 liters containers which was properly covered (Anaerobic), camphor in solid form (2No., 4No., 6No. and 7No.) with the same weight as described above to check the effects of surface area and two control containers having sewage alone. The sewage was collected using Two 25 liter containers and where properly shook and poured into the 4 liters containers. The following parameters were checked immediately the sample was poured into the containers and the camphor was added to it; pH, Temperature, Total dissolve solids (TDS) and Dissolve oxygen (DO).The analysis was done for 5 weeks (once a week). The ambient temperature was recorded for each day.

B. Method of Analysis

All the sewage samples collected for laboratory analysis were analyzed immediately they were brought into the laboratory. All the analysis were carried out using the Hanna Instrument Edge Multimeter.

C. Laboratory Determination

The pH, Temperature, Total dissolve solids (TDS) and Dissolve oxygen (DO) were determined using the Hanna Instrument Edge Multimeter.

Procedures
Temperature/pH
The sampling container was washed using a non-sulphate containing detergent (Ariel) and dried. The sewage samples were brought into the laboratory using a 25 litres container that was also washed using a non-sulphate containing detergent. The samples were properly shook in the container before pouring them into the 4 litres sampling container. The sampling containers were filled to the 2 litres mark. The pH/Temperature probe was properly cleaned and inserted into the Hanna instrument edge multimeter. The multimeter was switched on and allowed to boot. The probe was then calibrated using the standard buffer solution for pH (Solution 7.0). The sewage sample was stirred properly for homogeneity. The probe was then deep into the sewage sample and the readings for the pH at a particular temperature was recorded. The probe was cleaned after use.

Total Dissolve Solids (TDS)/Temperature
The sampling container was washed using a non-sulphate containing detergent (Ariel) and dried. The sewage samples were brought into the laboratory using a 25 litres container that was also washed using a non-sulphate containing detergent. The samples were properly shook in the container before pouring them into the 4 litres sampling container. The sampling containers were filled to the 2 litres mark. The total dissolve solids (TDS) probe was properly cleaned and inserted into the Hanna instrument edge multimeter. The multimeter was switched on and allowed to boot. The probe was then calibrated using the standard solution for total dissolve solids (HI7031 & HI8031). The sewage sample was stirred properly for homogeneity. The probe was then deep into the sewage sample and the readings for TDS at a particular temperature was recorded. The probe was cleaned after use. The unit for TDS is milligram per litre (mg/l).

Dissolve Oxygen (DO)/Temperature
The sampling container was washed using a non-sulphate containing detergent (Ariel) and dried. The sewage samples were brought into the laboratory using a 25 litres container that was also washed using a non-sulphate containing detergent. The samples were properly shook in the container before pouring them into the 4 litres sampling container. The sampling containers were filled to the 2 litres mark. The dissolve oxygen (DO) probe was properly cleaned and inserted into the Hanna instrument edge multimeter. The multimeter was switched on and allowed to boot. The probe was then calibrated using the standard solution for dissolve oxygen (HI7041 Electrolyte solution). The sewage sample was stirred properly for homogeneity. The probe was then deep into the sewage sample and the readings for DO at a particular temperature was recorded. The probe was cleaned after use. The unit for DO is parts per million (ppm).

RESULTS AND DISCUSSION

In Table 1 and Fig. 1, the results for the aerobic sample containing crushed camphor are reported for week 1. The results obtained for the pH, shows that there was a decrease in the pH value for the aerobic sewage sample as compared with that of control. Thus, the sewage sample is alkaline which is as a result of the camphor mixing with the sewage. The result also shows a varying temperature range of $26.9^{o}C$ to $27.7^{o}C$. From previous studies, it has been observed that a good septic tank has to have a pH value of 6 to 7.5 which is the best range for microbial growth and a temperature value above $4.44^{o}C$ for the aerobic bacteria to perform properly. Now looking at the data obtained from the results, only the temperature values are within the stipulated scale. The results also shows the amount of total dissolved solids (TDS) present in the sewage samples to be on the increase (Sample 3 & 4) comparing it with the control which implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. This shows that the bacteria is

using the oxygen present in the sewage to breakdown the organic matter.

In Table 2 and Fig. 2, the results of the anaerobic sample containing camphor in solid form are reported for week 1. The results obtained for the pH, shows that there was an increase in the pH level for sample 1, 2 & 4 and a decrease in the pH level for sample 3 with respect to control. The pH results for the anaerobic sample falls under the neutral range which is the best range for microbial growth in the septic tank. The temperature is between 27.7^{o}C to 27.9^{o}C which is also good for the microbes found in the septic tank. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to be on the increase (Sample 4) comparing it with the control which implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. This shows that the anaerobic bacteria is using the available oxygen present in the sampling container to breakdown the organic matter.

In Table 3 and Fig. 3, the results for the aerobic sample containing crushed camphor are reported for week 2. The results obtained for the pH, shows that there was an increase (sample 1) and a decrease (sample 2, 3 & 4) in the pH value for the aerobic sewage sample as compared with that of control. Thus, the sewage sample was in the alkaline range (sample 1 & 2) and the neutral range (sample 3 & 4). The result also shows a varying temperature range of 27.1^{o}C to 28.1^{o}C. From previous studies, it has been observed that a good septic tank has to have a pH value of 6 to 7.5 which is the best range for microbial growth and a temperature value above 4.44^{o}C for the aerobic bacteria to perform properly. Now looking at the results in the table, only sample 3 & 4 are within the stipulated scale for pH and temperature. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to be on the increase (Sample 1) comparing it with the control which implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. This shows that the bacteria is using the oxygen present in the sewage to breakdown the organic matter.

In Table 4 and Fig. 4, the results of the anaerobic sample containing camphor in solid form are reported for week 2. The results obtained for the pH, shows that there was an increase in the pH level for sample 1 and a decrease in the pH level for sample 2, 3 & 4 with respect to control. The pH results for the anaerobic sample falls under the neutral range which is the best range for microbial growth in the septic tank (except sample 1). The temperature is between 26.8^{o}C to 27.1^{o}C which is also good for the microbes found in the septic tank. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to be the same with control (except sample 4). This implies that the bacteria present is degrading the sewage or is dying off. The result also shows a decrease in the level of dissolved oxygen present in the sewage sample comparing it with the control. This shows that the anaerobic bacteria is using the available oxygen

present in the sampling container to breakdown the organic matter.

In Table 5 and Fig. 5, the results for the aerobic sample containing crushed camphor are reported for week 3. The results obtained for the pH, shows that there was an increase (sample 1) and a decrease (sample 2, 3 & 4) in the pH value for the aerobic sewage sample as compared with that of control. Thus, the sewage sample was in the alkaline range (sample 1 & 2)and the neutral range (sample 3 & 4). The result also shows a varying temperature range of 25.5^{o}C to 26.2^{o}C. From previous studies, it has been observed that a good septic tank has to have a pH value of 6 to 7.5 which is the best range for microbial growth and a temperature value above 4.44^{o}C for the aerobic bacteria to perform properly. Now looking at the results in the table, only sample 3 & 4 are within the stipulated scale for pH and temperature. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to be on the increase (Sample 1) comparing it with the control which implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. This shows that the bacteria is using the oxygen present in the sewage to breakdown the organic matter.

In Table 6 and Fig. 6, the results of the anaerobic sample containing camphor in solid form are reported for week 3. The results obtained for the pH, shows that there was an increase in the pH level for sample 1 and a decrease in the pH level for sample 2, 3 & 4 with respect to control. The pH results for the anaerobic sample falls under the neutral range which is the best range for microbial growth in the septic tank (except sample 1). The temperature is between 27.2^{o}C to 27.4^{o}C which is also good for the microbes found in the septic tank. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to be the same with control (except sample 4). This implies that the bacteria present is degrading the sewage or is dying off. The result also shows a decrease in the level of dissolved oxygen present in the sewage sample comparing it with the control. This shows that the anaerobic bacteria is using up the available oxygen present in the sampling container to breakdown the organic matter. Although, when the result is compared with the control, it is seen that camphor has an effect on dissolve oxygen.

In Table 7 and Fig. 7, the results for the aerobic sample containing crushed camphor are reported for week 4. The results obtained for the pH, shows that there was an increase in the pH value for the aerobic sewage sample as compared with that of control. Thus, the sewage sample was in the alkaline range. The result also shows a varying temperature range of 25.9^{o}C to 26.6^{o}C. From previous studies, it has been observed that a good septic tank has to have a pH value of 6 to 7.5 which is the best range for microbial growth and a temperature value above 4.44^{o}C for the aerobic bacteria to perform properly. Now looking at the results in the table, the pH requirements for the samples were not satisfied but the temperature requirements were satisfied. The results also

shows the amount of total dissolved solids (TDS) present in the sewage sample to be on the increase with respect to the control which implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. Although, the control has a high value for dissolve oxygen which may imply that the bacteria is inactive therefore the increase in dissolve oxygen.

In Table 8 and Fig. 8, the results of the anaerobic sample containing camphor in solid form are reported for week 4. The results obtained for the pH, shows that there was an increase in the pH level for all the samples. The pH results for the anaerobic sample falls under the alkaline range which is not good for bacteria growth. The temperature remains constant for all the samples at 27.9^{o}C which is also good for the microbes found in the septic tank. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to beon the increase (sample 1, 3 & 4) with respect to control. This implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen present in the sewage sample comparing it with the control. This shows that the anaerobic bacteria is using up the available oxygen present in the sampling container to breakdown the organic matter. Although, when the result is compared with the control, it is seen that camphor has an effect on dissolve oxygen as the control has a very high DO value.

In Table 9 and Fig. 9, the results for the aerobic sample containing crushed camphor are reported for week 5. The results obtained for the pH, shows that there was an increase in the pH value for the aerobic sewage sample as compared with that of control. Thus, the sewage sample was in the alkaline range. The result also shows a varying temperature range of 25.5^{o}C to 25.9^{o}C. From previous studies, it has been observed that a good septic tank has to have a pH value of 6 to 7.5 which is the best range for microbial growth and a temperature value above 4.44^{o}C for the aerobic bacteria to perform properly. Now looking at the results in the table, the pH requirements for the samples were not satisfied but the temperature requirements were satisfied. The results also shows the amount of total dissolved solids (TDS) present in the sewage sample to be on the increase with respect to the control which implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. Although, the control has a high value for dissolve oxygen which may imply that the bacteria is inactive therefore the increase in dissolve oxygen.

In Table 10 and Fig. 10, the results of the anaerobic sample containing camphor in solid form are reported for week 5. The results obtained for the pH, shows that there was an increase in the pH level for all the samples. The pH results for the anaerobic sample falls under the neutral range (except sample 4) which is good for bacteria growth. The temperature ranges from 27.3^{o}C to 27.6^{o}C which is also good for the microbes found in the septic tank. The results also shows the amount of total dissolved solids (TDS) present in the sewage

sample to beon the increase (sample 3 & 4) with respect to control. This implies that the bacteria present is degrading the sewage. The result also shows a decrease in the level of dissolved oxygen (DO) present in the sewage sample comparing it with the control. This shows that the anaerobic bacteria is using up the available oxygen present in the sampling container to breakdown the organic matter. Although, sample 1 has a high DO value as compared with other samples which implies that the micro-organisms are inactive likewise sample 5 (control). It can be deduced that camphor has an effect on dissolve oxygen as the control has a very high DO value.

Table 1. Results obtained from the Aerobic Sample Containing Crushed Camphor in Week 1

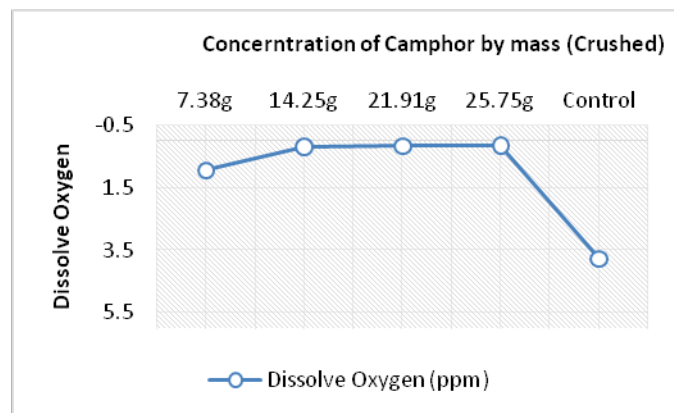| S/N	Wt. of crushed Camphor (in grams, g)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S. 1	7.38	7.92	27.7	23.0	1.55
S. 2	14.25	7.91	27.0	23.0	1.33
S. 3	21.91	7.79	27.1	24.0	0.46
S. 4	25.75	7.78	26.9	24.0	0.40
S. 5	Control	7.91	27.2	23.0	1.70
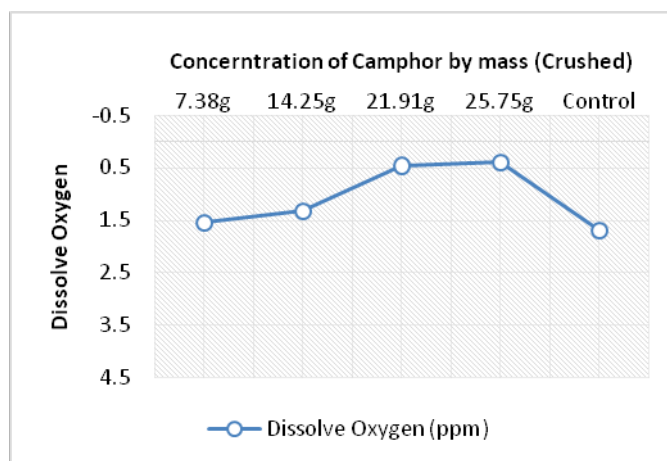
Fig. 1. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Aerobic sample in Week 1

Table 2. Results obtained from the Anaerobic Sample Containing Camphor in Solid form in Week 1

S/N	No. of Camphor (Solid form)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S. 1	2	7.55	27.9	25.0	0.11
S. 2	4	7.49	27.8	24.0	0.14
S. 3	6	7.41	27.7	25.0	0.12
S. 4	7	7.51	27.9	27.0	0.08
S. 5	Control	7.48	28.0	25.0	0.20
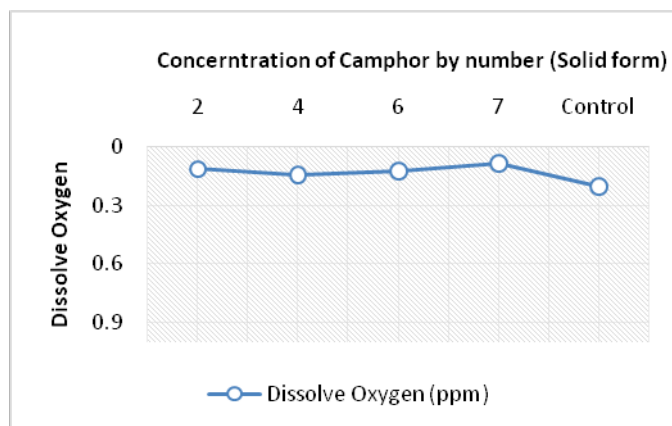
Fig. 2. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Anaerobic sample in Week 1
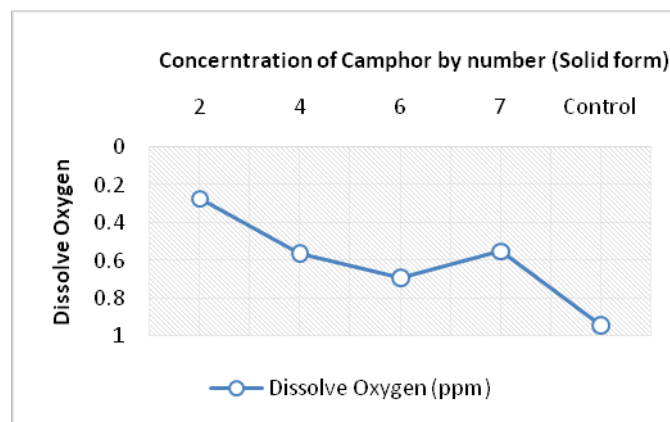
Fig. 4. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Anaerobic sample in Week 2

Table 3. Results obtained from the Aerobic Sample Containing Crushed Camphor in Week 2

S/N	Wt. of crushed Camphor (in grams, g)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S. 1	7.38	7.77	28.1	22.0	0.58
S. 2	14.25	7.70	27.9	20.0	0.67
S. 3	21.91	7.60	27.2	21.0	0.71
S. 4	25.75	7.59	27.1	20.0	0.67
S. 5	Control	7.74	26.6	21.0	0.92

Table 5. Results obtained from the Aerobic Sample Containing Crushed Camphor in Week 3

S/N	Wt. of crushed Camphor (in grams, g)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S. 1	7.38	7.77	25.5	22.0	0.22
S. 2	14.25	7.70	25.6	20.0	0.17
S. 3	21.91	7.60	25.9	21.0	0.16
S. 4	25.75	7.59	26.2	20.0	0.14
S. 5	Control	7.74	26.3	21.0	0.44
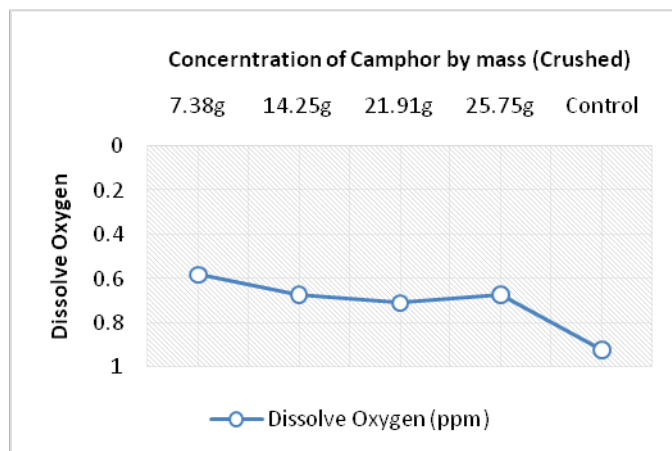
Fig. 3. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Aerobic sample in Week

Fig. 5. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Aerobic samples in Week 3

Table 4. Results obtained from the Anaerobic Sample Containing Camphor in Solid form in Week 2

S/N	No. of Camphor (Solid form)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S.1	2	7.84	27.1	25.0	0.27
S.2	4	7.60	26.8	25.0	0.56
S.3	6	7.55	26.9	25.0	0.69
S.4	7	7.54	27.0	24.0	0.55
S.5	Control	7.82	27.3	25.0	0.94

Table 6. Results obtained from the Anaerobic Sample Containing Camphor in Solid form in Week 3

S/N	No. of Camphor (Solid form)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S.1	2	7.84	27.2	25.0	0.68
S.2	4	7.60	27.2	25.0	0.65
S.3	6	7.55	27.3	25.0	0.64
S.4	7	7.54	27.4	24.0	0.56
S.5	Control	7.82	27.6	25.0	1.04
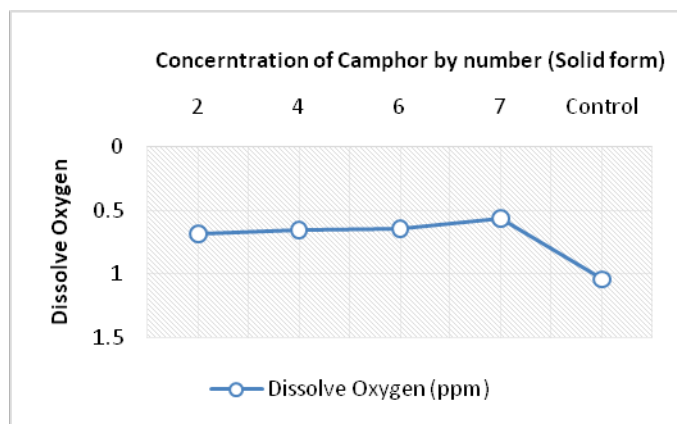
Fig. 6. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Anaerobic sample in Week 3

Fig. 8. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Anaerobic samples in Week 4

Table 7. Results obtained from the Aerobic Sample Containing Crushed Camphor in Week 4

S/N	Wt. of crushed Camphor (in grams, g)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S.1	7.38	7.68	26.6	24.0	0.50
S.2	14.25	7.73	25.9	21.0	0.46
S.3	21.91	7.73	26.1	21.0	0.44
S.4	25.75	7.74	26.2	21.0	0.29
S.5	Control	7.35	26.3	18.0	4.45

Table 9. Results obtained from the Aerobic Sample Containing Crushed Camphor in Week 5

S/N	Wt. of crushed Camphor (in grams, g)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S.1	7.38	7.51	25.9	23.0	0.94
S.2	14.25	7.52	25.5	22.0	0.18
S.3	21.91	7.64	25.8	22.0	0.17
S.4	25.75	7.62	25.9	22.0	0.14
S.5	Control	7.46	26.0	20.0	3.78

Fig. 9. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Aerobic samples in Week 5
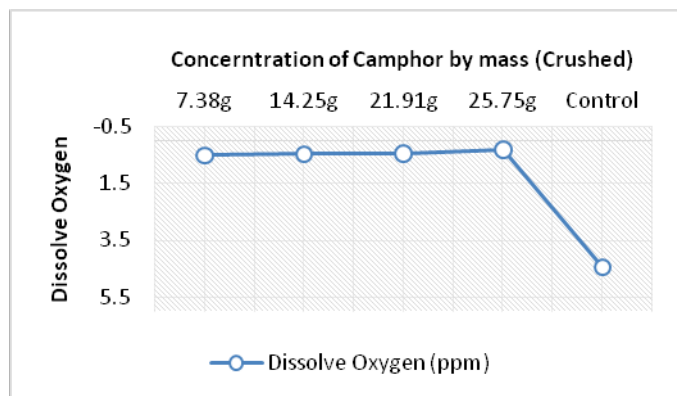
Fig. 7. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Aerobic samples in Week 4

Table 8. Results obtained from the Anaerobic Sample Containing Camphor in Solid form in Week 4

S/N	No. of Camphor (Solid form)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S.1	2	7.32	27.9	19.0	0.80
S.2	4	7.12	27.9	18.0	0.77
S.3	6	7.36	27.9	21.0	0.62
S.4	7	7.70	27.9	23.0	0.54
S.5	Control	6.77	28.3	18.0	5.99

Table 10. Results obtained from the Anaerobic Sample Containing Camphor in Solid form in Week 5

S/N	No. of Camphor (Solid form)	pH	Temp. (^{o}C)	TDS (mg/l)	DO (ppm)
S. 1	2	6.56	27.3	16.0	3.05
S. 2	4	7.22	27.3	16.0	0.86
S. 3	6	7.43	27.5	20.0	0.48
S. 4	7	7.51	27.6	23.0	0.25
S. 5	Control	6.51	28.0	19.0	4.35

Fig. 10. Results of Dissolve Oxygen (ppm) against Concentration of Camphor for Anaerobic samples in Week 5

CONCLUSION

An assessment of the dissolved Oxygen (DO) and some relevant physio-chemical parameter in sewage further polluted with camphor under aerobic and anaerobic conditions have been studied. The results showed that dissolved oxygen for both aerobic and anaerobic sample decreased from 0.78 ppm to 0.31 ppm and 1.07 ppm to 0.34 ppm respectively. This reduction was as a result of thick films of black substance produced during interaction of sewage and camphor thereby preventing the adequate exchange of oxygen between the air and water interface. Although in a typical septic tank system, the bacteria activity requires minimum DO for septic tank operation. However, this study has shown that when such chemicals are present in large quantities, there is a propensity of gulping the little or needed DO for anaerobic digestion. Obviously, this is not good as it could possibly lead to the die-off of those bacteria thereby resulting in less organic matter being degraded and increase in shock loading in the septic tank system. And as such, this could lead to failures in septic tank. Therefore, constant flushing of toilet system to increase dilution in the septic tank chamber may not be a sustainable approach. Alternatively, it is suggested that people need to be enlightened of the possible effects of the use of camphor as odor repellent while unconsciously subjecting the septic tank to failures. Furthermore, manufacturers are advised to put the health of septic tank system into perspective while producing these chemicals by producing chemicals with little or no interference to sewage degradation.

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Assessing the Adequacy of Public Housing Infrastructures in Lagos, Nigeria.

OGUNSANYA OYETORO. O
Dept. of Architecture
Covenant university, canaan land,
Ota, Ogun state, Nigeria.
oyelaitan@yahoo.com

FANU MAYOWA. O
Dept. of Architecture
Covenant university, canaan land,

Ota, Ogun state, Nigeria.
oyelaitan@yahoo.com

Dr. OLADIPO DARE-ABEL.
Dept. of Architecture
Covenant university, canaan land,
Ota, Ogun state, Nigeria.
oyelaitan@yahoo.com

Abstract— the provision of infrastructural amenities is an important ingredient in housing development and formal housing supply, thus adequate provision of housing facilities are regarded as critical facilitator for economic development and key to improving the quality of life in any community irrespective of size. While there is a plurality of housing issues, the problem of infrastructure in housing remains prominent especially when mass housing schemes are considered. The failure of some of these housing schemes has revealed that housing provision goes beyond the ordinary provision of shelter for needs of man. Hence, the need to approach the situation in a pragmatic way, with a focus on the infrastructural provision – an important aspect of housing that is often left to fate – in most common housing schemes in developing countries – like Nigeria. The aim of this study is to assess the adequacy of infrastructure provision in housing projects. This study adopts mixed method approach. A structured questionnaire was developed to harvest data from residents, developers and interested owners. Interviews were conducted with (e.g. 5) staff of development companies, professionals of the built environment and executives of community development association. The study underscores the need to consider relevant infrastructures for housing improvement and development in Nigeria with a view to ascertaining the sustainability of the housing environment and from this a conclusion would be drawn and recommendations in generating sustainable housing provision.

Keywords—**public housing, infrastructural amenities, sustainability of housing environment, economic development facilitator.**

I.   INTRODUCTION

Infrastructure generally refers to the systems and fundamental facilities required to serve an area, city or country. They are typically roads, water supply, electricity, sewers, etc. that enable, sustain or enhance the standard of living of people; it is the enterprise or the products, services and facilities necessary for the economy to function properly (Sullivan and Sheffrin, 2003). Providing infrastructural amenities for housing means birthing the first basic amenities and services required by every household in place for several activities and pursuit. However, this happen to be one of the most intricate problems cities face in developing countries such as Nigeria as they are not able to provide these infrastructures for the teeming urban population. Infrastructural development in many nations is one of the required bases of evaluating the accomplishments of the government and it is also the basis of the establishment of good governing administration. It proves that whenever people are denied of fundamental infrastructure, the outcome is impoverishment leading to urban communities with the greatest number of poor individuals. Housing provision and housing infrastructure are intertwined. Without infrastructures, housing cannot be sustainable and hence should be treated integrally (Otegbulu and Adewumi, 2008). An ideal urban neighbourhood should be provided with good roads, drainage networks, electricity and portable water supply, good waste management system and security. The condition of these services in Nigeria urban neighbourhood contradicts the principle of sustainability in urban housing. A sustainable housing development would not only have environment friendly and energy efficient buildings, it would also have access to employment, schools, shops, places of entertainment, primary health care, and it would be accessible by public transport.(Kolawole. O, 2014). Subsequently, the supply of adequate Infrastructural amenities is a significant part in housing provision particularly in developing nations like Nigeria. This emerges a need for a research into the condition of infrastructural supply in mass and public housing developments revealing the current situation of infrastructural decline, its causalities and the establishment of probable sustainable solutions to attain the right standard of living for people. One significant part of urban housing problem is the poor condition of the provided infrastructures (Ajanlekoko, 2001). Findings on housing supply tend to concentrate more on issues of policy, fund, and financial aspects of housing procurement issues, for example, infrastructures are dealt with en-passant. However as the interest for quality housing

increased, researchers are looking out for approaches to present housing from a comprehensive point of view. The role of infrastructures in housing provision cannot be overemphasized what's more, ought not to be dealt with as a very late thought. The study goes for assessing housing infrastructural provision in a selected housing estate as a case study with a perspective to give policy makers and other stakeholders the required information needed for achieving sustainable development in the housing sector and environment.

I. RESEARCH QUESTIONS.

1. What are the effects infrastructural developments have on the provision of housing?
2. What is the relationship between infrastructural development and provision of housing?
3. What is the level of Nigeria government's commitment towards infrastructural development in the country?

II. OBJECTIVE OF STUDY

The main objectives of this paper include:

i. To assess the adequacy of public housing infrastructure in a selected public housing estate in Lagos state, Nigeria.
ii. To evaluate the level of occupants satisfaction with the infrastructural amenities available.
iii. To evaluate the maintenance services rendered by the management authorities in relation to the occupants level of satisfaction.

II. REVIEW OF LITERATURE

Infrastructure development in Nigeria

i. Pre-colonial Nigeria

The Nigerian government started the provision of infrastructural amenities in 1917 when there was a township ordinance promulgated by the colonial government then. The ordinance divided Nigeria into 3 distinct classes namely: first class- harbouring the whites, rich citizens and their workers and having a heavy concentration of infrastructural amenities i.e. Lagos. Second class and third class- harbouring the middle and low income earners with little or no infrastructure available. This hierarchical class continued until 1952 when Local government councils were established to extend infrastructural facilities to rural areas. But this wasn't very effective at that time because there were little or no allocation of funds to local government for provision and maintenance of these familiarities. This remained evident in all development plans initiated since 1960.Udoka, I. (2013).

ii. Present day Nigeria

In Nigeria today, the provision of infrastructure or social services such as feeder roads, electricity grids, water supply, communication supply, good drainage and sewerage disposal are thought of by the federal, state and local government respectively to be very essential and have tried in several ways to tackle all problems relating to infrastructural amenities provision. In recent times, series of construction projects have been embarked on by concerned governing bodies to combat housing infrastructure problems which are still far from being solved and this can be said to be as a result of ineffective strategies that have been implemented. (Kolawole, M. 2014)

INFRASTRUCTURAL PROVISION AND ITS IMPACTS IN HOUSING SUPPLY

Generally, the state of infrastructure facilities in housing is bad especially in public housing provided by the government (federal or state). The major issues affecting these projects are the fact that planning and provision of infrastructure are not thought to be important and left to the hands to the occupants or community to provide for them.

For the sake of this study, we would be considering infrastructural amenities that are required to support a housing scheme or project in a community. Infrastructure in this study is taken to be the engine needed to drive housing provisions put in place by the government, public or private involvement and expenditure aimed at improving the effectiveness of a housing environment.
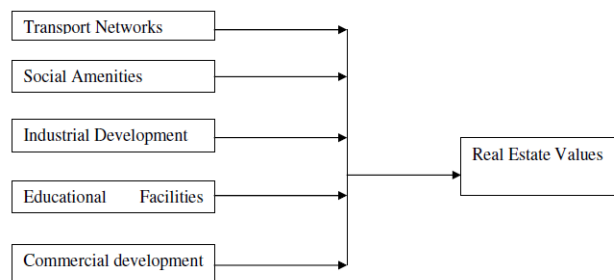
III. BRIEF OF THE STUDY AREA

The study area of this paper is the Alimosho Local Government areas in Lagos State, Nigeria. It happens to be the largest of all 20 local government areas present in Lagos State occupying 1,288,714 inhabitants (Official Census, 2006) although the Lagos state government disputes this and claims that it occupies more than 2 million residents who then divided it into several Local Community Development Areas, (LCDA). Alimosho which was created in 1945 has its geographical coordinates at 6° 36' 39" North, 3° 17' 46" East. The climate of Alimosho Local Government area is a characterized by two wind masses which includes the Southwest monsoon wind and the Northeast trade wind. They are responsible for the moisture breathing air caused by the April to October rainfall and the cold and dry Sahara wind caused by the harmattan season respectively. The Alimosho Local Government Area has a number of public housing estate provided to house the growing population of the area. Some of these housing estates were studied for the adequacy of their infrastructural amenities. These estates include:

i. OJOKORO LOW COW COST HOUSING ESTATE (LSDPC), Meiran, Alagbado, Lagos

3.2 DATA ANALYSIS
POPULATION AND SAMPLE SIZE

The study area population is approximately 3000 people based on a sampling technique using an estimate of 3 people in 160 flats in the housing estate. The target population was 150 being homogeneous consisting of respondents that are knowledgeable and can provide the researcher with adequate and appropriate in-depth information. The sample size is 20% of the target population since it is representative of the entire population.

The study dealt with a sample of 120 respondents from the Low cost housing estate, Ojokoro. Out of 150 questionnaires, 120 were responded to. This is a valid response to data analysis

Table 3.1: Response Rate

Response	Frequency	Percentage
Response	120 residents	12.5%
Non response	840 residents	87.5%
Total	960 residents	100%

INFRASTRUCTURE DEVELOPMENT
94% of the residents of the estate agreed and 6% disagreed with the research question that infrastructural developments have an effect on the provision of public housing in Lagos, Nigeria. This shows that majority of respondents confirm that the infrastructure developments is inadequate in relations to public housing provision in Lagos Nigeria.

Table 3.2: Infrastructure Development

	Frequency	Percentage
Yes	118	98.3%
No	2	1.66%
Total	120	100%

SURVEY OF INFRASTRUCTURAL FACILITIES AND SERVICES
For this study, the following key infrastructures (availability or lack of them) would be considered to have a direct impact on the quality of housing environment in Lagos, Nigeria. These facilities are important for improving the quality and standard of living of the occupants of these public housing estates. During the course of this study, it was made known that all the areas are provided with necessary infrastructural facilities, although these facilities in some cases are not adequate for the public housing dwellers as at the time of the survey. The following facilities were surveyed in the visited public housing estates:

a. ROAD TRANSPORTATION SYSTEM.
Good transport systems are a vital part of a safe and developed housing environment. From a general viewpoint, good public transport is regularly the main method for transport for poor and middle income earners. Without it, it would be difficult to enhance their employment opportunities as their jobs would have to be within walking distances from their homes. It additionally gives them better access to other important facilities needed by them such as quality education, recreation and also health care services. For individuals with handicaps, senior citizens and youngsters public transport is likewise their

primary method of mobility. (Kyte .R . (2011). The field study on these estates show that the major access roads leading to the estates are in average conditions while the feeder roads to individual houses in the estate are in very bad conditions, but is was noticed that due to the government policy that mandates all local government to grade their roads, some improvements are being put to place to maintain the roads.

b. ELECTRICITY GRID SUPPLY AND DISTRIBUTION.
Electricity is a very important aspect to the development of urban areas in developing countries like Nigeria (Kaseke & Hosking, 2013). Nigeria which is one of the most populous countries in the world unfortunately has one of the lowest net electricity supply rates in the world. PHCN being the organization responsible for the supply of power in Nigeria puts all their effort in the adequate provision of electricity to service all of Nigeria. The field study carried out on the estates show that there has been an inadequate supply of electricity and there has been a power outage for about 2 weeks. The residents of both estates complained a lot about the inadequacy of electric power supply and the enormous bill being charged for electricity. It was also observed that all other facilities have been affected due to the inadequacy of electric power supply in the area.

c. WATER SUPPLY.
Water supply in Nigeria is considered to be one of the poorest in the world. Lagos state which happen to be surrounded by water from the Atlantic Ocean and the lagoon supply 81.32%. The city has an old water treatment plant located in Iju on the Ogun river. Water supply in the housing estates studied show that water is supplied by individual families. It was observed that most of the houses in the estates have no pipe borne water; the households drill boreholes and pumps in order to supply clean water for their families. This facility is not provided by the government making the burden fall on the occupants and household heads of the estates

d. DRAINAGE AND SEWERAGE SYSTEM.
Drainage systems in Lagos, Nigeria are constructed to allow the free flow of waste and rain water. But in most cases, the drainages are blocked by refuse and dirt dumped in them hence, causing pollution and sometimes flooding in the communities as there is no place for the water to flow.
Beyond flood, dumping of waste in drainage has a lot of effects such as making the environment un-conducive for occupants and visitors, stagnant water can course infections and create a mosquito prone environment. The estates happen to be in this situation also of drainage being blocked by dirt and can lead to flooding and mosquitos' infections from stagnant water not cleaned and drained.

e. REFUSE DISPOSAL SYSTEM.

The generation and disposal of waste is an intrinsic part of any developing or industrial society. Waste, both from domestic and commercial sources has grown significantly in Nigeria over the past decade. Every time a householder shops at the store, and open market he contributes to the mountain of waste. It is possible to quote figures which show that the production of waste amounts to millions of tons. The percent of Nigeria's population living in cities and urban areas has more than doubled in the last 15 years.1 The cities and urban areas experience continuous growth which contributes to enormous in generation of solid and liquid waste. (WHO / UNICEF 2010).

Due to the population increase in Nigeria as a whole, the challenges of solid waste management in the country has increased drastically and has become complex. Bulk of the challenge come from the inadequate framework provided to take care of these issues. Refuse in the housing estates are being handled by the Lagos Waste Management Authority (LAWMA). The occupants of the estates pay a fee to have their dirt taken out every weekend making life easier and more comfortable for them.

EFFECTS OF INADEQUATE INFRASTRUCTURAL FACILITIES ON THE PEOPLE AND THEIR ENVIRONMENT IN THE STUDY AREA.

According to the information gathered through the questionnaires distributed and retrieved from the Low Cost Housing Estates, several effects caused by provision on infrastructural facilities are recorded. The study show that inadequate infrastructural facilities affect several other aspects of life such as the increase in cost day to day transactions that might have been cheaper, hence discouraging trade and businesses within the neighbourhood. The cost of inputs used in producing virtually all goods and services required in the neighbourhood automatically also increase.

Inadequate electric supply in this neighbourhood discourages the start of small scale business opportunities for many of the occupants of the estate and also reduces the profit derived by already existing ones. This does not encourage human capital and increases the level of unemployment present in the estate since the economic factors are not available to respond to the demand. The water supply in the estate is left to individual household to provide for themselves and those that cannot do that tend to look for alternative methods like buying water that might be unsafe for their health, thereby making them fall ill and sometimes die prematurely. This result into a huge sum of money being spent on the maintenance on health. These cost of maintenance rises considerable during dry season when water supply is inadequate and usually more prone to bacteria. Those who cannot afford making a borehole or buying from those who have in the area die of water borne diseases.

The drainage facilitates not properly maintained or blocked due to dumping of refuse in them cause an accumulation of stagnant water that eventually breeds mosquitoes and other insects making the area prone to several infections. Only the occupants who can afford medical attention and other preventive methods are safe while those who can't are left with several illnesses and possibly death.

The study also shows that the inadequacy of these facilities have increased other environmental problems such as declining biodiversity, deteriorating water and air quality through excessive use of wood for fuel. It is important to know that the adequate provision and proper maintenance of these facilities will definitely increase the quality of life in the environment.

IV RECOMMENDATIONS

The following measures are considered to be a good way in improving the standard of living and improving the adequacy of infrastructural amenities in the OJOKORO LOW COW COST HOUSING ESTATE (LSDPC), Meiran, Alagbado, Lagos and the MILLENNIUM HOUSING ESTATE (OJOKORO), Ijaiye - Ojokoro, Lagos.

a. Provision of Estate water project
Inspite of the numerous efforts to establishing rural water developments programmes by the Federal and State government in order to boost the housing development and improve the quality of life of the rural populace, the situation remains unchanged. This has adverse effects on the provision of housing in Lagos state. Government should intensify efforts in the provision of more boreholes and hand-pump wells in the study area.

b. Maintenance of existing road networks
It was observed that most of road network linking the residences in the study area are in very bad shape. The government should embark on grading and rehabilitation of some roads in the area.

c. Proper drainage systems
d. Adequate supply of electricity

V CONCLUSION

The migration of people from the rural to urban areas has become a big deal in the cities which causes infrastructural facilities already provided to become inadequate for the population of the area. It is important to provide basic and adequate infrastructural facilities at all levels in order to improve the standard of living of those living in that area, facilitating the growth and development of Nigeria's public housing schemes.

Rural neglect coupled with the host of other factors has adversely affected the functioning of the social, economic, political life of people. The result has been the migration of the potentially most productive and innovative individual from rural to urban areas which indirectly affects housing development , however, the provision of basic and adequate infrastructural facilities at all levels of government and private participation in infrastructure development should be considered a criteria in facilitating housing supply in Nigeria.

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Differentials in Risk of Neonatal Mortality among children of young mothers in Nigeria: Empirical Evidence from NDHS 2013

Dorcas O. Adekoya* and Gbolahan Oni
Department of Economics, Covenant University,
Ota, Ogun State, Nigeria
yemidunni@gmail.com

Abstract—This study assessed the correlates of neonatal mortality among young mothers in Nigeria. Data were extracted only for singleton births. A total of 10,455 women aged 15-29 years old reported to have given birth during the previous period of five years. Statistical analyses included univariate and bivariate techniques. Results showed that neonatal mortality rate for teenage mothers was 46.5 per 1000 and for mothers 20-29 years old it was 24.21 per 1000. However, the difference was not statistically significant (Chi-square = 1.96, on 1 d.f; P > 0.05). Mortality decreases with woman's education, higher in the Northeast and Northwest than in the Southern States, higher in rural than urban areas and higher among the poor than the rich women. Hence all hands must be on deck to ensure that teenage pregnancies are reduced to minimum among Nigerian women. Government policies that ensure that young girls receive education up to completed secondary level will go a long way to reduce teenage pregnancies.

Keywords—*Neonatal Mortality, Young Mothers, Bivariate Analysis, Education*

I. INTRODUCTION

Neonatal mortality is a strong significant public health problem across the world. It accounts for more than 60% of child mortality [1, 2]. Out of the 7.7 million under-five mortality worldwide, 3.1 million occurred in the first 28 days of life (neonatal deaths) with about 99% occurrence in low and middle-income countries, mostly in sub-Saharan Africa, including Nigeria [3]. Uwaezuoke (2004) [4] discovered that about 36% of these deaths are caused by preventable diseases such as tetanus infection and asphyxia.

Globally, Nigeria has persistently recorded highest number of neonatal deaths in Sub Saharan Africa 48/1000 live births annually [5]. Studies revealed that countries, such as Ghana and Uganda experienced significant decline in neonatal mortality [2, 6]. Also, WHO, 2011a [7] report shows that, approximately one in every 25 neonates born in Nigeria died in the first month of life. Nigeria contributes about 8% of the world's annual neonatal mortality of about 242,000 [8]. Aigbe (2012) [1] reported that Nigeria has neonatal deaths rate of 247 per 1000 births whereas other researchers argued that the stated figures were still underestimated [1, 5]. There are complex issues of political sentiments and mismanagement of information leading to void in vital statistics in neonatal mortality rate in Nigeria.

II. LITERATURE REVIEW

In investigating the socio-demographic factors influencing neonatal mortality, there are proximate (direct) causes of mortality. For instance, Zupan (2005) [9] and Reynolds (2006) [10] identified that use of health care services as a key proximate determinant of maternal and infant outcomes. Vishnu *et al*. (2014) [11] clearly stated that education, place of residence and household wealth index were strong determinants of antenatal visits and place of delivery. Whereas, Titaley (2012) [12] found no difference in neonatal mortality occurrence of deliveries at home assisted by trained attendants or untrained attendants.

Ezeh *et al*. (2014) [13] discovered that there were collective factors responsible for neonatal mortality among newborns. This was supported by the works of Vishnu *et al*. (2014) [11]; Titaley (2012) [12]; Ganchimeg *et al*. (2013) [14] that although neonates born to teenage mothers have higher risk of neonatal death than mothers in their twenties, others factors such as low birth weight, preterm delivery, physical deformity, severe neonatal conditions and an increased risk of intra-hospital late neonatal death were contributing to neonatal deaths. Mothers' educational level was also identified by Fotso (2006) [6]; Aigbe *et al*. (2008) [1] and Ezeh *et al*. (2014) [13] to have significant direct relationship with child survival, especially in the developing countries of the world. This was supported by UNICEF (2013) [15].

Several hospital-based case-control and experimental studies that identified direct causes of neonatal mortality [14, 16-19] do not take into cognizance neonate delivered at homes, whereas, 58%, 66% and 62% of neonates were delivered at home as recorded by NDHS 1999, 2003 and 2008 respectively [20-22].

III. METHODS AND MATERIALS

This study used Nigerian Demographic Health Survey NDHS (2013) [23]. This is a nationally representative sample collected by face to face interview among 38,948 women aged 15-49 through a stratified two stage cluster sampling. The data provides basic information on the characteristics of

*corresponding author

respondents, including age, sex, marital status, education, and relationship to the head of the household.

Out of the total of 38,948 eligible women aged between15 and 49 years that were interviewed, The analysis extracted information on all single births of women aged 15-19 and women aged 20-29 totaled 10,455 who had given birth in the last 5-year period preceding the 2013 NDHS.

This study adopted Mosley Chen [24] conceptual framework because it provides specific and clear concept for studying of child mortality. The Conceptual framework hypothesized relationship between socio-demographic characteristics, proximate determinants and neonatal mortality. The outcome variable for this study was neonatal deaths as reported by the mothers who participated in the survey, and it was defined as the death of a neonate between day 0 till first month. It was extracted and recoded from ratio scale to nominal scale, such that neonate that died within this period will be regarded as (1 = if death occurs in the specified age period) or failure (0 = if the newborn survived this period). The outcome variable was examined against all background variables, and these variables were classified into socio-demographic and proximate variables. Only two proximate variables were used for this analysis (antenatal visits and place of delivery). Specifically, only two analytical procedures were adopted namely: univariate and bivariate analysis. The univariate featured the descriptive analysis of selected background variables. The bivariate estimated the significant associations between the independent and outcome variables.

IV. RESULT AND DISCUSSION

The total respondents were 10,445 (12.1%) of the respondents were women aged 15-19 years while 87.9% were age 20-29 years. The mean age at 1st Childbirth was 16.2 years for the teenagers and 18.7 for women aged 20-29 years. Table 1 shows that NMR was 46.5 and 24.2 for teenage mothers and mothers aged 20-29 years respectively. Higher percentage (55%) of the teenage mothers were not educated, (38.2%) mothers in their twenties had secondary or higher education. Higher percentage (92.5%) of women in their twenties were already married. The table also shows that higher percentage (83%) of the teenage mothers lived in the rural areas compared to the non-teenage mothers (67.7%). It can also be seen from the Table 1 that higher percentage (60.4%) of teenagers who had becomes mothers were from poor households compared to mothers in their twenties (40.4%). Furthermore, greater percentage (63.9%) of teenage mothers did not attend antenatal compared to non-teenage mothers (46.3%). Finally, it can also be deduced that (73.7%) of the teenage mothers delivered at home compared to non-teenage mothers (62.7%).

In Table 2, we present the bivariate analysis of this work: It clearly shows that education, regions, place of residence, wealth index and place of delivery were the only variables that were statistically significant with neonatal mortality. There were regional differences in neonatal mortality ratio with South East having the highest rate (NMR=29.9) and a (P>0.01) which also shows that region is significantly associated with neonatal mortality. Education, place of residence, wealth index and place of delivery were also significantly associated with neonatal mortality at (P<0.05).

TABLE 1: FREQUENCY DISTRIBUTION OF SOCIO-ECONOMIC AND PROXIMATE VARIABLES AMONG TEENAGE AND NON-TEENAGE MOTHERS

Selected variables	Age group\15-19	Age group\20-29	Selected variables	Age group\15-19	Age group\20-29
Total births	1268	9187	**Place of residence**		
Mean age @ 1st child birth	16.2	18.7			
Education level			Urban	215 (17.0)	2964 (32.3)
No education	698 (55.0)	4070 (44.3)	Rural	1053 (83.0)	6223 (67.7)
Primary education	225 (17.7)	1610 (17.5)	**Wealth index**		
Sec./higher edu.	345 (27.2)	3507 (38.2)	Poor	766 (60.4)	4083 (44.4)
Marital status			Intermediate	278 (21.9)	1915 (20.8)
Not married	165 (13.0)	692 (7.5)	Rich	224 (17.7)	3189 (34.7)
Married	1103 (8.0)	8495 (92.5)	**Antenatal**		
Religion			No Antenatal	773 (60.9)	4255 (46.3)
Christians	369 (29.1)	3629 (39.5)	Yes Antenatal	473 (37.3)	4711 (51.3)
Moslems & others	899 (70.9)	5558 (60.5)	**Place of delivery**		
Employment status			Home	935 (73.7)	5761 (62.7)
Not working	702 (55.4)	3295 (35.8)	Health facility	329 (26.0)	3412 (37.1)
Working	566 (44.6)	5892 (64.1)			

CONCLUSION AND RECOMMENDATION

The result provided empirical evidences on neo-natal mortality in Nigeria which is relevant for current monitoring and effective programme of action in this regard. It demonstrated that lower level of education and poverty are key determinants of neonatal death. This finding has a top-line implication for implementation of girl-child education and poverty alleviation in Nigeria. Although, the study has its own limitations in terms of a single-year dataset used, perhaps, better understanding would have been highlighted if several years data have been analysed. Notwithstanding, the understanding of the correlates of neo-natal mortality in

Nigeria can be explored for other countries in sub-Saharan Africa.

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TABLE 2: BI-VARIATE ANALYSIS OF SELECTED SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS AND NEONATAL MORTALITY RATIO (NMR)

Selected Variables	Total Live Births	Neonatal Death	NMR	Chi-Square	Selected Variables	Total Live Births	Neonatal. Deaths	NMR	Chi-Square
Age group					**Region**				
15-19 years	1268	59	46.5		North Central	1658	39	23.5	
20-29 years	9187	223	24.2	1.955	North East	2235	67	29.9	
Education level					North West	3395	93	27.4	
No education	4768	130	27.3		South East	764	20	26.2	
Primary education	1835	60	32.7		South South	1252	33	26.4	
Sec./higher edu.	3852	92	23.9	14.232***	South West	1151	30	26.1	11.755**
Marital status					**Place of residence**				
Not married	901	30	33.3		Urban	3179	74	23.2	
Married	9554	252	26.4	2.631	Rural	7276	208	28.6	8.356**
Religion					**Wealth index**				
Christians	3998	110	27.5		Poor	4849	145	30.0	
Moslems & others	6393	171	26.8	3.661	Intermediate	2193	59	27.0	
Employment status					Rich	3413	78	22.9	9.453**
Not working	3948	116	29.4		**Antenatal visit**				
Working	6458	163	25.2	0.424	No	5028	149	30.0	
					Yes	5184	121	23.3	1.781
					Place of delivery				
					Home	6696	175	26.1	
					Health facility	3741	102	27.2	11.420***

Significant Level ***$p < 0.001$, **$p > 0.01$, *$p < 0.05$

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Characterisation of Airborne Fine Particulate Matter (PM$_{2.5}$) and Its Air Quality Implications in Ogun State, Nigeria

Winifred U. Anake, Nsikak U. Benson

Department of Chemistry,
Covenant University,
Ota, Ogun State, Nigeria
winifred.anake@covenantuniversity.edu.ng

Godson R. E. E. Ana

Department of Environmental Health Sciences,
University of Ibadan,
Ibadan, Nigeria.

Abstract — **Atmospheric aerosols pose a serious threat to environmental quality and health of the public. Several studies in Nigeria have documented the pollution levels from coarse particles but very few have elucidated the nature of the fine particles in the context of air quality index. Our investigation therefore focused on air quality index in relation to ambient fine particulate and composition of PM$_{2.5}$ collected from an industrial area (IA) and a university community (UC) in Ogun State, Nigeria. The PM$_{2.5}$ samples were collected using Environtech gravimetric sampler according to standard methods. The morphology and elemental composition of PM$_{2.5}$ were assessed by scanning electron microscope (SEM) coupled with an energy dispersive X-ray (EDX). The SEM images of fine particles indicated the following clustered groups: soot particles, alumino silicates, and mixture of alumino silicate with soot. Energy dispersive X-ray spectra showed nine most abundant elemental composition in all samples. Possible source emissions of elements identified by principal component analysis are industrial processes, vehicle emissions, crustal dust, fuel-oil and biomass burning. Air quality index (AQI), for particulate pollution was calculated for each location. Fine particle pollution indices scaled from 51 to 500, reflecting six out of the seven AQI categories in varying proportions. The absence of 0 to 50 gradation representing the good AQI category is conspicuously highlighted. Results indicate that most AQI values were above 100. Possible adverse health concerns mostly for the vulnerable populations are indicated considering the unhealthy air quality state of studied locations.**

Keywords—PM$_{2.5}$ pollution; elemental composition; SEM-EDX; air quality index

I.   INTRODUCTION

Fine particulate matter (PM$_{2.5}$) refers to tiny subdivision of solid matter floating in a gas or liquid. It is characterised by small particle size, large surface area and high activity [1]. Given their minute size and effective ability to readily dissolve in fluids and produce a chemical reaction, exposure to PM$_{2.5}$ has become a leading environmental risk factor associated with many cardiopulmonary and respiratory diseases as well as premature deaths [2]. Therefore, PM$_{2.5}$ has aroused growing public health and environmental concerns, and has become a fundamental area of air pollution studies by many researchers [3, 4, 5]. They are associated with several chemical species, including trace metals and are emitted from natural (windborne dust, sea spray, volcanic emission, road dust, dust outbreaks and biomass burning) sources, and anthropogenic (fossil fuel combustion and industrial emissions, coal and oil combustion, open solid waste burning, construction activities) sources [3, 6].

Depending on the location, variation in the morphology and chemical composition, some group of fine particles are sometimes observed. However, other specific groups namely carbon-rich fluffy soot aggregate from incomplete combustion of hydrocarbons, minerals with high content of metals from coal-fired power plants, and spherical fly ash made of metal-silicates from road dust, construction, coal combustion and secondary atmospheric reactions have been reported [3]. Understanding the chemical composition of fine particulates is not sufficient especially when considering the carcinogenotoxicity. Therefore, additional knowledge on their morphology can further authenticate their origin [7, 8]. Scanning electron microscopy (SEM) combined with energy dispersive X- ray (EDX) has been employed to access information on atmospheric fine particulate's chemical composition, morphological characteristics and origin [5, 9]. Despite the numerous observations of air pollution in different cities in Nigeria, there has been a lack of research on outdoor PM$_{2.5}$ concentration in major institution sites and industrial areas in Ogun State. The Ewekoro industrial area and Covenant University community are two of such typical environment that have been investigated and reported in the present work. Therefore, the objectives of the present study are (a) to determine the PM$_{2.5}$ air quality index of the study area (b) to investigate the morphology of atmospheric fine

particulates using SEM– EDX, and (c) to identify the fine particle sources based on PM$_{2.5}$ chemical composition.

II. METHODOLOGY

A. Sample collection

Sampling of PM$_{2.5}$ was carried out at Ewekoro community (31N 0523068 UTM 0763651) and Covenant University (31N 0517507 0737605) in Ogun State, Nigeria, between August and September 2014. For effective data management, the Ewekoro community and Covenant University sites were designated as IA and UC, respectively. PM$_{2.5}$ samples were collected for 4 hours weekly at a height of 1.5 m from the ground level at each study location with Environtech gravimetric sampler on glass filters (47 mm). The filters were equilibrated in a desiccator for 48 hours to eliminate the effect of humidity and also to obtain accurate PM$_{2.5}$ measurements. Pre-weighed and conditioned filters were placed in the filter holder and screwed properly before operating the sampler. After sampling, the PM$_{2.5}$ filter papers were removed with forceps, stored in a petri dish, conditioned, weighed, and stored in the refrigerator at 4°C to prevent thermal degradation and evaporation of volatile components prior to further analysis. Laboratory blank and field blank filters were collected to reduce the gravimetric bias.

B. Air quality index (AQI)

PM$_{2.5}$ air quality index was calculated following a standard formula developed by the United State Environmental Protection Agency as shown below [10].

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}} \left(C_P - BP_{Lo} \right) + I_{Lo}$$

where:

I$_p$ = the index for pollutant p,

C$_p$ = the rounded concentration of pollutant p,

BP$_{Hi}$ = the breakpoint that is greater than or equal to C$_P$,

BP$_{Lo}$ = the breakpoint that is less than or equal to C$_P$,

I$_{Hi}$ = the AQI value corresponding to BP$_{Hi}$ and

I$_{Lo}$ = the AQI value corresponding to BP$_{Lo}$.

Air quality index is a colour-coded tool for reporting the quality of air with respect to its effects on the human health [10, 11]. It is divided into six levels of health concern and their implications namely; good (0–50), implies that AQI is satisfactory; moderate (51–100*), AQI is acceptable; unhealthy for sensitive groups (101–150), implies that this AQI range may not affect the general public, but could affect persons with heart and lung disease, older adults and children; unhealthy (151–200), everyone may begin to experience some adverse health effects; very unhealthy (201–300), everyone may experience adverse health effects and hazardous (301–500), this triggers health warning of emergency conditions. Therefore to protect the public from fine particle pollution, EPA has set an AQI value of 100 as identified with the asterisk symbol [10, 12].

C. SEM-EDX analysis of PM$_{2.5}$ particles)

The surface morphologies and elemental composition of airborne particles of PM$_{2.5}$ samples were examined by field emission scanning electron microscopy (FESEM, Hitachi, SU-8020) coupled with energy-dispersive X-ray spectroscopy (EDX, Oxford X-Max^N Model). 0.5 cm of the dry and loaded glass fiber filter samples were cut and coated with a thin film of platinum (Pt) to make the samples electrically conductive for SEM-EDX analysis. Samples were placed in the corner of SEM-EDX chamber and three images of each sample were taken at a magnification of X1500, X5000, X20000. After which, EDX spectra of individual particles were obtained for determination of individual elemental composition of particles after scanning an electron beam with an accelerating voltage of 20 kV, a beam current of 10 μA and a Si (Li) detector 15 mm away from the samples to be analyzed. Peaks were identified and the quantifying function of the computer programme was used to determine the peak intensities, which were converted to percentage weight [13].

D. Statistical analysis

The EDX data obtained from elemental analysis were analysed using the XLSTAT-Pro software (AddinSoft, Inc., NY, USA). Principal component analysis (PCA) was used to establish the interrelationship between investigated PM$_{2.5}$–bound elements and identify their sources. Varimax rotation was used as the rotation method for PCA analysis and the number of principal components was decided based on eigenvalues >1. The statistical methods were performed with a 95% confidence interval (significance p<0.05).

III. RESULTS AND DISCUSSION

A. PM$_{2.5}$ air quality index in IA and UC

Fig. 1, shows average of two months air quality index for UC and IA computed during the wet season (August and September). The "good" air quality category, which represents the index value 0-50, was significantly absent in both study areas. AQI for UC ranged from "moderate" to "very unhealthy" categories, while the IA fell within the range of "unhealthy for sensitive group" to "hazardous" categories. Comparatively speaking, the results indicate that UC site recorded no values within the hazardous gradation and showed relatively better AQI than IA site.

However, the present state of air is still of concern, particularly to those in the sensitive categories. Possible sources of pollutants in the University community (UC) includes, vehicular emission, construction activities, emission from power plant, transport of pollutants from neighboring environment, most especially the nearby Ota industrial estate with continuous active production involving scrap recycling, production of chemical, plastics, metals and steel etc.

Furthermore, particle pollution in IA (Ewekoro community) has been closely associated with diverse activities such as industrial emission, most especially the Lafarge Cement WAPCO Nigeria Plc, Portland Paints and Products Nigeria Plc, and Dulphin steel industry, limestone quarrying, vehicular emission, woodstoves, biomass burning, solid waste burning, power plants, unpaved roads etc. [14, 15].
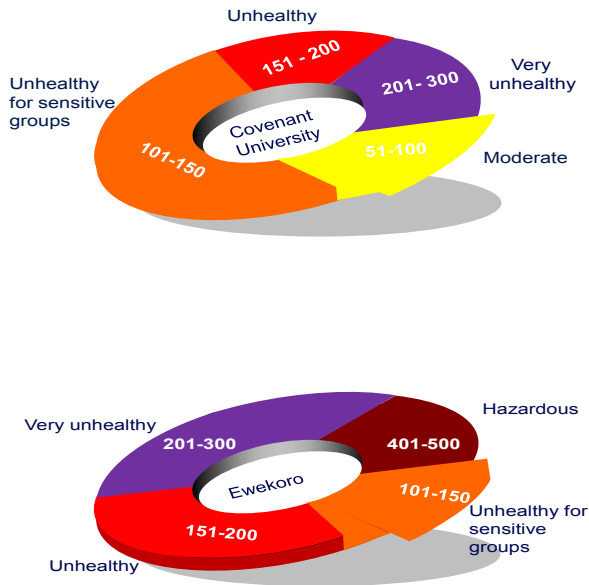
Fig. 1. PM$_{2.5}$ AQI at the two measurement sites during wet season

The observed categories of AQI for IA indicate that the air quality was unhealthy for both the sensitive groups and for everyone in this location [10].

B. Morphology and Elemental composition of PM$_{2.5}$ particles

As shown in Fig. 2, the morphological characteristics of atmospheric fine particles (PM$_{2.5}$) detected at UC, and IA sites were classified into three most abundant groups such as soot aggregation, alumino silicate, and mixture of silica with soot.

1) Aluminosilicates particles: These particles are formed basically from natural sources, and composed primarily of Si, Al, Ca or Si, Al, K classified as feldspar and Si, Al or Si, Al, Fe such as clay. Aluminosilicates also originate from road dust, agricultural activities, fuel and biomass burning [6, 9]. UC and IA aluminosilicate particles are shown on Fig. 2 (a) and (b) SEM images respectively. The distribution of the major elements and atomic percentages in the analysed particles for IA were O (47.6%), Si (17.7%) C (16.2%), Na (5.47%), Ba (3.51%), Zn (3.04%), Al (2.64%), K (1.85%), and Ca (0.95%). Also, for the UC particles the major elements and atomic percentages observed were O (49.7%), Si (18.3%), C (15.0%), Na (5.65 %), Ba (3.52%), Zn (2.98%), Al (2.11%), K(1.83%) and Ca (0.90%) respectively.
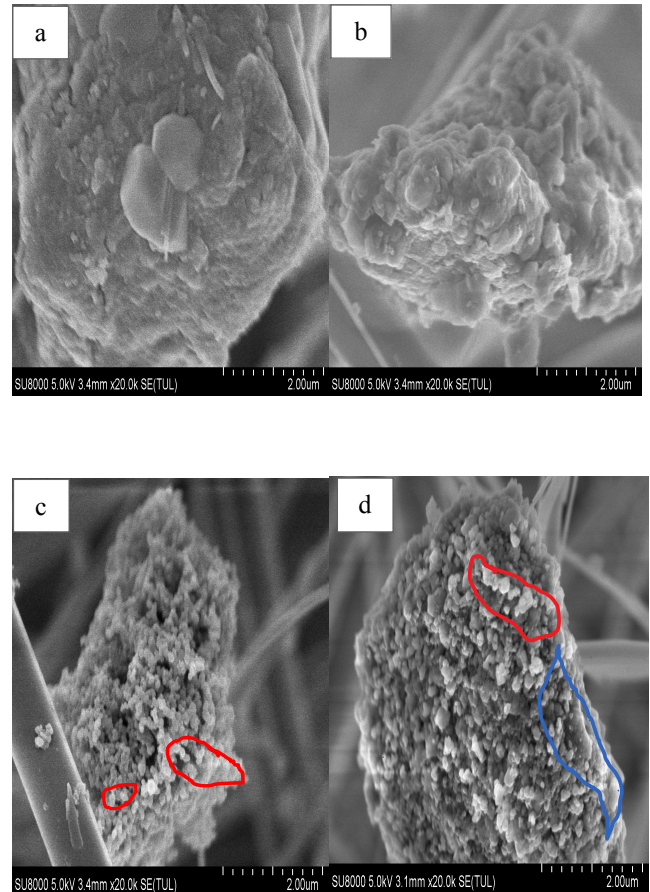
Fig. 2. SEM images of most abundant groups of PM$_{2.5}$ particles identified: (a) aluminosilicate at IA; (b) aluminosilicate at UC; (c) soot particles at IA; (d) aluminosilicate- soot particles at UC

2) Soot particles: Soot particles have unique morphology that distinguishes it from other groups of particles. It is present as agglomerates of many fine spherical primary particles in the form of chainlike soot particles, cluster soot particles, simple soot particles etc. They are major tracer of vehicular exhaust and are also emitted from diverse sources including heating systems, gasoline, diesel and fuel oil from incomplete combustion processes [5, 3].

As shown in Fig. 2c, cluster soot particles were identified at IA site and the distribution of major elements and atomic percentages in such aggregates include O (50.7%), Si (18.9%), C (12.9%), Na (5.69%), Ba (3.57%), Zn (2.43%), Al (2.43%), K(1.94%), Ca (1.14%) and Cl (0.23%) respectively, with high contents of O, Si, and C. Si is due to mixed sources such as crustal airborne particles and industrial combustion. Also, the high proportion of C confirms heavy carbonaceous emission already detected in the morphology. This findings indicates that anthropogenic combustion is the main source of soot in the investigated site [12,16].

3) Alumino silicate- soot particles: As shown in Fig. 2d, UC SEM image of PM$_{2.5}$ particles revealed a mixture of aluminosilicate with absorbed smaller size soot particles. Their elemental composition and atomic percentages were

O (49.7%), C (15.6%), Si (17.8%), Na (5.2%), Ba (3.8%), Zn (2.50%), Al (2.31%), K (1.9%) and Ca (1.1%) respectively.

C. Source apportionment of PM₂.₅ particles

The principal component analysis (PCA) of EDX elements (O, Si, C, Na, Ba, Zn, Al, K, Ca) was performed in order to study the correlation among the elements and for the source identification. Table 1 presents two rotated factor loadings with eigenvalues >1, for UC and IA study areas. The PCA of the chemical data of the particles from UC site, shows two factors which accounted for 82.5%, of the overall variance. As shown in Fig. 3a, it is evident that the first factor, explains most of the variance (55.45%), and is characterized by high loadings of K, Si, Ca, Zn and Na and strong negative factor loadings for C and O while factor 2 explained 27.06% of the total variance with high loading of Ba and strong negative loading for Al.

The presence of Zn was suspected to come from wear and tear in brake line and tires associated with vehicular emission sources, corrosion of galvanized steel as well as metal processing due to the proximity of UC site to Ota industrial estate [9, 17], Ca is associated with, emission from buildings, road renovations/construction [18]. Also, K is a known marker of vegetation and biomass burning and it is associated with contributions from the neigbourhood and surrounding farm lands, while Na and Si has been identified as crustal elements from soil dust. Si is equally produced in large quantity in heavily industrialized areas during industrial combustion process and from generator sets usage in the neighborhood of the sites. Also, they are easily transported in airborne particles in the form of fly ash [19, 20, 21, 22]. In factor 2, Ba is associated with mineral origin (barite) from the soil, metallurgical production, open air solid waste burning and industrial activities [23, 24]

For the industrial site (IA), PCA revealed two (2) components that accounted for 95.51%, of the overall variance in Ewekoro.

Table 1: Factor loadings of trace metals after PCA varimax rotation at UC and IA

Trace Metals	UC		IA	
	PC1	PC2	PC1	PC2
O	**-0.774**	-0.391	0.429	**-0.903**
C	**-0.973**	0.193	**-0.965**	0.264
Si	**0.976**	-0.216	**0.976**	-0.218
Na	**0.572**	-0.276	**0.925**	0.204
Ba	-0.146	**0.987**	**0.994**	0.105
Zn	**0.664**	0.434	0.596	**0.668**
Al	-0.424	**-0.804**	0.660	**0.751**
K	**0.988**	0.156	**1.000**	0.031
Ca	**0.713**	-0.536	0.460	**-0.795**
Eigenvalue	4.990	2.434	5.941	2.655
Variability (%)	55.45	27.05	66.01	29.50
Cumulative %	55.45	82.50	66.01	95.51

(a)

(b)
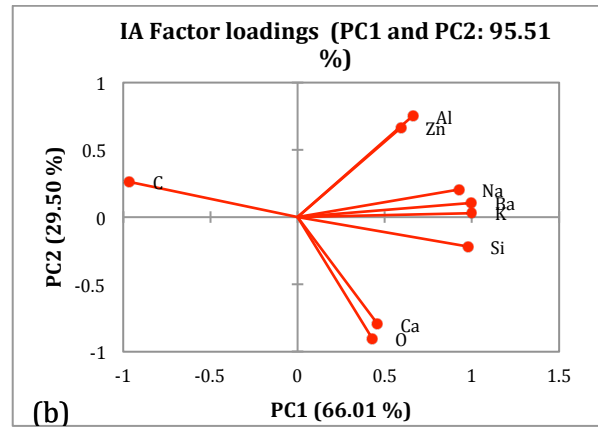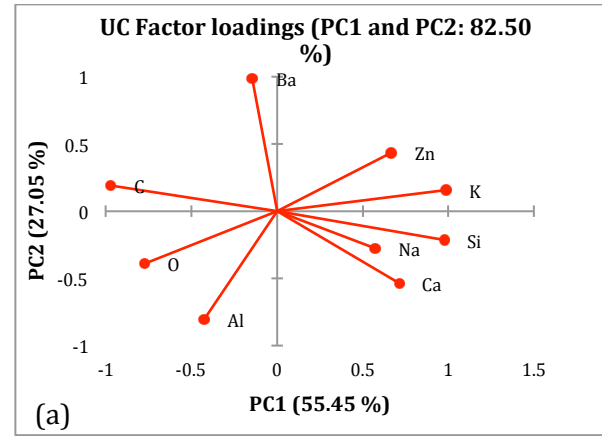
Fig. 3. Loading plots of the principal components obtained for elements at (a) UC and (b) IA

As shown in Fig. 3b, factor 1 (66.01%) had high loadings for K, Ba, Si, Na and strong negative loading for C while factor two (29.5) had high loadings for Al and Zn and strong negative factor loadings for O and Ca .The general description for sources of elements described above holds as well for IA elements. In addition to this Al are markers of emission from cement production, metal recycling, steel production, vehicle wear and tear and re suspended dust mineral dust, but their presence in the IA environment has been increased due to various anthropogenic activities such as, associated with construction [25, 26]. It was observed that in both UC and IA, different groups of elements were related to one or several sources. Hence, groups of elements associated with a specific type of origin were identified as tracers of the main emitted particles by the polluting sources.

I. CONCLUSION

The SEM–EDX technique is a valuable tool for the characterisation of the morphology and chemical composition of fine particles. Our results presented in this paper showed three major clustered groups (soot particles, alumino silicates, and mixture of alumino silicate with soot), with greater

percentage of aluminisilicate identified for the fine particles in both sites during the investigated period. Nine most abundant

elements present in all samples were indicated with Energy dispersive X-ray spectra and application of PCA to the elements highlighted industrial processes, vehicular emission, crustal dust, fuel-oil and biomass burning as sources of $PM_{2.5}$. However, the air quality index of fine particle pollution for the "good category" was not observed in both sites. From the findings UC, had no record of hazardous category, and recorded a better AQI when compared with IA. The AQI for IA indicates that the air quality was unhealthy for both the sensitive groups and for everyone in this location. There is need for adequate government regulation, industrial compliance and public awareness toward the control of $PM_{2.5}$ pollution.

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Investigation of Bio-Waste As Alternative Fuel For Cooking

Collins N. Nwaokocha

Department of Mechanical Engineering,
Olabisi Onabanjo University, Ibogun Campus,
P.M.B. 5026, Ifo, Ogun State, Nigeria
collinsnwaokocha@gmail.com,
collinsnwaokocha@oouagoiwoye.edu.ng

Solomon O. Giwa

Department of Mechanical Engineering,
Olabisi Onabanjo University, Ibogun Campus,
P.M.B. 5026, Ifo, Ogun State, Nigeria
sologiwa2002@yahoo.com

Abstract—**Nigeria has a vast natural resources especially forestland with the majority of its households relying on solid biomass such as charcoal and firewood as their cooking fuels. Combustion of solid biomass is a significant source of particulate and carbon monoxide emissions. However, the increasing demand and use of charcoal and firewood has led to an escalation of deforestation and the emission from the combustion of these fuels have been highly correlated to harmful health effect among other related problems. Bio-waste as an alternative fuel for cooking in Nigeria is still in its infancy and hence the need for this research. The research was carried out using binders (starch and spent oil) and biomass (rice husk and sawdust) to produce Refuse Derived Fuel (RDF) often referred to as pellets. Properties such as moisture content (%), ash content (%), tensile strength (N/mm) and higher heating value (kJ/kg) were determined for the RDF. Prior to the production of the RDF, the moisture and ash contents of rice husk and sawdust were 5.72% and 17.14%, and 15% and 10.23%, respectively. After the production of the RDF from rice husk, moisture content, ash content, higher heating value, and tensile strength of 0.908%, 11.5%, 6160.7 kJ/kg and 508.7 N/mm^2 of tensile strength, respectively, were obtained. Also, for the RDF produced from sawdust, moisture content of 0.93%, ash content of 16.5%, higher heating of 7808.1 kJ/kg and tensile strength of 576.8 N/mm^2 were measured. These results were found to be in agreement with previous studies on RDFs sourced from bio-wastes. Conclusively, the RDF seems to be a good substitute to wood as cooking fuel and would also reduce greenhouse gas emissions and thus save our environment from effects of climate change.**

Keywords—RDF, Biowaste, GHG, Cooking fuel, Climate change, Sustainable Energy.

I. Introduction

A large part of the world's population uses wood as fuel for household cooking and space heating, mostly in the developing countries. In poor developing countries' households, wood, charcoal and other solid fuels are often burned in open fires or poorly functioning stoves. It's a great challenge finding a means of expanding its energy resources especially to the rural households and also addressing the health risks and environmental consequences associated with over dependence on such fuels for cooking. Also, incomplete combustion leads to the release of small particles and other constituents that have damaging effect to human health in the household environment. The consequences of these are deforestation, desertification, pollution and global warming [1-4].

Hence, the search for a safe substitute fuel for firewood is essential. There are quite a lot of alternative energy which are expected to replace fossil fuel in the future, i.e. biomass, hydro, solar, tidal, wind and ocean thermal energy. Advances in biotechnology and bioengineering, have classified some resources classified as waste, which now form a basis for energy production. Literatures affirm that 86 % of energy being consumed all over the world is from fossil fuels. The large quantities of agricultural residues produced in developing nations can play an important role in meeting her energy needs [5-11].

Biomass pellets are made from organic wastes such as agricultural wastes, sawdust etc. and are suitable replacements for fossil fuels such as oil or coal, and can be used for cooking and to heat boilers in manufacturing plants. Biomass pellets are renewable sources of energy and prevents the release of fossil-derived carbon to the atmosphere. Use of biomass pellets can help in earning carbon credits for reducing emissions in the atmosphere, which is a critical target of the Sustainable Development Goals (SDGs) Programme [5,12].

One of the popular biomass pellets emerging in developed and developing countries is the sawdust pellets. This involves compressing and extruding sawdust to make a reconstituted log that can replace firewood. There are no binders involved in this process. The natural lignin in the wood, binds the particles of wood together to form a solid. Burning a wood pellet is far more efficient than burning firewood. Moisture content of pellets can be as low as 4 %, whereas green firewood may be as high as 65 %. Sawdust pellets have developed over time with two distinct types: those with hole through the centre, and those that are solid. A solid pellet is manufactured using a piston press that compresses sandwiched layers of sawdust together. Pellets with a hole are produced with a press. The hole is from the screw thread passing through the centre but it also increases the surface area of the log and aids efficient combustion [5,12-13].

Fuel pellets can be made from readily available waste materials. In urban areas, this can be sawdust and shredded

paper. In villages and rural areas, they can be made from leaves, grass, coffee and rice husks and other agricultural waste in many combinations. Waste plastic material cannot be used because the plastic gives off toxic gases when it burns. The use of biomass waste can contribute towards a reduction in the utilization of conventional solid fuels and thus resolve some of the long standing environmental issues. Currently, full scale utilization of biomass briquettes is in biomass stoves for domestic applications and in industrial grade boilers for power plants [14-15]. As a result of the growing importance and need for briquettes, particularly from biomass materials, literatures abound on various aspects of briquetting, the nature of the materials, the behaviour and characteristics of such materials during and after briquetting. The behaviour and characteristics of biomass residue briquetting can be classified into physical, mechanical and combustive depending on the measured parameters [9,16,17,18,19].

This study focuses on biomass pellets as Refuse Derived Fuel (RDF) from Municipal Solid Wastes (MSWs) such as sawdust, rice husk, waste papers. The aforementioned wastes constitute nuisance to our environment and are mostly burnt in open air which leads to environmental pollution with the release of harmful substances to the atmosphere. This present work intends to harness some MSWs as earlier stated as a source of heating as substitute to firewood and charcoal. In Nigeria, rural inhabitants and urban dwellers mainly use firewood, charcoal and fossil fuels as their source of energy for cooking and heating. Consequently, these sources cause deforestation; environmental pollution and it also result to high cost of living.

II. MATERIALS AND METHODS

A. Pre-Treatment of Raw Materials

The pre-treatment of the raw materials (sawdust, rice husk, waste paper and spent oil) was carried out mechanically. The mechanical process is to reduce the biomass size by grinding or shredding. The size reduction by mechanical process (Grinding) facilitates handling, increases surface area, decreases crystallization and improves the efficiency. After the pre-treatment of raw materials, it improves the energy density of the biomass allowing it to be efficiently stable at the point of use. For the pre-treatment of the spent oil, a sieve of 4cm was used to remove the particles away from the spent oil before the point of use.

B. Preparation of Mixture

Before mixing the raw materials, which comes after the pretreatment of the sawdust, the ash content and moisture content were determined. Thereafter, the binder (starch) was boiled to solidify it before mixing it with the biomass (sawdust, rice husk, waste paper) and a little quantity of waste engine oil in a bowl, to produce a crude unfinished material. The quantity of biomass was less than that of the binder before mixing them in the bowl. After which a pellet mixture of approximately 12 g was produced.

C. Procedure for the Production of Refuse Derived Fuel

Pellet formation is fairly straight forward. The biomass (sawdust, rice husk, waste paper) and binders (starch and engine oil) were mixed by weight ratio and blended manually in a large mixing bowl. Various ratios of binders (38.5 g and 31.3 g) to waste biomass (50 g) of different types were then mixed to produce unfinished products. The crude mixture (approximately 12 g) was placed inside newspaper wrapping, and the ends were folded down so that both ends of the wrapping were covered. No adhesive was used until the crude mixture was compressed and this will remain prone to unwrapping. This raw pellet was then transferred into the mould, a short length of PVC with one end sealed. The diameter of the PVC pipe is 12.5 mm, and its length is 101.6 mm (four inches). The mould is to assist the pellet retain its cylindrical shape while a short metal rod slightly smaller than the PVC internal diameter was inserted into the open end of the mould to compress the pellet. Pressure (approximately 250 psi) was applied manually for a period of 15 seconds. This pressure not only reduced the pellet size, but also encouraged the binders to permeate the materials and form a single firm unit. It should be noted that this form of production is only used in laboratory experiments and actual commercial production will of course be large scale and automated. The size of a pellet produced as RDF was either 6 or 8 mm in diameter and about 3-4 times the diameter in length.

After the production of the pellets, they were sun–dried for 3 - 5 days to reduce the moisture content and to make a good mechanical durability. Randomly selected pellets were then taken to the laboratory for characterization as fuel.

D. Characterization of RDF

The combustible fraction, consisting of rice husk, sawdust and other non–biodegradable fractions of solid waste is processed into refuse derive fuel. RDF is thus a dry solid fraction usually with a high calorific value. The composition of RDF and Municipal Solid Waste (MSW) will vary according to the origin of waste material and the separation process [16, 20-22]. This will in turn greatly influence the properties of RDF such as moisture content, ash content, and higher heating value.

III. RESULTS AND DISCUSSION

Heat value or calorific value determines the energy content of a fuel. It is the property of Refuse Derived Fuels (RDFs) that depends on its chemical composition and moisture content. The most important fuel property is its heat value [20-21]. Table 1 gives the fuel properties of the raw materials used in the production of RDF on a laboratory scale. The moisture content of rice husk that went into the production is 5.72 %, which is relatively lower than that of sawdust (15 %). Whereas, the ash content of sawdust (10.23 %) prior to the RDF production is moderately lower than that of rice husk (17.14%). It is observed from Table 2 that the moisture content of the RDFs decreased after processing the raw materials into the final products. This is due to the fact that the raw materials adjusted with the relative humidity of its surroundings. A reduction in moisture content increases the

mechanical strength of the raw materials and promotes hydrogen bridge cross-bonding between adjacent cellulose chains in regions of low spatial order which are primarily responsible for stiffness and rigidity. Same goes for the ash content of the material. Biomass has higher heating value due to lower moisture content and high oxygen content. The results from the analyses of pellets are summarized in Table 2. It is obvious that all the properties of sawdust pellet are higher than the properties of rice husk pellet. These energy values are sufficient enough to produce heat required for household cooking and small scale industrial cottage applications [20-22]. The starch waste pellet is very suitable source in replacing or supplementing low end coal and RDFs.

Fig. 1. Sample picture of the pellets

TABLE I.   FUEL PROPERTIES OF THE BIOMASS (RICE HUSK AND SAWDUST) BEFORE PRODUCTION

Types of fuel	Moisture content (%)	Ash content (%)
Sawdust	15	10.23
Rice husk	5.72	17.14

TABLE II.   FUEL PROPERTIES OF THE BIOMASS (RICE HUSK AND SAWDUST)

Types of fuel	Moisture content (%)	Ash content (%)	Higher heating value (kJ/kg)	Tensile strength (N/mm^2)
Sawdust	0.93	16.5	7808.1	576.8
Rice husk	0.908	11.5	6160.7	508.7

The pellet is made from biomass (sawdust and rice husk), they are categorized by their heating value, moisture content and ash content and dimensions. The pellets can be used as fuel for power generation, commercial or residential heating and cooking. These pellet are extremely dense and can be produced with low moisture content below (10%) as shown in the table above, that allow them to be burned with very high combustion efficiency. Further, the advantage of the pellet geometry size is that it can be fed to a burner by hand or pneumatic conveying. The sample picture of a pellet is shown in Figure 1.

The study was pursued with the hope of promoting biomass and sustainability. Additionally, this process will lessen the impact of refuse on landfills and reduce our dependence on fossil fuels. RDFs (sawdust, manure, grass clippings and corn husks, etc) is a very benign and chemically-inactive material. There are no hazards that are associated with it, aside from accidental ingestion and possible splinters during handling. Therefore basic precautions regarding handling be followed to avoid unintentional consumption.

IV.   CONCLUSION

The study was pursued with the hope of promoting biomass and sustainability. The result of this study indicates that pellets produced from the two biomass residues would make good biomass fuels. However, findings show that sawdust pellets has more positive attributes of biomass fuel than its rice husk counterpart. The study assessed biowaste as an alternative fuel for cooking in Nigeria. The Refuse Derived Fuels (RDFs) was found to be a good substitute to wood as cooking fuel. Of note is that the quality and energy amount of biomass briquettes depend on the type of original biomass residue and type of binders used among other variables. We hope that our work will lead to an appreciable rise in the use of RDFs not only from the surrounding community but in a global sense. Since this study is structured around waste products, there is no ultimate sacrifice or risk that the society has to make concerning the adoption of RDFs.

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Natural Gas as Transportation Fuel: Solution to National Carbon Dioxide Reduction and Fuel Related Issues in Nigeria

Giwa Solomon Olanrewaju, Nwaokocha Collins Neko
Department of Agricultural and Mechanical Engineering,
Olabisi Onabanjo University (OOU),
Ifo, Nigeria
sologiwa2002@yahoo.com

Abstract—**This In this study, strategic substitution of natural gas (NG) as transportation fuel in place of gasoline and diesel has been proposed due to the volume of NG flared on daily basis and its negative impacts on the micro-environment. Data on the volumes of gas flared and quantities of gasoline and diesel distributed from 2000 to 2014 used in this work were sourced from bulletins published by Nigerian National Petroleum Corporation. Empirical formulae and standard conversions were employed to estimate variables (carbon dioxide and cost benefits) based on current price regimes and energy contents of the fuels. The strategic utilization of NG - scenario 1 - (33% to 1% of flared volume) and the baseline (actual situation in 2014) were the two scenarios considered. Findings from this study revealed that at 33% and 1% utilization of flared gas (11.30 x 10^9 m^3), CO_2 released were 2.5 x 10^7 tons and 3.43 x 10^7 tons, as against 3.46 x 10^7 (scenario 1) and 3.42 x 10^7 tons emitted for the baseline scenario, respectively. These values correspond to CO_2 reduction of 9.63 x 10^6 tons (27.79%) and 2.92 x 10^5 tons (0.84%), for 33% and 1% NG utilization, respectively. Based on energy contents of the fuels, NG as transport fuel is 60.7% and 62.5% cheaper than gasoline and diesel, respectively. The implementation of strategic NG substitution as transportation fuel proposed seems a lasting solution to gas flaring, and petroleum products and their associated problems in Nigeria.**

Keywords— Natural gas; Gas flaring; Diesel; Gasoline; Carbon dioxide; Nigeria; Strategic substitution

I. INTRODUCTION

One of the most fundamental issues for sustainable development is energy. Economic and technological development of a nation is strongly connected to energy. Energy security of a nation must be vigorously pursued with the ultimate aim of energy independence. In Nigeria, over 70% of the petroleum products used in the country are imported despite her being the 10th largest oil producer in the world [1]. In August, 2015, 376.02 x 10^6 litres and 6.54 x 10^6 litres of premium motor spirit (gasoline) and automotive gas oil (diesel), respectively, were distributed for consumption in the country [2]. The distribution of these fuels are oftentimes characterized with variation in their prices, long queues at fuel stations, scarcity of supply, increase in transport fare, injuries, ripple effect on prices of other commodities etc., especially for gasoline as its demand is more. The transport sub-sector is second to the largest contributor (gas flaring sub-sector) in the

energy sector as reported in the year 2000 for national emission inventory [3]. Emissions from these sub-sectors translate to 40.3% and 18.4% (energy sector) and, 24% and 12.1% (total national emissions) for gas flaring (GF) and transport sub-sectors, respectively.

In context with the above, continuous GF activities (since inception of oil exploitation operations) in Nigeria have ranked the country second to Russia in the world in terms of the volume of GF [4]. Several attempts at putting a stop to this barbaric act of international concern have proved abortive and this singular action has been tagged globally as wastage of natural resource and a significant source of emission [5,6,]. Elvidge et al. [7] reported that the estimated amount of GF in Nigeria in 2008 was 15.1 billion cubic meter (bcm). The huge amount of money lost annually due to GF over a long period of time is incomparable to the devastating effect of this action on immediate environment and people in the vicinity of flare sites all over the Niger Delta region of Nigeria [4,6].

In light of this, the use of NG as transportation fuel to substitute gasoline and diesel has been suggested at different fora by several authors as a probable lasting solution to curb the notorious act of GF and the problems linked to it [5,6,8,9]. Among the reasons highlighted for the future use of NG in vehicles, especially in compressed form included; economic advantage, environmental friendliness, non-dependency on imported fuel, reduction of flared gas, increased domestic utilization of NG, low-carbon strategy and conservation of oil reserves. Owing to the fact that the country is blessed with more gas than oil with an estimated reserve of 187 trillion cubic meter, the strategic substitution of NG for gasoline and diesel is inevitable. In addition, the technology to this effect is not new as it has been in operation in other countries long before now. Nigeria is rich in NG but its use as transportation fuel in the form of compressed natural gas (CNG) is in its infancy with a pilot project inaugurated in 2010 in Edo State, which was promoted by the Nigerian Independent Petroleum Company in partnership with the Nigeria Gas Company [8].

CNG is a fossil fuel substitute for gasoline, diesel, or propane (liquefied petroleum gas). It is a more environmentally clean alternative to those of other fossil fuels. The use of CNG in vehicles has a wide range of advantages over gasoline and diesel. CNG is used in traditional gasoline

and diesel vehicles that have been converted into bi-fuel vehicles or dedicated vehicles. The primary purpose of this paper was to assess the possible use of strategic NG substitution for gasoline and diesel as transportation fuel in Nigeria. This is in order to reduce the volume of gas flared by increasing NG utilization beyond its present use. Consequently, this would mainly address the problems of gas flaring, national GHG emissions, supply, distribution and cost of gasoline and diesel in the country.

II. MATERIALS AND METHOD

A. Study Area

The Niger Delta region of Nigeria is currently the sole deposit of oil and gas which accounts for over 95% of export income and around 85% of national revenue [9]. This region is the second largest mangrove forest in the world and it is a renowned hotspot for biodiversity conservation [10]. The region's biodiversity is seriously threatened by the continuous degradation of the micro-environment as a result of oil and gas exploration activities.

B. Data Source, Collection and Analysis

The data utilized in this study were sourced from bulletins released by the national agency (Nigerian National Petroleum Corporation) overseeing oil and gas sector of the country. Information on the volume of gas produced, flared, percent flared and the quantity of gasoline and diesel distributed in Nigeria was collected for a period of 15 years (2000 to 2014). The volume of gas was in cubic meter while that of gasoline and diesel were in liters. Microsoft Excel (2013) was used as the statistical tool to calculate and analyze the data gathered. The correlation between the volume of gas produced, GF, gasoline and diesel was carried in addition to analysis of variance test at 95% confidence interval to check the significance of the data employed in this study. The cost benefits of utilizing NG as transportation fuel was also estimated and analyzed.

C. Calculations

Of the emissions discharged into the atmosphere from burning of diesel, gasoline and NG, CO_2 is prevalence and constitutes a major environmental footprint. The estimation of the amount of CO_2 emitted from the burning of the aforementioned fuels were carried out with using empirical formulars. The cost benefits of substituting NG for gasoline and diesel were also estimated. Basic conversions (Eqs. 1-7), empirical formular (Eqs. 10) and emission factors (in Eqs. 11-12) were obtained from literature [11,12] while mathematical expressions (Eqs. 8-9 and 11-16) were developed.

$$1 \text{ ft}^3 = 0.0283 \text{ m}^3 \tag{1}$$
$$126.67 \text{ ft}^3 = 1 \text{ GGE} = 4.5 \text{ l} \tag{2}$$
$$131.73 \text{ ft}^3 = 1 \text{ DGE} = 3.785 \text{ l} \tag{3}$$
$$1.14 \text{ GGE} = 1 \text{ DGE} \tag{4}$$
$$8.91 \text{ kg of } CO_2 = 1 \text{ gallon of gasoline} \tag{5}$$
$$10.15 \text{ kg of } CO_2 = 1 \text{ gallon of diesel} \tag{6}$$
$$0.0545 \text{ kg of } CO_2 = 1 \text{ ft}^3 \text{ of NG} \tag{7}$$
$$NG_{GE} \text{ (l)} = ((\%GF \text{ (m}^3) \times GGE \text{ (l)} \times Ratio_G))/(3.587 \text{ m}^3) \tag{8}$$
$$NG_{DE} \text{ (l)} = ((\%GF \text{ (m}^3) \times DGE \text{ (l)} \times Ratio_D))/(3.7279 \text{ m}^3) \tag{9}$$
$$CO_2 \text{ (F) (tons)} = (GF \times \text{molar volume} \times MW \text{ (CO}_2) \times \text{mass}$$

conversion $\times (\sum(((\text{mole Hydrocarbon})/(\text{mole gas}) \times (\text{A mole C})/(\text{mole Hydrocarbon}) \times (0.98 \text{ mole } CO_2 \text{ formed })/(\text{mole C combusted})))$ + $(\text{B mole } CO_2)/(\text{mole gas}))$ (10)

$$CO_2 \text{ (G) (tons)} = (V_G \text{ (l)} \times \rho_G \text{ (kg/l)} \times HHV_G \text{ (MJ/kg)} \times EF_G \text{ (kg/TJ)} \times 10^{-6} \text{ (tons))} \tag{11}$$

$$CO_2 \text{ (D) (tons)} = (V_D \text{ (l)} \times \rho_D \text{ (kg/l)} \times HHV_D \text{ (MJ/kg)} \times EF_D \text{ (kg/TJ)} \times 10^{-6} \text{ (tons))} \tag{12}$$

$$CO_2 \text{ (NG}_{ge}) \text{ (tons)} = 1.956 \times NG_{GE} \times Ratio_G \times \text{ton}/1000 \tag{13}$$

$$CO_2 \text{ (NG}_{de}) \text{ (tons)} = 2.668 \times NG_{DE} \times Ratio_D \times \text{ton}/1000 \tag{14}$$

$$CO_2 \text{ (T) (tons)} = CO_2 \text{ (F)} + CO_2 \text{ (G)} + CO_2 \text{ (D)} + CO_2 \text{ (NG}_{ge}) + CO_2 \text{ (NG}_{de}) \tag{15}$$

$$CO_2 \text{ (S)}_{(@ X\% \text{ GF})} \text{ (tons)} = CO_2 \text{ (T)}_{@ 100\% \text{ GF}} - CO_2 \text{ (T)}_{@ X\% \text{ GF utilized}} \tag{16}$$

Where:
ft^3= Cubic feet;
m^3 = Cubic meter;
l = Liter;
kg = Kilogram;
GF = Gas flared in m^3;
$Ratio_G$ = Ratio of fifteen years distribution of gasoline to diesel (0.857);
$Ratio_D$ = Ratio of fifteen years distribution of diesel to gasoline (0.143);
NG_{GE} = Natural gas gasoline equivalent in liter;
NG_{DE} = Natural gas diesel equivalent in liter;
GGE = Gallon gasoline equivalent;
DGE = Diesel gasoline equivalent;
CO_2 (F) = Carbon dioxide from flared gas in tonnes;
CO_2 (G) = Carbon dioxide from combustion of gasoline in tonnes;
CO_2 (D) = Carbon dioxide from combustion of gasoline in tonnes;
CO_2 (NG$_{ge}$) = Carbon dioxide from combustion of NG-based gasoline in tonnes;
CO_2 (NG$_{de}$) = Carbon dioxide from combustion of NG-based gasoline in tonnes;
CO_2 (T) = Total carbon dioxide in tonnes;
CO_2 (S) = Carbon dioxide saved (in tonnes) using strategic fuel substitution;
ρ_G = Density of gasoline (0.745 kg/l);
ρ_D = Density of diesel (0.832 kg/l);
V_G = Volume of gasoline in liters;
V_D = Volume of diesel in liters;
HHV_D = Higher heating value of diesel (45.77 MJ/kg);
HHV_G = Higher heating value of gasoline (46.54 MJ/kg);
EF_G = Emission factor of CO_2 for gasoline engine (69300 kg/TJ);
EF_D = Emission factor of CO_2 for diesel engine (74100 kg/TJ);
Molar volume = conversion from molar volume to mass (23.685 m^3/kgmole);
$MW_{(CO2)}$ = CO_2 molecular weight;
Mass conversion = tonne/1000 kg;
A = the number of moles of carbon for the particular hydrocarbon;
B = the moles of CO_2 present in the flared gas stream.

It is worth noting that the NG composition of Nigeria origin was engaged in this work as utilized and reported in literature [11].

A. Procedures

The procedures undertaken with some assumptions made in this study demand details. Also, the need to succinctly describe the procedures used in this work for proper understanding of the subject is paramount. The procedures include:

i. Fifteen year data as earlier stated were used in order to probe back in terms of the key input parameters (volume of gas produced, GF, gasoline and diesel) used in the study. Since the data for the year 2015 were not complete as at the time of this work, 2014 was used as baseline year.

ii. The total volume of GF in 2014 was assumed to be utilized as transportation fuel in vehicles, hence converted to gasoline and diesel equivalents in terms of energy content. The average ratio of distribution of gasoline and diesel for 15 years as obtained from NNPC was used in rationing the NG-sourced gasoline and diesel. These involved Eqs. (1-4 and 8-9).

iii. The percent of the total amount of GF approximately equals to the volume of gasoline and diesel distributed for the baseline year subject to the ratio mentioned in (ii) was determined. Maximum of 33% of total GF in 2014 gave approximately the volume of both gasoline and diesel for the baseline year. Therefore, this informed the choice of NG utilization (from 33, 30, 25, 20, 15, 10, 5, 3, 1 and 100%) of the total GF for this work. This is termed scenario 1, which involved the strategic NG substitution. The second scenario is termed baseline scenario, where the actual values of the amount of gasoline and diesel distributed as sourced from NNPC in the year 2014 was used. The 100% in scenario 1 and the baseline scenario are for comparison purposes.

iv. For scenario 1 at 33% utilization of the total GF, no gasoline and diesel was utilized since the entire NG equivalent of gasoline and diesel were used. At less than 33% use of the flared gas as fuel, gasoline and diesel were utilized to complement the total fuel distributed for use. This provides for flexibility in the quantity (% flared gas) that can be used as fuel from 33% to 1%.

v. The amounts of CO_2 from the volume of GF, volume of NG equivalent of gasoline and diesel and volume of gasoline and diesel consumed were estimated depending on the percent of flared gas utilized as transportation fuel (scenario 1). Eqs. (5-7, 10-14) were used for estimation of the amounts of CO_2 from the fuels (flared gas, NG-sourced gasoline and diesel, diesel and gasoline).

vi. Estimated total CO_2 released via this work was the sum of CO_2 from all the fuels (Eq. (15)) while estimated total CO_2 saved at specific percent utilization of flared gas was estimated as total CO_2 at 100% flaring of gas minus estimated total CO_2 at the same specific percent utilization of flared gas (Eq. (16)).

vii. Energy contents of the fuels and the current local prices were used to evaluate the cost benefits of using NG as fuel substitute for gasoline and diesel. The payback period was also estimated based on the price of NG and the cost of engine retrofitting.

viii. The exchange rate used was Nigerian Naira (N) 197 to US$1. The price of N86.50 per liter (gasoline), N120 per liter (diesel) and $2.5 per 1,000 ft^3 (N17.32 per m^3) was used in this work. Energy contents of 1 gallon of gasoline and diesel, and NG were taken as 125,000 BTU (British thermal unit), 139,200 BTU and 1,050 BTU. Engine retrofitting cost was N150,000.

III. RESULTS AND DISCUSSION

A. Gas Flaring and Pretroleum Consumption

A.1 Gas Flaring

GF is a wasteful and destructive act which has been on in the country for more than five decades. The irremediable and immeasurable implication of this notorious action lives with us as a nation and it is hugely bore by the inhabitants of the micro-environment of the Niger Delta region. Domestically, this act has left indelible footprint of environmental degradation, ecological destruction, socio-economic problems and serious health concerns. National and global effects of gas flaring as to do with the colossal damage on the atmosphere due to the discharge of obnoxious gases and particles [13]. Though GF flaring activities in the country is on the decline due to fair increase in the utilization of NG domestically and as export commodity, internationally. As seen in Table 1, percent GF has decreased from 56.76% in 2000 to 15.28% in 2014. Apparently, this shows a considerable reduction in the volume of GF yet the quantity of gas produced signifies that the quantity flared is still much and this needs to be addressed urgently. CO_2 from the flaring of gas contributes to global warming and this source is nationally important as it contributes to 24% of total national emission in the year 2000 [3].

TABLE 1. GAS FLARING (MILLION CUBIC METER) AND, GASOLINE AND DIESEL (000 LITERS) DISTRIBUTION IN NIGERIA

Year	GP	GF	%GF	Gasoline	Diesel
2000	42,732	24,255	56.76	4,761,073	1,985,639
2001	52,453	26,759	51.02	7,142,715	2,664,542
2002	48,192	24,836	51.53	8,687,595	2,645,976
2003	51,766	23,943	46.25	8,725,938	2,375,711
2004	58,964	25,091	42.55	8,676,810	1,916,000
2005	59,285	23,003	38.80	8,644,260	2,368,000
2006	82,037	28,584	34.84	8,306,985	1,649,749
2007	84,707	27,307	32.24	8,859,802	1,384,956
2008	80,604	21,811	27.06	7,206,729	1,273,203
2009	64,883	17,988	27.72	6,876,577	648,417
2010	67,758	16,468	24.30	6,353,518	879,368
2011	60,720	12,318	20.29	5,688,450	977,892
2012	64,695	11,279	17.43	5,017,535	676,728
2013	61,642	12,701	20.60	3,816,267	733,822
2014	72,962	11,269	15.28	3,969,710	397,898

Note: GP = Gas Produced; GF = Gas Flared. Source: [16 -23]

A.2 Petroleum Products Consumption

The volume of gasoline and diesel distributed from 2000 to 2014 is presented in Table 1. A reduction in the quantities distributed in the country was observed from 2007 to 2013. This may be due to increased utilization of renewable energies and NG for electricity generation by some companies in the country. From Table 1, it was observed that more of gasoline was distributed compared to diesel. This increase is in multiple of five to seven and can be attributed to the demand and applications of gasoline as fuel to that of diesel. The average ratio of distribution of gasoline to diesel was 7:1 (Table 1). Combustion of these fuels in internal combustion engines, especially in the transport sector can lead to release of pollutants (majorly CO_2) into the atmosphere which contributes to global warming and climate change. Nationally, the transport sector has been reported to contribute 12.1% of total emissions in the country [3]. This value reflects 18.4% of the total national emissions from the energy sector.

TABLE 2. CARBON DIOXIDE (TONS) FROM GAS FLARING AND CONVENTIONAL FUELS (GASOLINE AND DIESEL)

Year	CO_2 (GF)	CO_2 (Gasoline)	CO_2 (Diesel)	CO_2 (Total)
2000	50,598,437	11,439,860	5,603,027	67,641,325
2001	55,822,040	17,162,447	7,518,739	80,503,226
2002	51,809,587	20,874,470	7,466,350	80,150,407
2003	49,947,635	20,966,600	6,703,723	77,617,958
2004	52,342,232	20,848,556	5,406,522	78,597,309
2005	47,986,030	20,770,345	6,681,964	75,438,340
2006	59,629,992	19,959,944	4,655,221	84,245,157
2007	56,965,495	21,288,247	3,908,036	82,161,778
2008	45,500,000	17,316,258	3,592,693	66,408,952
2009	37,523,972	16,522,973	1,829,687	55,876,631
2010	34,354,326	15,266,172	2,481,378	52,101,875
2011	25,696,162	13,668,152	2,759,391	42,123,705
2012	23,528,117	12,056,085	1,909,574	37,493,775
2013	26,494,764	9,169,690	2,070,681	37,735,135
2014	23,509,175	9,538,380	1,122,779	34,170,334

B. Carbon Dioxide from Gas Flaring and Petroleum Products Consumption

Table 2 shows the quantity of CO_2 released through the flaring of NG and consumption of gasoline and diesel. Estimated total CO_2 from GF, gasoline and diesel were 7.41 x 10^7 tons, 2.10 x 10^7 tons and 6.73 x 10^6 tons, respectively, for the 15-year consideration (Table 2). For the baseline year, 2.35 x 10^7 tons, 9.54 x 10^6 tons and 1.12 x 10^6 tons of CO_2 were estimated for GF, gasoline and diesel. For the duo of petroleum products a sum of 1.07 x 10^7 tons of CO_2 were discharged into the environment (Table 2). Obviously, the amount of CO_2 released via gas flaring (2.35 x 10^7 tons) is significantly higher (1.78 x 10^7 tons) than the combined CO_2 emitted through gasoline and diesel. This is corroborated by the fact provided in the national emission inventory that the total emissions from gas flaring (24%) is more than total emissions from transport (12.1%), as the transport section of the nation uses mainly gasoline and diesel as fuel.

In this context, the two main contributors to the amount of CO_2 released from the energy sector (responsible for 53.6% of total CO_2 emission and 70.4% of national total GHG emission (1.55 x 10^8 CO_2 e)); gas flaring and transport sub-sectors can be harnessed as sources of CO_2 reduction on national scale. The carbon and environmental footprints as presented by both the current study and national emission inventory show the urgency to addressing the amounts of CO_2 released to the environment as a country. In addition, the global clamour to cut down CO_2 emissions by nations of the world (Nigeria inclusive) and the global drive to curb global warming and climate change, this nation is under compulsion to seek ways and technologies to reduce CO_2 emission. Furthermore, in consonance with the international outcry for sustainable development in terms of sustainable energy development and sustainable environment, the large quantity of CO_2 from these two sources needs prompt attention.

C. Strategic NG Utilization

The substitution of NG for conventional fuels (gasoline and diesel) using various percent of total volume of GF (from 33% to 1%) is presented in Table 3. The strategy herein is that different percent of the volume of GF can be employed at any point in time to displace the use of gasoline and diesel distributed for consumption. For this study, the strategy is that at 33% utilization of flared gas as fuel substitute for gasoline and diesel, 3.72 x 10^9 m^3 of NG is available, which translate to 39.98 x 10^8 l of gasoline and 53.99 x 10^7 l of diesel equivalent in energy terms (Table 3). As these volumes of NG equivalent of gasoline and diesel correspond to the total volume of gasoline and diesel distributed in the year 2014, the supply is sufficient and there is no need for gasoline and diesel fuel for use. At less than 33% utilization of GF, there is need to use gasoline and diesel to complement the supply as there will be shortfall in supply of the petroleum products. It can be seen in Table 3 that the more the volume of NG used as substitute to gasoline and diesel, the less of these products are consumed and vice versa.

TABLE 3. SUBSTITUTION OF NATURAL GAS FOR CONVENTIONAL FUELS

GF utilized (%)	NG (10^7 m^3)	NG$_{GE}$ (10^7 liter)	NG$_{DE}$ (10^7 liter)	Gasoline (10^8 liter)	Diesel (10^7 liter)
33	371.88	399.82	53.99	0	0
30	338.07	363.47	49.08	3.63	4.91
25	281.73	302.89	40.90	9.69	13.09
20	225.38	242.31	32.73	15.75	21.27
15	169.04	181.74	24.54	21.81	29.45
10	112.69	121.16	16.36	27.87	37.63
5	56.35	60.58	8.18	33.92	45.81
3	33.81	36.35	4.91	36.35	49.08
1	11.27	12.12	1.64	38.77	52.36

D. Carbon Dioxide Reduction by Strategic NG Utilization

The amounts of CO_2 emitted under the fuel substitution strategy are illustrated in Figure 1. From Table 3, the volumes of fuels used for the strategic NG substitution were given while in Figure 1, the CO_2 released from these fuels are shown. It can be observed that increase in NG substitution via percent of GF utilized (33% to 1%) results in reduction in CO_2 released in burning the fuels (see Figure 1). Comparing the substitution strategy with the 100% flaring of NG (inclusive of total volume of petroleum products), reduction in the quantity of CO_2 was noticed. In addition, the more the volume of fuels substituted (less volume of NG-equivalent diesel and gasoline), the more the amount of CO_2 emitted from gas flaring and consumption of diesel and gasoline. At 100% gas flared (0% NG utilization), CO_2 released is the sum of CO_2 from flaring and combustion of total volume of gasoline and diesel (under scenario 1). The latter is similar to the baseline scenario where 100% actual total volume of gas is flared and 100% actual total volume of gasoline and diesel are burnt.

The aforementioned reduction in the amounts of CO_2 due to the fuel substitution strategy is clearly illustrated in Figure 1. Based on the strategic NG substitution involving the two scenarios, the same trend is observed for total CO_2, volume of GF, CO_2 from GF and combustion of gasoline and diesel (Figure 1). This trend is indicative of the fact that there is a gradual decrease in the aforementioned variables as shown in Figure 1 as the NG substitution strategy is increasingly applied. That is, as the percent NG utilized is increasing with the corresponding substitution of gasoline and diesel, the volume of GF, total CO_2 and CO_2 from GF, and gasoline-diesel consumption are decreasing. This also applies to the 100% gas flaring situation in scenario 1 and the baseline scenario.
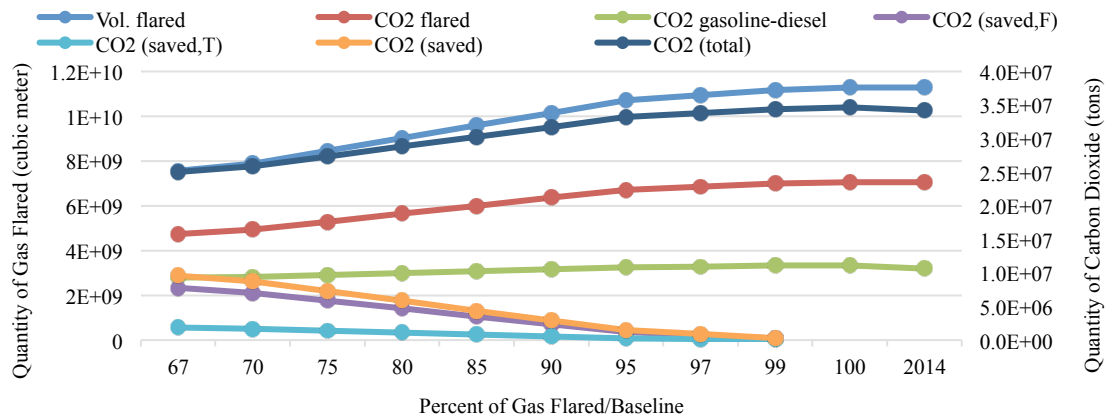
Fig. 1. Carbon dioxide reduction via strategic NG substitution

Since two main sources of CO_2 (gas flaring and transportation) are involved in this study using strategic NG substitution, CO_2 reduction is to be achieved at both sources. As observed in Figure 1, CO_2 saved from GF, transportation and total CO_2 from these sources follow the same pattern. The increase in the strategic substitution of NG for gasoline and diesel has impacted positively on reducing CO_2 from these sources. With a gradual increase in percent of flared gas used as NG substitute, an increase in the amount of CO_2 saved from these sources is observed in Figure 1. At 33% utilization of the total volume of GF, total CO_2 was 2.5×10^7 tons, which implies that 9.63×10^6 tons (27.79%) of CO_2 were saved using the strategic fuel substitution as against 3.46×10^7 tons and 3.42×10^7 tons at 100% flaring situation and baseline scenario, respectively. Also, at the least volume of GF (1%) utilized for fuel substitution, 0.84% (2.9×10^5 tons) of CO_2 (3.43×10^7 tons) was saved. This demonstrates that the percent reduction of CO_2 possible from the two sources subject to the strategic fuel substitution (33% to 1%) is between 27.79% and 0.84%. By deduction, the more the volume of GF available for fuel substitution, the more the amount of CO_2 saved.

E. Statistical Analysis Result

In this present study, correlation coefficients of -0.0463, 0.0856, -0.5301, 0.7888, 0.7904 and 0.6610 were obtained as relationships between GF and gas produced, gasoline and gas produced, diesel and gas produced, gasoline and GF, and diesel and

GF, and diesel and gasoline, respectively. Of all these, moderately strong and positive relationships exist between gasoline and GF, diesel and GF, and diesel and gasoline while negative and fairly strong correlation exists between diesel and gas produced. For GF and gas produced, and gasoline and gas produced, very weak and negative, and very weak and positive relationship exist, respectively. In addition, the ANOVA test carried out on all the data used in this work showed that the data were statistically not the same as indicated by $F_{critical}$ (2.7694) < $F_{observed}$ (159.1). With P-value << 0.00001 at 95% confidence interval, the data obtained and employed in this study were significant.

F. Cost Benefits

F.1 Based on Energy Content

For the development of strategic NG substitution to be viable, each segment of the chain must be feasible in its own right. For this reason, the economics of NG supply is considered solely. GGE is the amount of alternative fuel equal to the energy content of one gallon of petrol. GGE allows consumers to compare the cost of competing other fuels against gasoline. In the light of the above, NG (₦1,213/mmBTU) is clearly of lower cost compared to gasoline (₦3,114/mmBTU) and diesel (₦3,270/mmBTU) in terms of energy content. The economic benefit of NG as a substitute fuel shows 61.0% and 62.9% cost reduction for

gasoline and diesel, respectively. This result is in agreement with previous study which reported that NG is at least 30% cheaper than gasoline [14].

F.2 Based on Mileage and Payback Period

For this study, cost per millage of N5.5/km for NG in car (gasoline engine) and N7.5/km for NG in bus (diesel engine) as against N14/km and N20/km, for gasoline and diesel respectively, was adopted [14]. It was observed that the percent cost reductions (60.7%, gasoline; 62.5%, diesel) based on energy content reported was similar to the values estimated in this study. Thus, this informed the choice of the cost per millage. Since this work is similar to a previous study in this regard, it can be reported here that profits of N850/day (N8.50/km) and N1250/day (N14/km) for a distance of 100 km are obtained. A payback period of 6 months is also reported for initial cost of N150,000 in retrofitting the engine [14].

G. Implication of Strategic Fuel Substitution on Sustainable Development

Millennium development goals (MDGs) gave birth to sustainable development goals (SDGs) on September 25, 2015 as countries of the world adopted a set of goals to end poverty, protect the planet and ensure prosperity for all [15]. In order to achieve the said milestones in the next 15 years, 17 goals with specific targets were highlighted. As Nigeria is a signatory to this global treaty, the onus is on the country to fashion out policies, plans and strategies to implementing the SDGs. This can go a long way in addressing the issue of SD in both the Niger Delta region (gas flaring activities) and the whole country (gasoline and diesel consumption in the transport sector and gas flaring operations) as it relates to this present study.

The fact that gas flaring and transportation are majorly significant sources of emission is corroborated by the national emission inventory [3]. In Nigeria, the indiscriminate flaring of NG and unsustainable consumption of gasoline and diesel which affect both energy and environmental sustainability could be solved via the strategic substitution of fuel using NG. In view of the findings of this study, the strategy of fuel substitution seems a potential way of abating CO_2 emissions from the two sources under focus, which by extension reduces the national emission of CO_2 in the country. This assertion is supported by a previous study on the assessment of millennium development goal 7 in the Niger Delta region of Nigeria via emissions inventory of flared gas that considerably progress has been achieved through increased NG utilization that has significantly reduced gas flaring [11]. In similar way, the strategic fuel substitution presented in this work could assist in achieving the SDGs, especially goals 7 (ensuring access to affordable, reliable and sustainable energy) and 13 (urgent action to combat climate change and its impacts).

NG substitution strategy is not rocket science but a long existing technology that can be tapped into to ameliorate or solve completely the protracted fuel supply and distribution related problems in the country. The political will-power of the government serving as the driving force towards achieving the aforementioned and unending list of merits attached to it is fundamental.

H. Conclusion

This study proposed strategic substitution of NG as transportation fuel in place of gasoline and diesel. The results obtained from this work showed that at 33% and 1% utilization of flared gas, CO_2 released were estimated as 2.5 x10^7 tons and 3.43 x 10^7 tons, compared to 3.46 x 10^7 tons (scenario 1) and 3.42 x10^7 tons released for the baseline scenario, respectively. These results correspond to CO_2 decrease by 9.63 x 10^6 tons (27.79%) and 2.92 x 10^5 tons (0.84%), for 33% and 1% NG utilization, respectively. Based on energy contents of the fuels, CNG use as transport fuel is 60.7% and 61.0% cheaper than gasoline and diesel, respectively, with six months of payback period on engine retrofitting. The results revealed the possible positive impact of this work on SDGs.

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Appendix

From Eq. (2), the cost per energy content of gasoline is given as:

1 gallon of gasoline = 125000 BTU and 1 gallon of gasoline = 4.5 l

1 l (gasoline) = 27,778 BTU

At the current pump price of gasoline in Nigeria = ₦86.50/liter

This implies that 1 l (gasoline) = ₦86.50/27,778 BTU = ₦3,114/mmBTU.

Also, using Eq.(3) to estimate the cost per energy content of diesel:

Energy content of 1 gallon of diesel =139,200 BTU and 1 gallon of diesel = 3.785 l

1 l (diesel) = 36,777 BTU

At the current pump price of diesel (Nigeria) = ₦120/l

This gives 1 l of diesel = ₦120/36777 BTU = ₦3,270/mmBTU

For cost per energy content of NG,1 ft^3 of NG = 1,050 BTU

1 m^3 of NG = 35.34 ft^3 = 35.34 x 1050 BTU = 37,102 BTU

At the current pump price of CNG in Nigeria = ₦45/m^3

This implies 1 l of NG = ₦45/37,102 BTU = ₦1,213/mmBTU.

Utilization of the Internet in
Pipeline Protection against Vandalism

Udeme E. Okon
Department of Electrical and Information Engineering
Covenant University, Ota, Ogun State
Nigeria.
udy4life2014@gmail.com

Abstract— **The huge nightmare defying Africa's economy known as pipeline vandalism had obviously rendered all forms of protection innovations abortive because these innovations were strictly centered on a lone and narrow method of "sensor this; sensor that" type of protection design. Although prevalent in rural communities, it is clear that the perpetrators of this crime are no novice to plugging out the sensor based detection/protection systems' eye/ear before they carry out any operation; therefore, it becomes needful for the introduction of a thoughtful and appropriate method of protection that will ensure a global permanent solution to this atrocious nightmare. Consequently, this paper proposes the utilization of the internet in pipeline protection against vandalism; it also demonstrates the utilization of the Internet in the protection of pipelines taking into cognizance an accurate measure and comparison of the physical quantities around the conveyed fluid.**

Keywords— Pipeline; Protection; Vandalism; Internet.

I. INTRODUCTION

Pipeline transportation right from the 19th century, has proven to be the most effective method of transferring some kind of raw product from the point of extraction to the refinery or finished product from the refining point to the final consumers. Pipeline transportation is also a means for transporting toxic materials and waste to the points of neutralization or storage. In areas where there are minimal threat probabilities, it has proven to be the most cost effective and safest method. Pipeline management and flow control is very important to ensure that there is no service break to customers and consumers at the other end. Safety of pipeline is very important to the health of the people and the environment. Sometimes pipeline can be very lengthy travelling long distance away from the control station making it highly susceptible to vandalism. There must be proper system management to ensure pipeline security. This type of management usually involves highly sophisticated equipment that can capture especially the flow rate through the pipeline, operational status, pressure, and temperature which can be used to evaluate the healthiness of the pipeline at a particular point in time. Such equipment must be able to operate at real time and at the same time ensuring accuracy for effective monitoring. This work demonstrates the application of the Internet to pipeline monitoring and management to circumvent both planned and unplanned incidents. Planned incidents include security breaches while unplanned incidents are those resulting from natural conditions [2]. The importance of the

damage incurred can be graded as first, damaged by third party second, corrosion and third, equipment malfunction [1]. It is therefore the major concern of the government to ensure security maintenance of the pipelines [2]. Overtime, numerous surveillance methods have been proposed and utilized in the servicing and management of pipeline to ensure safe operation. Modern methods of pipeline protection are operated either at ground level or may be airborne. Some of the mature technologies include; the use of sensor architectures both wired and wireless, physical patrolling around the site and pipeline Supervisory Control and Data Acquisition (SCADA) systems shown in figure 1. However, these technologies are not without practical drawbacks and limitations which serve as a spur for endless inquisition towards more reliable solution.
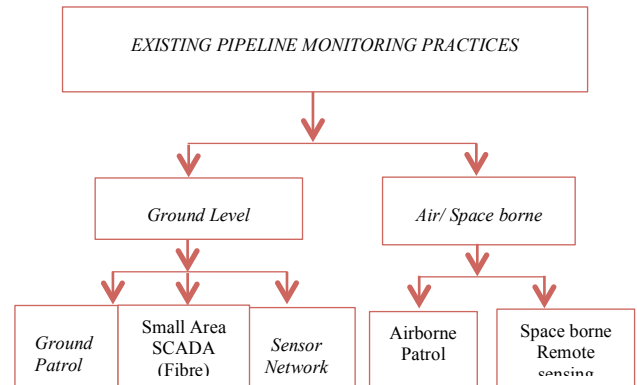
Fig. 1. Grouping Established methods for monitoring

A. Ground Level Methods for Pipeline Monitoring and Controls

The ground methods employed for pipeline monitoring majorly cut across three commonly practiced techniques, namely; Ground Patrol, Wired Sensor Network and small area SCADA systems.

1) Ground Patrol: Pipeline monitoring by ground patrolling has been a legacy technique over the years [1]. This involves a physical patrolling and inspection of the pipeline area either by leg or by land transportation system in order to

identify possible threat, intrusion or anomaly along or around the vicinity of the pipeline. Also to obtain an accurate measurement and assessment of defects so that human operators can take appropriate actions in the case of an incidence to prevent further damage. In Nigeria, a combined team of Pipelines and Products Marketing Company (PPMC) police and community vigilante groups are engaged to guard the pipelines. For efficiency purpose this method is always carried out in combination with other advanced method such as the aerial surveillance technique by the PPMC/Nigerian National Petroleum Corporation (NNPC) [2, 3].

2) Pipeline SCADA Systems: Supervisory Control and Data Acquisition (SCADA) systems used for pipeline monitoring centers on integrated data collection and control. The overall aim is to provide real-time security status of the entire pipeline to ensure applicable steps are taken by the monitoring team supervising the central information to either avoid or mitigate the threat. This technology utilizes several Remote Terminal Units (RTUs) that receive information from field instrument on the level of pressure, temperature, and rate of flow of the fluid flowing through the pipes in conjunction with the conditions of valves and pumps along the pipeline as seen in figure 2 [2].
In a typical SCADA network the RTUs are in turn linked to a central master station via communication channels such as satellite, cable, cellular, or fiber optic transmission media which determines whether the SCADA architecture is wired or wireless [2, 4].

Fig.2. Sowing RTUs linking Main Control Center
Source: http://3.bp.blogspot.com

3) Sensor Network: Sensor network has been in as one of the modern techniques available for pipeline monitoring and control. A sensor network can be either wired or wireless. The type of infrastructures available can determine the type of network architecture suitable for a particular application. A number of linear topology sensor networks have been designed to detect, locate and report anomalies such as leakages, corrosion, fracture and any other damages on the pipeline infrastructures [2]. In wired sensor networks, copper cables or fiber optic cables are used to effect both communication and electrical power supply to the different parts of the pipeline system. This network is feed with signals from regular sensor devices that measure specific qualities in and around the pipeline as seen in figure 3, such quantities include flow rate, pressure, temperature, vibration and probably humidity [2]. A Wireless Sensor Network (WSN) as the name implies comprised of several interconnected sensor nodes linked by a wireless communication channels. These sensor nodes are minute devices that can collect data externally, perform simple evaluations and communicate with other nodes in the network or the central station [2]. This type of network can either be categorized as infrastructure or infrastructureless network. An example of infrastructure network is the cellular wireless network and such network consists of wireless node with a network backbone. On the other hand ad-hoc and Wireless Sensor Network (WSN) can be said to belong to the infrastructureless network category since they are widely distributed, independent, dynamic topology, low-power, task–oriented wireless nodes [2].
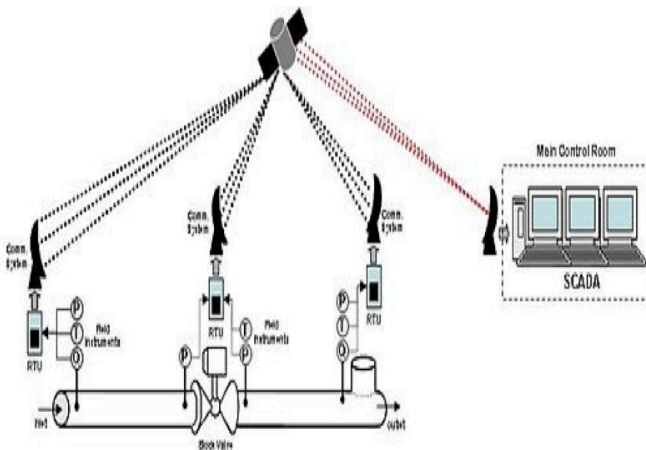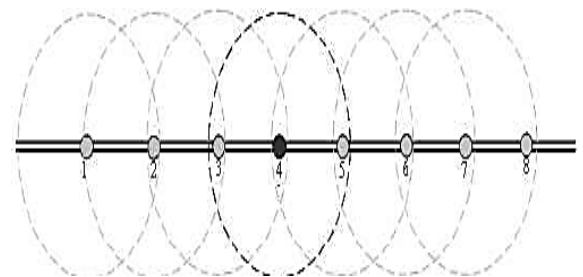
Fig.3. Showing Linear Sensor Network for Pipeline Monitoring Source: https://www.researchgate.net/

B. Air Space borne Methods for Pipeline Monitoring and Control

There are certain constraints that must be eluded with extra effort if the economic and environmental damage caused by pipeline injury is to be mitigated or absolutely avoided. To this end, air/space borne method for pipeline monitoring and control has been introduced as additional measure in combating threat intrusion and possible vandalism.

1) Airborne Patrol: Airborne patrol employs special patrol team which used airborne transportation to move along the area where pipeline intrusion and vandalism are rampant. Helicopters or other forms of aircraft can be used to achieve this aim. This method has the advantage of covering areas of restricted accessibility such as mountainous or swampy areas where ground patrolling is impossible. Special equipment and airborne scanners are used to capture the status and circumstances around the pipeline. Data and images are captured and sent through very complex processes which include automated classification, noise removal, layer extraction, automated filtering, georeferenced, calibration of geocoordinate system, data reprocessing and quality control. The final data is used as a warning signal for decision making [1].
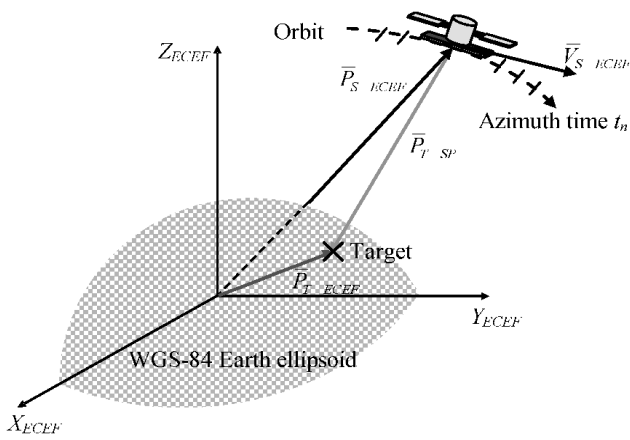
Fig. 4 Remote Sensing from Space Platform

2) Space borne Remote Sensing : Space borne sensors design depends on the type of orbit or platform they are mounted as shown in figure 4. There are no airborne scanner due to low temporal, long interval, inadequate number of data and limitation in flight over the pipeline corridor. The geostationary orbit, the polar orbit, and the sun-synchronous orbit are the three orbits where satellites are placed around the earth. However, the sun-synchronous orbit makes a good choice for space borne laser profile [1].

II. DRAWBACKS IN CURRENT PIPELINE INFRASTRUCTURE MONITORING

Pipeline infrastructure monitoring and control techniques discussed in section (1) have numerous benefits derived from their proper implementation. However, these methods are not without some drawbacks. Some of these drawbacks either make implementation of these techniques ambiguous or totally impracticable. Examples of these drawbacks are discussed below:

A. Coverage Limitation

Limitation in coverage may arise as a result numerous factors depending on the technique used in the monitoring process. In the physical patrol technique, limitation in coverage area can be as a result of inaccessibility of some areas where pipeline is running. In mountainous areas for example, the problem of accessibility may be as a result of unfavorable terrain [1]. Lack of adequately skilled personnel for airborne patrol operation also results in limitation of coverage and makes it necessary to have a backup plan. Coverage limitation can be experienced in the SCADA systems due to the inflexible architecture and rigid design of RTUs which limits their operational compatibility with other systems posing serious difficulty in extending the SCADA to other applications thereby limiting the coverage [2, 4].

B. Sensor Blackoutn

In pipeline monitoring and control the linear topology network is preferably employed for sensors' interconnectivity. This type of networking is very effective for communication since all sensor nodes are distributed on straight lines. But then, a lot of attention is also needed to justify the numerous demands essential for a linear network. Power supply to all the sensor nodes is very important. Connectivity is ensured as long as all nodes are up and functioning. This is a major requirement in pipeline monitoring because of the continuity of operation. However, reliability issues set in when there is malfunctioning of one or more of the sensor nodes with a consequential and unavoidable blackout of the entire network [2, 5].

C. System Complexity

For a timely response by human agents overseeing security status updates supplied by pipeline monitoring systems, real-time information covering the entire length of the pipeline is needed. For SCADA systems, network complexity may result from installation of several hundred RTUs communicating over dedicated links to a central master station. In systems where different sensor network or combined network architectures are used for reliable communication in pipeline monitoring systems, system may become bulgy and costly on the attempt to account for the combination of wired and wireless network architectures. Also, remote sensing platforms that used space may involve tedious technical manipulation which is common to very few expert personnel. Network maintainability and fault recovery mechanism should be taken seriously, as faults in the network or in the nodes can occur at any time for different reasons and can lead to very damaging consequences [2, 4].

III. PROPOSED SYSTEM

The proposed system used optical fiber technology intrinsically, in pipeline monitoring and control with the Internet used as the medium for communication. Optical fiber applications have been used as sensors to measure physical quantities such as temperature, pressure and strain by varying the intensity of the optical fiber properties. Intrinsic or active fiber sensing is when the optical fiber itself is used as sensing element [6].
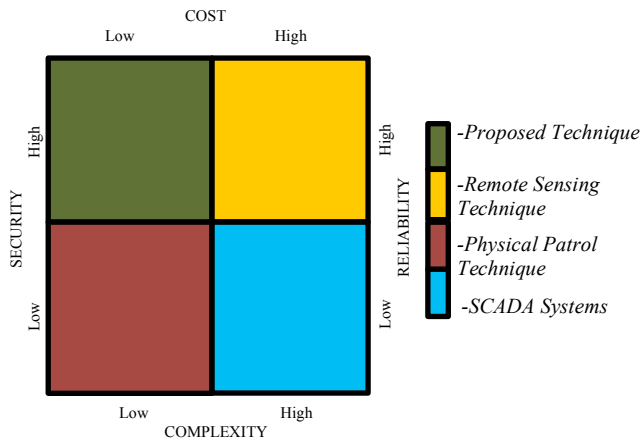
Fig. 5. Tile Chart Comparing Different techniques

In this form, optical fiber can be utilized in sonar application as optical acoustic sensor in pipeline monitoring. With Distributed Acoustic Sensing (DAS), acoustic events can be detected, discriminated and located on an optical fiber over a long distance based on optical fiber sensing [7]. This method has an advantage over other techniques in terms of security, reliability, and noncomplex system design. This can be seen in figure 5 above.
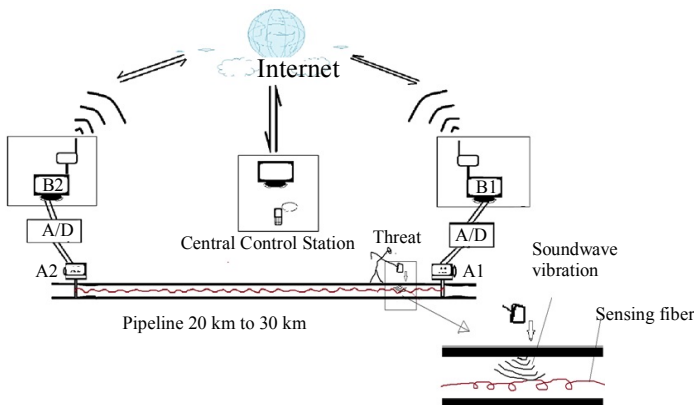
Fig. 6. Utilization of the Internet in Pipeline Protection

A. System Description

The diagram in Figure 6 is used to demonstration how the internet is used to achieve solution to pipeline vandalism. In the diagram, A1 represents control station equipment consisting of Distributed Acoustic Sensing (DAS) interrogator that separates out the optical fibers that is run through the pipeline into a collection of separate microphones.

This is spanned several kilometers from control station A1 to another control station at (A2). A/D is an advance signal processor and converter. B1and B2 comprised of some bi-

directional computing and routing devices that aid in signal conversion, recovery and real-time transmission of processed signal via the internet.

B. Principle of Operation/ Implementation

On the occasion of intrusion where there is a bang or a noise which is unmatched with the steady background hums around the vicinity of the pipeline, the distributed acoustic sensor in the optical fiber running inside the pipeline will detect and transfer the sound through real-time backscattering of light to control station at A1 or A2 where the detected signal is processed and passed to system B1 or B2 for transmission over the internet to the nearest protection station, depending on the point of the threat. The protection station personnel can then interpret and use such information for appropriate decision making to rescue the situation.

CONCLUSION/RECOMMENDATION

The design and installation of a pipeline transmission system, if to be totally saved from wasteful assaults, requires an excellent and applied protection mechanism of this form, pipeline vandalism which is virtually prevalent in this part of the world seems to be an African problem and it is likely that, the solution also will come from this part of the world. It has been shown in this work, how optical fiber technology can be intrinsically used with the Internet as the medium for communication to deliver an effective method for pipeline monitoring and control. As shown in figure 5 this technique has comparative advantages of low cost of implementation, low system complexity, high reliability and high security above existing methods. Is a well thought out solution as a contributive effort to the global battle against this lingering cynicism and is therefore, recommended for the Oil and Gas Sector to unify with existing expertise in the field during the design and installation of fluid transmission systems.

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Leadership Succession Planning: An Examination of Sole Proprietor Estate Surveying and Valuation Firms in Lagos Metropolis, Nigeria

Victor O. Oloyede
MTN, Nigeria
Falomo, Ikoyi,
Lagos

Mayowa Ajibola, Caleb Ayedun
Department of Estate Management
College of Science and Technology
Covenant University, Ota
Ogun State

Abstract - **This paper reports the results from a survey of 38 small sole- proprietor estate surveying and valuation firms in Lagos, Nigeria. A 45% questionnaire retrieval rate was achieved while CEOs/owners of estate surveying and valuation firms were interviewed. Descriptive statistics were used to analyze the respondents' general characteristics as well as their attitude toward business succession planning. The study found that sole-proprietor firm owners desired that their firms outlive them through transferring of the firms' businesses to their next generation. However, majority of these sole proprietors' next generation were not keen on pursuing real estate business related courses in their undergraduate daysin view of their exposure to modern technology and the influence of peers. Also, the study found that the ownersof these firms have not, as a matter of policy, planned for their succession because of the cultural and attitudinal beliefs and values, which forbid thoughts about death or incapacitation about a living soul. As a result, the study indicated that only 5% of sole proprietor estate surveying and valuation firms in this category have continued to the second generation in the study area. This outcome has serious implications for small professional service businesses' economic and job creation potential for Nigeria**.

Keywords: Succession Planning, Sole Proprietor Firm, Estate Surveying and Valuation Firm

I.   INTRODUCTION

Professional advices, more than ever before, are daily becoming more challenging in various ways. Integrity is dwindling among employees as much as in employers of labour, real estate business inclusive. Academically, standards are fallen as certificates obtained in some educational institutions are subject to doubts based on the performance of a few of their products. In view of the glaring poor performance in the past twenty years, heavy political upheavals and election re-runs, poor economy and the ever increasing unemployment situation in Nigeria coupled with inability of the monthly entitlements of State government employees, the economic landscape in Nigeria has actually changed. The identified disruptive tendencies have produced changing customer expectations therefore for any service industry to survive or compete and win in today's business world, such service firm needs to cultivate executive talent and teams that can recognize and seize strategic opportunities in constantly shifting conditions. Succession planning can help minimize the disruptive tendencies occasioned by unplanned leadership change.

Westhead [1] explained that the reason of succession failures is mainly the lack of planning and preparations since people claim that the operational demands of running a service firm can be all-consuming, forgetting that it is very vital that business leaders take the time needed to assess their organization's business succession planning.As a business grows, the long-term survival of the business and the preservation of the wealth that has been saved will likely depend on getting ahead of those changes through strategic succession planning. For owner-managed business, a solid succession plan can stimulate the growth of the business, reduce taxes, and set the stage for retirement. No one would go through the troubles of establishing a service firm, bearing the risk associated and making the necessary sacrifices without hoping that the business outlives him. Knowing and relentlessly building value that endures is the dream that motivates entrepreneurs but, surprisingly, in many businesses, too little of that work goes into determining who will take over when the founders leave the

stage later or sooner than anticipated. In the words of Gersick et al., [2], succession is the final test of any business outfit becauseif business becomes large, continuity becomes a unifying interest and if the enterprise is passed on while it is profitable and in good condition, it will be the main driving force for the new generation of leaders.

2.1 Succession Planning in Estate Surveying and Valuation Firms

Most estate surveying and valuation firms are small scale enterprises. Berryman [3] defined a small enterprise as a business in which one or two persons are required to make all the critical management decisions such as finance, accounting, personnel, purchasing, processing or servicing, marketing and/or selling, without the aid of internal specialists and with specific knowledge in only one or two functional areas. They are smaller, more localized firms which constitute a significant proportion of the industry and provide tailored services to smaller customers in their geographic area. Hillman [4] noted that suchfirms areof sole proprietorships adapting to fit the needs of the changing market through business specialization. Bucher and Stelling [5] found that the professionals in such service firms tend to resist traditional roles, highly spontaneous and more competitive and politically active as they aspire to become recognised and relevant in business.

Headd [6] studied small businesses in America and found that they represent a significant portion of the global economy, employing one-half of the entire work force while Anonymous [7] confirmed that they represented 99 percent of all businesses in America. Althoughsmall business ventures contribute to the local economy and are a source of growing capitalism around the globe yet they face a number of challenges in areas such as acquiring resources, obtaining and retaining clients. Research by Klein [8] found that about 50 percent of small businesses fail in the first five years of existence owing to poor organizationoccasioned by ineffective management of the transition from one life cycle stage to the next.

World Bank [9] study onsmall and medium enterprises in Africa showed that problems that existed among small local markets included undeveloped regional integration and very difficult business conditions. These difficult business conditions include cumbersome official procedures, poor infrastructure, poor legal systems, inadequate financial system and unattractive tax regimes. The World Bank [9] defined succession planning as a processthat takes years of careful decision-making to set the stage bearing in mind, the forces of at play in succession planning. The supply element is focused on assessing and developing talent along defined principles so that the people you see as your successors will be ready for their future roles, while the demand element considers compensation planning to make sure those rising leaders know you appreciate them, so they either join or remain with the company long enough to play those roles.

2.2 Leadership Types, Characteristics and Outcomes

Various researchers identified twelve types of leadership. These types of leadership and the researchers concerned are: Responsible leadership [10]; Stakeholder leadership [11]; Ethical leadership [12]; Servant leadership [13]; Authentic leadership [14]; Transformational leadership [15]; Charismatic leadership [16]; Spiritual leadership [17]; Virtuous leadership [18]; Stewardship theory of leadership [19]; Relational leadership [20] and Shared leadership [21]. Many factors lead to the challenges faced in succession planning. First, is the inability to pin down very few members of staff or any of the firm's owner children with requisite skills and attributes. Second, Managers are often to blame for failing to cultivate leadership talent in the junior managers. Most people pay little attention to structuring job experiences, do little to furnish appropriate models and rarely provide ongoing reinforcement and support for the skills and competencies available via training. In a few cases, individuals who truly want to develop and bring positive change to a firm may ultimately be misconstrued of their intention and thus leave in frustration. According to Rahman [22], highly skilled workers are not often comfortable with the traditional autocratic leadership styles hence 'job hopping has become a trend among young highly qualified and experienced people.

2.3 Leadership Competencies and Traits

Leadership is commonly seen as an important variable affecting organizational performance. Leadership is a process by which an individual influences a group of individuals to achieve common goals. Yukl [23] found several traits that were related to leadership effectiveness which include a high energy level and tolerance for stress, self-confidence, including self-esteem and self-efficacy, an internal locus of control orientation, emotional stability and maturity, and personal integrity. The skills approach suggests that while leadership abilities can be developed, whereas traits are more inherent in an individual.

Leadership competencies have been defined as "the combination of knowledge, skills, traits, and attributes that collectively enable someone to perform a given job" [24]. Yukl [23] offered some general suggestions for applications on leadership styles. These styles include maintaining self-awareness, developing relevant skills through continuous learning and leadership development, noting that strength can become a weakness in a different situation, and compensating for weaknesses by using delegation or staff with complementary skills.

Attitudes are a complex combination of things we tend to call personality, beliefs, values, behaviors, and motivations. An attitude includes three components: an affection (a feeling), cognition (a thought or belief), and behavior (an action). Attitudes help us define how we see situations, as well as define how we behave toward the situation or object. According to Yuki [23], leaders who want to be great must think about the future most of the time by thinking about where they are going rather than where

they have been, maintain a positive attitude and think about the opportunities which tomorrow may avail rather than focusing on the problems of the past and finally maintain a positive attitudein addition to being long-term thinkers. At all things and in any situation, one of the most important leadership qualities is the acceptance of personal responsibility. Leaders never complain, never explain and instead of making excuses, they make progress and accept responsibility for either success or failure of any action taken.

2.4 Leadership Succession Planning

Winn [25] noted that a business owes its success to the drive, vision and creative energy of its owner and identified four main components to leadership succession planning. These are: identifying the potential successor; changing management style; successor training and development and selecting the successor. The sole-proprietor must be able to identify what the firm need from the future leader,whatthe future leader needs from sole-proprietor owner, the extent of would-be leaderstrategic thinkingand consistent drive for results, ability to lead and build talent,entrepreneurial edge and commitment to the firm's mission and values. In the same vein, the future leader needs the support of the owner to ensure consistent drive for results, commitment to the firm's mission and values, identify opportunitiesforfirm growth, ensure competitive compensation andgive rewards and recognition by acknowledging value of contribution of the future leader.

The role of leaders, according to George [26], in today's turbulent environment is crucial. Leaders can be identified and chosen through their skills and talents. According to Mumford et al., [27] there are cognitive, interpersonal, business and strategic skills. A future leader must be able to communicate clearly in writing or by discussion, be an active listener and be able to weather turbulent periods with less stress. It must be borne in mind that leaders, depending on their intentions, visions, experience, strategies, objectives, hidden drives and motives, education and expertise have the power to cause either significant improvement or degradation of the world around them. In the words of Hollenbeck et al., [28], a high potential leader must always seek opportunities to learn, act with integrity, adapt to cultural differences, be committed to make a difference, seek broader business knowledge, bring out the best in people, sees thingsfrom a new angle, has the courage to take risks, seek and use feedback, learn from mistakes and be open to criticism.It is through all these that a potential leader can be identified and chosen.

3. Methodology

According to Denzin and Lincoln [29], a study of succession planning of individual firms is a social phenomenon. For this reason, the researcher employed the descriptive survey method by presenting facts concerning the nature and status of a situation, as it exists at the time of the study.

According to the 8th edition of the directory of the Nigerian Institution of Estate Surveyors and Valuers (2014), there are eight hundred and forty-four (844) Estate Surveying and Valuation firms in Nigeria. From the collated list by ESVARBON office, apart from the 23 demised sole proprietors as at 12th November, 2014. There are three hundred and sixty-six (366) estate surveying and valuation firms with their head offices in Lagos State alone. Thus Lagos State accommodates about 43.4% of the entire Estate Surveying and Valuation firms in the country. Simply put, 366 principal partners/owners of the firms would form the study population of Estate Surveyors and Valuers to be used for the study. Taking 10% of the population of 366 principal partners/owners of the firms in Lagos State as the sample size, the study sampled 8 firmsin Victora Island, Ikoyi and Lekki axis; 13 firms within Broad Street /Marina, Yaba axis; 4 firms within Surulere, Ilupeju, Anthony, Festac, Isolo axis; 12 firms within Ikeja, Maryland Magodo, Ojota, Egbeda, Magodo and 1firm within Apapa, Ojoo axis. Thirty-eight firms were involved in the study across board. Responses to items on the each questionnaire were analyzed using several descriptive and inferential statistic methods with the use of Statistical Package for Social Science (SPSS) Version 16.0. The results of data analysed were presented with the use of tables, charts, percentages, mean and ranking.

4. Data Analysis and Discussion

Thirty-eight questionnaires were distributed to staff of sole-proprietor estate surveying and valuation firms and monitored for retrieval between December 2015 and February, 2016. It took many personal visits to the respondents before 17 questionnaires were retrieved giving a 44.7% success rate. This could be as a result of members of staff of CEOs/Founders estate surveying and valuation firms were reluctant to commenting on their employers. All efforts to guarantee the confidentiality of any information willingly given, by any of them, fell on deaf ears. Only 17 CEOs/Founders gave express permission for their staff to fill the questionnaire.

Table 1: General Data on CEOs/Founders and Staff of Selected ESV Firms

Information	Groupings	Staff (%)
Age	Up to 30 years	7 (41%)
	31-40 years	6 (36%)
	41-50 years	4 (23%)

Academic and Professional Qualifications	(a) HND/B.Sc. (b) Probationer (c) ANIVS (b) ESV (c) RICS	17(100%) 3 (18%) 5 (49%) 8 (27%) 1 (6%)

The age groups of staff of estate surveying and valuation firms sampled showed that 41%were within 26 and 30 years of age with another 36% being between 31 and 40 years of age. One can safely infer that this category of staff are matured enough to handle sensitive issues concerning real estate business transactions between staff and clients as well as between staff and founder/CEO. With these age groups, issues relating to leadership succession at the lateral level must have been heard about in the office level thereby gingering thoughts on vertical leadership succession as people in business age along. For staff members who are curious, family leadership succession challenges among children of or among children and wives of deceased clients, whose properties the firm is managing, must have been an eye opener.

An examination of the academic status of staff showed that all of them have either HND or B.Sc., 49% were associates while 27% were fully registered. This is as expected of a truly professional firm qualified for government or corporate assignments both nationally and internationally.In terms of firm size, 70% of estate surveying and valuation firms sampled are of small size. 75% of staff in the firms surveyed concluded that leadership succession challenges rear their ugly heads where the family of the sole proprietor firm becomes unreasonable in terms of financial demands or, in some instances, insist on having their favorites in office. In addition, eight other factors were given as human-induced challenges that do hinder leadership succession in professional service firms. Where any of these eight listed human weaknesses (Table 2) are found to be conspicuous, on the part of a sole proprietor/manager or the family of a deceased owner of firm, choosing a leader may be very cumbersome and where care is not taken, may lead to the winding-up of the firm in the end.

From the data analysed, as in Table 2, being stingy, greedy and selfish were considered very common among human beings while been too rigid on official and management issues were considered common among people who fail to see official position of leadership as a transient post.

Table 2: Staff Opinion on Human Weaknesses

S/n	Human Weaknesses	Staff opinion of sole proprietors
I	Too rigid	Common
Ii	Not accommodating	Very rare
Iii	Greedy/selfish	Very common
Iv	Uncaring	Rare
V	Wasteful	Rare
Vi	Stingy	Very common
Vii	Morally weak	Very rare
viii	Likes gossips	Very rare

Among people in leadership positions, especially male sole-proprietor firms, being uncaring or wasteful were considered rare while being morally weak or being interested in gossips were considered very rare. For any service firm to be sustainable, the manager needs to be caring, very accommodating, avoiding gossiping and bearing in mind, the interest of staff of the firm while making the best use of available income at all times.

The road to leadership of any organization is not dependent on the academic achievement of man alone. To be an achiever in business, a man must imbibe the four leadership attributes listed in Table 3and make same his frame of mind at all times. The data analysis shows that the crop of leaders among estate surveying and valuation firms within the study area performed poorly in the areas ofthinking about where they are going rather than where they have been, as well as, forgetting the problems of the past and thinking about the opportunities of tomorrow.

Table 3: Assessment of Leadership Attitudes by staff

S/n	Attitudes	Scoring
1	think about the future most of the time	Good
2	think about where they are going rather than where they have been	Poor
3	maintain a positive attitude	Good
4	forgetting on the problems of the past and thinking about the opportunities of tomorrow	Poor

Human beings tend to remember too often the so called "class or level" they belong, i.e. where they had been in the past. Again, human beings remember too often someone who had refused to 'play ball in business' forgetting that there are many competitors in business deals. These poor attitudes need to be seriously addressed to move the real estate profession forward.

Another major issue of concern towards being relevant in any business setting is leadership competence. A leader, who wants to excel must be capable of maintaining self-awareness, developing relevant skills through continuous learning, remembering that strength can become a weakness in a different situation andcompensating for weaknesses by using staff complementary skills through delegation of duties. All these four competencies must be pronounced in a man who desires to be referred to as competent in his area of calling.

Tale 4: An Assessment of Leadership Competencies by staff

S/n	Leadership Competencies	Scoring
a	maintaining self-awareness	Very glaring across board
B	developing relevant skills through continuous learning	Low because they refer always to years of experience
C	remembering that strength can become a weakness in a different situation	Very low and arrogant
D	compensating for weaknesses by using staff with complementary skills through delegation of duties	Yes but not rarely acclaimed

Cross sectional responses from structured interview among staff of sole proprietor estate surveying and valuation firms, in the study area, showed that maintaining self-awareness was the leadership trait considered very glaring among estate surveying and valuation proprietor-firms. This is expected because for any service oriented firm to be sustainable in a competitive environment, the leader must be able to stand shoulder-to-shoulder with others in his field of endeavour.

No man can be an island in a dynamic business such as the real estate business. Laws vary a bit across geo-political zones in Nigeria in terms of cultural differences in land ownership, land transfers, power of government at State and Federal levels, etc., the human factor in the family-owned land, community land and State land; human factor among civil servants processing land transaction documentations, among others. In doing all these things listed, the reports of estate surveying and valuation firms are compulsory and there are gifted staff in valuation of assets. Such a skill is developed over time and there are specializations. The ability of sole-proprietor estate firm's readiness, at all times, to compensate for weaknesses by using staff with complementary skills through delegation of duties, was acknowledged by respondents as being recognized by sole-proprietors but not rarely acclaimed openly. Such a situation needs to be addressed since no man can know it all. On the issue of self-examination and self development, respondents rated owners of sole-proprietor estate surveying and valuation firms very low. On developing relevant skills through continuous learning, sole-proprietors prefer to rely always on their years of experience in practice forgetting that a lot of things do change with the advancement in technology and exposure of human beings to advanced developments globally. Also, considering or remembering that strength can become a weakness in a different situation, the memories of human beings are shallow and at the same time, they are arrogant. Until the damage is done, most people fail to learn first from the past mistakes to avoid a repeat performance.

5. Findings, Conclusion and Recommendation

The findings from this study showed that:
(i) members of staff of CEOs/Founders of the studied estate surveying and valuation firms were reluctant to commenting on their employers
(ii) 75% of staff in the firms surveyed concluded that leadership succession challenges rear their ugly heads where the family members of the sole- proprietor firms are divided on the issue.
(iii) being stingy, greedy and selfish were considered very common while been too rigid on official and management issues were considered common among leadership of sole- proprietor firms
(iv) that the crop of leaders among estate surveying and valuation firms within the study area performed poorly because they think more about the present than the future.
(v) Sole-proprietors estate firms rarely compensate for their professional weaknesses even after using staff with complementary skills through delegation of duties to achieve results.
(vi) sole-proprietors rely always on their years of experience in practice forgetting that a lot of things do change with the advancement in technology and exposure of human beings to advanced developments in real estate business globally

The paper concludes that to survive and remain relevant in any professionally service business during extraordinary times, the partners in each estate surveying and valuation firm need to look critically at employees age, background, educational status, job experience, if any, marital status during interviews.This is paramount because it is from these individuals that unit heads would be chosen to manage a set of clients with their varying requests, frames of mind and expectations.

The study recommends that CEOs/Founders estate surveying and valuation firms must be conscious of inevitable change in life by taking leadership succession planning seriously and by educating the family on what he expects of his firm in the future. The real estate business can only be handled by dedicated few hands, hence the reward system, in varying capacities, must be robust to retain staff and sustain their loyalty.

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Multiple Exposure to Information about Family Planning and Contraceptive Use among Women in Nigeria

Bose, J. ODEWALE, Muyiwa, OLADOSUN, Emmanuel, O. AMOO
Department of Demography and Social Statistics,
Covenant University,
Ota Ogun State, Nigeria.
Email: bose.odewale@stu.cu.edu.ng

Abstract— **Exposure to the media advertising is known to help change attitudes and behavior of a targeted population. This study examined multiple exposures to Information about Family Planning and Contraceptive use among Women in Nigeria. The study used 2013 Nigeria Demographic Health Survey (NDHS) data set. Data analysis included Univariate, Bivariate, and Multivariate (binary logistic regression) techniques. Bivariate analysis findings showed that exposure to family planning information via radio, television, newspapers and told at health facility are significantly related to contraceptive use in Nigeria (p-value = 0.000). Also, Contraceptive use is significantly related to women characteristic such as age, marital status, residence, region, work status, religion, education and wealth index. (P-value = 0.000). Binary logistic regression showed that show that married women who heard FP information at health facility were 1.5 times as likely as those who did not, to report using contraception, and those exposed to multiple channels of family planning information were 2.5 times as likely as those who were not exposed to use contraceptive methods. Therefore policies that encourage more qualified health workers should be put in place so as to persuade women to use contraceptive. Also, NGO and family planning programmers should make use of multiple media channel for their campaign strategy in order to increase contraceptive use in Nigeria.**

Keywords—Contraceptive use, Media, Family Planning and Multiple exposure.

INTRODUCTION

Multiple exposure through the media play important role in educating couple on the benefits of small families and provide regular information on contraception and its use [9]. Until recently, the traditional media like television, radio and Newspaper have long been tools for promoting public health [9] [8]. Exposure to the media advertising is known to help change attitudes and behavior of a targeted population. Mass media is known to serve as a means of getting information across to the general public, and the extent it information could reach cannot be over emphasized [6] [1] [10] [2]. The information gotten from popular soap opera in television and radio station explaining the benefits of having a small family size is indirectly changing people's attitude towards large family size and consideration of family planning [15] [4] [7]. Nigeria contraceptive prevalence rate is 15% (10% for modern method and 5% for natural method) and have 20% unmet needs for contraception [16]. Research has shown that low contraceptive prevalence experience low fertility while countries with low contraceptive use like Nigeria will experience high fertility [16]. Evidences abound that exposure to information on mass media has effects on changing people's attitude or behavior towards contraceptive use [15] [5]. Exposure to mass media makes first hand information about contraceptive methods possible there by making women have adequate knowledge about various contraceptives methods, its benefits, side effects and correct the wrong perception about family planning in the population [13] [7].

This study examines the relationships between contraceptive use and media exposure to information about family planning among women in Nigeria. This is with a view to reducing fertility among sub-groups with the highest fertility rates in the country. The study considers background factors of respondents with a view to providing additional information that may help to increase use of contraceptive among this sub-group in the country. Studies in sub-Sahara Africa and Nigeria have explored the relationship between media exposure and their influence at the level of contraceptive use though these studies were not specific on the exposure to family planning messages [2]. A research conducted in Nigeria using mass media as a means of communication to the general public about family planning and using three cities reported rise in attendance of people seeking Family Planning (FP) [12].

Several agencies have been propagating family planning information and services in Nigeria using mass media. They include government agencies and non-governmental agencies such as Planned Parenthood federation of Nigeria (PPFN), Society for Family Health (SFH), Federal Ministry of Health (FMH), Women Advocates Research and Documentation Centre (WARDC) and so on [11]. Some of the programmes targeting Family Planning through mass media include "Flavour" in radio, "Story Story" in radio, "one thing at a time" in radio, "Wetin Dey" in television and the Widow in television [11]. Some of them are currently running in Nigeria. Therefore, this paper looks into impact of multiple exposures to media and contraceptive use in Nigeria.

BACKGROUND FACTORS AND EXPOSURE TO MEDIA INFORMATION

Literatures suggest linkages between socio-economic factors and exposure to family planning information [15] [7]. The socioeconomic status of an individual determines her state economically, being that a poor person may not have access to radio, or TV [15] [14]. Women with household possessions like radio or television reported higher percentage of exposure to mass media information than women who do not have in their homes [3].

Socio-demographic factors of exposure to media Information
Previous studies have shown that socio-demographic factors such as age, marital status, residence and number of living children influenced exposure to family planning message [15]. Some of the family planning programmes are produced in urban areas. Television and radio station, newspaper and some health centers are situated in the city and also durable goods like television radio and newspaper are been sold in the city [15]. In addition, number of living children is a factor that can influence exposure to mass media information. Women that have attained the desired number of children have the desire to seek information about how to limit their births [7].

DATA AND METHOD
The study used Nigerian Demography Health Survey (NDHS) dataset of 2013. Generally, the NDHS data were collated on women, maternal and child health, fertility and family planning among others [14]. In this study, only relevant variables in the 2013 data file were extracted and analysed. Nigeria has six zones, and 36 states including Federal Capital Territory (FCT). In order to select a representative sample, Nigeria is divided into 36 states, with each state subdivided into 774 local government areas (LGAs), and each LGA is divided into localities and each locality was further divided into enumeration area. The survey adopted multistage sampling and focus on women between age group 15-49. The selection of sample was by stratified three-stage cluster design making a total of 904 clusters [14]. Each cluster has map and households listing (45 households per cluster). Total sample size is 38,948 women in their reproductive age of 15 to 49 were included in this study. Data analysis was done at the Univariate, Bivariate, and Multivariate levels.
The general model of the logistic regression equation used in the analysis is of the form

$$Ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k$$

…………..(1)

Where X_1, X_2…, X_K are set of independent variables such as age, residence etc., β_0 is a constant and β's are regression coefficients. P is the probability of currently using Contraceptive

RESULTS
Respondents' background characteristics
Results in Table 1 show that 69% of women who participated in the study were in age group 15-19 years, were located in the rural areas (60%), and were either married or living with their spouse (70%) The majority of respondents were from the three northern regions (57%), while the 42% were from the three southern regions.

Statistics show that 25.2% of respondents are not in union, 70.0% are married and living with their husband while 4.8% were widowed, divorced or separated. About 35% of respondents had no education, 37.0% had secondary education, and 18.2% had primary education while 9.5% had higher education. The distribution of respondents by religious affiliation indicates that 41.8% practiced Islamic/Traditional religion, 10.6% belonged to the Catholic faith while 40.6% were in other religious category. The distribution of respondents by working status shows the majority (62%) were working. Also, percentage distribution shows that 21.5% of respondents were in the richest category, while 21.7%, 20.5%, and 30% were in the rich, middle, and poorer/poorest wealth categories respectively

Concerning respondent's exposure to family planning information, about a third (33%) heard FP from the radio, a fifth (20%) heard from TV, about 38% heard from health facility, and only 7% heard from the newspapers.

Multivariate Results
Contraceptive Use & Background Factors
This study examines the relationship between background factors such as age, residence, religion, education, working status and religion and contraceptive use. Results in Table 2 shows that the odds of contraceptive use among women increases with age. Women age 40 and above were five times (5.080) as likely as their counterparts in age group 15-19 to report use of contraceptive. The odds of contraceptive use for women in age groups 35-39, 30-34, 25-29, and 20-24 compared to the reference category were 4.3, 3.9, 2.9, and 3.0 respectively.

Contraceptive use & Media Exposure to Family Planning Information
Results in Table 2 show that married women who heard FP information at health facility were 1.5 times as likely as those who did not, to report using contraception, and those exposed to multiple channels of family planning information were 2.5 times as likely as those who were not exposed to use contraceptive methods. And those who were exposed to one channel of FP information were 1.5 times as likely as those who were not exposed to use contraceptive method. Lastly, married women heard FP information from the radio were 0.7 times as likely as those who did not to use contraceptive method.

DISCUSSUION & CONCLUSIONS

This study examines the relationships between background characteristics of married women/those in stable relationship with exposure to FP information, and contraceptive use. The aim is to provide useful information on how to increase the impact of family planning information and thus, increase contraceptive use among the study population.

Results suggest that age, region, education, religion, socioeconomic status of women measured by wealth index are important background factors that should be considered in programs geared to increase contraceptive use among married women/those living with male partners in the country.

Findings show that exposure of the study population to FP

information at health facilities is effective in changing their behavior to use contraceptive, and a more effective strategy is multiple exposure to FP information which has more than double odds of making women to use contraceptive methods in the country. Future programs need to consider these factors, to increase contraceptive use among Women.

An unexpected result of this study is the negative effect of radio on the use of contraceptive by this sub-group although evidence in the literature quite mixed on the influence of the media on contraceptive use [15]. It seems that the lack of specificity of the message typical of social marketing may have affected the results.

TABLE 1: BACKGROUND CHARACTERISTICS OF RESPONDENTS' EXPOSURE TO MEDIA INFORMATION ABOUT FP AND CONTRACEPTIVE USE

Variable	Frequency (N=38,948)	%	Variable	Frequency (N=38,948)	%
Age			**Wealth Index**		
15-19	7905	20.3	Poorest	6602	17.0
20-14	6714	17.2	Poorer	7515	19.3
25-24	7037	18.1	Middle	8001	20.5
25-29	5373	13.8	Richer	8450	21.7
30-34	4701	12.1	Richest	8380	21.5
40+	7218	18.5			
Residence			**Heard FP from Radio**		
Rural	23403	60.1	No	26160	67.2
Urban	15545	39.9	Yes	12758	32.8
Region					
North Central	6251	16.0	**Heard FP from TV**		
North East	6630	17.0	No	31025	79.8
North West	9673	24.8	Yes	7870	20.2
South East	4462	11.5			
South-South	6058	15.6			
South West	5874	15.1			
Educational Level			**Read about FP in News-paper**		
No Education	13740	35.3	No	36083	92.9
Primary	7104	18.2	Yes	2767	7.1
Secondary	14407	37.0			
Higher	3697	9.5			
Marital Status			**Told about FP at health facility**		
Never in Union	9820	25.2	No	5409	61.8
Married-living with partner	27274	70.0	Yes	3338	38.2
Not living with partner-					
widowed-divorced-separated	1854	4.8			
Religion			**Multiple exposure to FP Information**		
Islam-Trad	18930	48.8	None	24057	61.8
Catholic	4081	10.5	One	6709	17.2
Other Christian	15757	40.6	2 or more	8182	21.0
Currently working			**Contraceptive use**		
No	14733	38.0	Not using	32723	84.0
Yes	24006	62.0	Using	6225	16.0
Source: NDHS, 2013.					

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TABLE 2: MULTIVARIATE ANALYSIS OF EXPOSURE TO MASS MEDIA AND CONTRACEPTIVE USE

Variable	Odd	Variable	Odd
Age		**Religion**	
15-19 (ref)	1.00	Islam-Trad (ref)	1.00
20-14	3.001***	Catholic	2.026***
25-24	2.867***	Other Christian	1.470***
25-29	3.917***	**Wealth Index**	
30-34	4.306***	Poorest (ref)	1.00
40+	5.080***	Poorer	1.103
Residence		Middle	1.533*
Rural (ref)	1.00	Richer	1.810**
Urban	0.961	Richest	2.547***
Region		**Heard FP from Radio**	
North Central (ref)	1.00	No (ref)	1.00
North East	0.612***	Yes	0.672
North West	0.793**	**Heard FP from TV**	
South East	0.891	No (ref)	1.00
South-South	1.044	Yes	0.928
South West	1.033	**Read about FP in News-paper**	
Educational Level		No (ref)	1.00
No Education (ref)	1.00	Yes	1.004
Primary	2.231***	**Told about FP at health facility**	
Secondary	2.327***	No (ref)	1.00
Higher	2.318***	Yes	1.473***
Marital Status		**Multiple exposure to FP Information**	1.00
Never in Union (ref)	1.00	One	1.535***
Married-living with partner	0.549***	2 or more	2.511***
Widowed-divorced-separated	0.375***		
Currently working			
No (ref)	1.00		
Yes	1.087		
Chi square	2100.102		
Nagelkerke	0.196		
-2log Likelihood	8320.615		
Source: NDHS, 2013.			

Fertility desire and Contraceptive Use among Women in Nigeria

Bose J. Odewale, Muyiwa Oladosun, Emmanuel O. Amoo
Department of Economics, Demography and Social Statistics Programme,
Covenant University,
Ota Ogun State, Nigeria.
bose.odewale@stu.cu.edu.ng

Abstract— **Studies have showed that decision making at the household level whether joint or solely by husband or wife have effect on whether a woman would use contraceptive or not. This study examines regional differences in decision making in households on whether or not to use contraceptives and how this influence actual use in Nigeria. It employed the 2013 Nigeria Demographic Health Survey (NDHS) data set in which variables of interest were extracted. The data set was analysed using Univariate, Bivariate, and multivariate (i.e. binary logistic regression) techniques. Results of the analysis is statistically significant in husband/wife fertility desire on contraceptive use by place of residence (p-value = 0.000), education (p-value = 0.000), and wealth index (p-value = 0.000). Findings also showed statistically significant husband/wife fertility desire on contraceptive use by age of respondent (p-value = 0.000), religion (p-value = 0.000), region (p-value = 0.000), and work status (p-value = 0.000) among women. Binary logistic result shows that Women who want the same number of children as their spouse were 1.4 times as likely as those who don't know their husbands desire to use contraceptive methods, while women whose husband want fewer children were 1.8 times as likely as those who don't know to use contraceptive methods. Policy and programmes geared towards improving contraceptive decision making and use in households will need to consider these factors.**

Keywords— fertility desire; contraceptive use; women

INTRODUCTION

The goal of International Conference on Population and Development in 1974 is that the world today are able to access hitch free family planning services and regard it as fundamental right for women [4] [14]. It follows that people should be able to make decision pertaining to their productivity. Less than 222 million women were not able to adopt contraceptive and the result is unwanted pregnancy by 76% women worldwide [19]. However meeting the needs for family planning will abate 29 % of maternal deaths [2]. Developed countries has been experiencing low births rate as a result of increase in contraceptives use over the years [26] [12], while in developing countries birth rate are high. There are different modern methods of contraceptive available all over the world but the rates of use and accessing their services vary significantly which has resulted in the differences in child and maternal mortality, fertility rate and contraceptive use across the regions of the world [5]. Some regions might have a desire for a natural method due to their religions believe, in

another region the modern method may be preferred, leading to the use of Family planning for contraception purposes [5].

The research has shown that an Africa man has higher desire for large family size [1] than their women counterpart thereby women are left out in determining the number of children they will give birth to and the decision to use contraceptive will solely be the man's decision [6] [15]. Evidence from Nigeria demographic and health survey (NDHS) show that there is a difference in total fertility rate across the regions with highest 6.7% in North West to the lowest 4.3% in South-South, it shows there are factors responsible for the variation [21]. Demand for children is determine by family size preference. Husband desire number of children will determine the number his wife will give birth to and invariably determine contraceptive use. In Nigeria, because man is known to be the head of the family, so wife will always admits her husband desire. In this case woman with husband wants more children will less likely use contraceptive [9]. Among the Yoruba, husband and wife fertility preference determines their fertility but husband desire influences their behaviour towards the number of children [9]. Therefore, this study looks into fertility preferences and contraceptive use in Nigeria.

According to behavioral models of fertility, individual or couple is unknowingly involved in fertility management which means individual or couples have desire concerning the number and timing of children they want to have [18]. Fertility preference is a result of biological factors, husband fertility desire, social expectation, marital conditions and child bearing experience [18]. Looking at the people's view about fertility desire, there are two paradigm broadly captured fertility preferences. Couple formulates number of their family size after they might have attained the desired fertility number. It means giving birth to another child must have being because the desired fertility number has not been reached. The second paradigm explained that couple takes decision about child bearing based on their current socioeconomic status and reproductive circumstances and not just by targeting family size or pursuing fertility desire [18]. Therefore, this study looks into how fertility desire influence contraceptive use in Nigeria.

Contraceptive use are affected by socio-economic factors which are culture, religion, marital status, husband and wife fertility desire, women autonomy, education, place of

residence, wealth index, occupation, age, case of abortion or sexually transmitted disease and spousal communication [1] [6] [29] [27]. Nigeria, a study carried out on men sample on their reproductive decision in urban areas revealed that men want more children because it adds to their status thereby affecting women decision making on the use of contraceptive [17] [15]. Although, men know at least one method of contraception but the decision to use by the wife must be made by them [17].

SOCIO DEMOGRAPHIC FACTORS AFFECTING CONTRACEPTIVE USE

An age difference is another factor that affects decision making about contraceptive [1] [3]. A wide difference in the age of the husband to his wife will create a gap in their discussion because wife will always see his husband to be old enough to be his father or uncle and more experience than her [3]. In such relationship, wife is seen by the husband to be his junior sister and inexperience that need instruction rather than discussion on the say matter. In this case, mutual agreement may not be reached on issues including reproductive health there by joint decision about family planning may not be possible [16]. Also, older women tend to enjoy joint decision on family planning with their husbands because they have already attained husband desired number of children and most of them go for highly effective ones. In Nigeria, family planning decision between husband and wife vary from urban to rural area, the reason being that urban area women are well educated and exposed to information about family planning than their rural counterpart. Another factor is the number of living children. Couple that has attained their desire number of children tends to use contraceptive after they might have discussed and joint agreement has been made. A study by Khan and Patel (1997) explained that couples that actually come to agreement on contraceptive use are those that have already have living children up to two or three and mostly initiated by men. Also, older women with four or five living children have discussed and took joint decision with their husband on contraceptive use [17].

SOCIO-ECONOMIC FACTORS

Education increases women status. It gives them the opportunity of gainful employment as the men in the society and such position gives women upper hand in decision making about contraceptive [6]. Women are able to provide for household needs whether the husband give them money or not may decide to take decision about contraceptive alone or come to agreement with their husband [8] [20]. Husband and wife's education exposes them to benefits of reproductive health they got to know that limiting family size will improve his developmental state [23]. A lot of money spend on ante-natal care, hospital bill and children school fees will be used for investment and improve his financial status, such husband tends to be in agreement with his wife and make a joint decision to use contraceptive [23]. Religion plays an important role in family planning decision making [13] influence exposure to mass media information. Women that have attained the desired number of children have the desire to seek information about how to limit their births.

CULTURAL FACTOR

A woman with strong religion conviction is less likely to use contraceptive though her fertility desire have been met. Some religions do not allow the use of artificial contraceptive so women go for less effective natural method or abstain from contraceptive [22].

COMMUNICATION AND DECISION ABOUT FAMILY PLANNING

The effective communication is very important in decision making and it serves as one of the way of bringing men into safe motherhood [7] [15]. Couples that communicate on various issues of life, like buying of family asset like land, communication on care of extended family member, family visitation, number of children to have etc. [15] will not have problem in discussing and come to agreement about their reproductive health thereby adopt the use of contraceptive [6]. Bridge in communication could be affected by the position of individual in the family and society [11] [10] [15]. Husband's position as the breadwinner of the family and the wife as complete dependant on the husband for living and for the care of the home makes the husband decision to override the wife though they may come to an agreement but it is the husband decision that will be approved at the end of the day [30]. Several studies on decision making and its influence on contraceptive use has been documented, some look into impact of male perception attitude, knowledge and their involvement in contraceptive decision making [24] [5] [17] [15] [27]. Communication among husband and wife in some selected area [6], behavior and decision to use contraceptives [29] [30]. Little has been done on how husband and wife fertility preference could influence contraceptive use in Nigeria

DATA AND METHOD

The study used Nigerian Demography Health Survey (NDHS) dataset of 2013. Generally, the NDHS data were collated on women, maternal and child health, fertility and family planning among others [21]. In this study, only relevant variables in the 2013 data file were extracted and analyzed. Nigeria has six zones, and 36 states including Federal Capital Territory (FCT). In order to select a representative sample, Nigeria is divided into 36 states, with each state subdivided into 774 local government areas (LGAs), and each LGA is divided into localities and each locality was further divided into enumeration area. The survey adopted multistage sampling and focus on women between age group 15-49. The selection of sample was by stratified three-stage cluster design making a total of 904 clusters [21]. Each cluster has map and households listing (45 households per cluster). Total sample size is 38,948 women in their reproductive age of 15 to 49 were included in this study. Data analysis was done at the Univariate, Bivariate, and multivariate levels.

The general model of the logistic regression equation used in the analysis is of the form

$$Ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k$$

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Where $X_I, X_2…, X_K$ are set of independent variables such as age, residence etc., β_0 is a constant and β's are regression

Variable	Frequency (N=38,948)	%	Variable	Frequency (N=38,948)	%
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Residence			**Religion**		
Rural	23403	60.1	Islam-Trad	18930	48.8
Urban	15545	39.9	Catholic	4081	10.5
Region			Other Christian	15757	40.6
North Central	6251	16.0	**Currently working**		
North East	6630	17.0	No	14733	38.0
North West	9673	24.8	Yes	24006	62.0
South East	4462	11.5	**No of living Children**		
South-South	6058	15.6	None	11914	30.6
South West	5874	15.1	1-2	9596	24.6
Educational Level			3-4	8664	22.2
No Education	13740	35.3	5 or more	8774	25.5
Primary	7104	18.2	**Husb. desire for children**		
Secondary	14407	37.0	Don't know	6008	22.2
Higher	3697	9.5	Husband want more	10635	39.3
Marital Status			Husband want fewer	1053	3.9
Never in Union	9820	25.2	Both want same	9350	34.6
Married-living with partner	27274	70.0	**Contraceptive use**		
Not living with partner-			Not using	32723	84.0
widowed-divorced-separated	1854	4.8	Using	6225	16.0
Source: NDHS, 2013.					

coefficients. P is the probability of currently using

TABLE 1: BACKGROUND CHARACTERISTICS OF RESPONDENTS' FERTILITY DESIRE AND CONTRACEPTIVE USE
Contraceptive

RESULTS
Respondents' background characteristics

Results in Table 1 show that 69% of women who participated in the study were in age group 15-19 years, were located in the rural areas (60%), and were either married or living with their spouse (70%). The majority of respondents were from the three northern regions (57%), while the 42% were from the three southern regions.

Statistics show that 25.2% of respondents were not in union, 70.0% were married and living with their husband while 4.8% were widowed, divorced or separated. About 35% of respondents had no education, 37.0% had secondary education, and 18.2% had primary education while 9.5% had higher education. The distribution of respondents by religious affiliation indicates that 41.8% practiced Islamic/Traditional religion, 10.6% belonged to the Catholic faith while 40.6% were in other religious category. The distribution of respondents by working status shows the majority (62%) were working. Also, percentage distribution shows that 21.5% of respondents were in the richest category, while 21.7%, 20.5%, and 30% were in the rich, middle, and poorer/poorest wealth categories respectively.

Results show that the 48% of respondents had 3 or more children, while 25% had one or two children, and 31% had no children. With respect for husband desire for children, 39% reported that their husbands want more, 35% reported that they want the same number with their husband, and 4% reported that their husband want fewer number of children.

MULTIVARIATE RESULTS
Contraceptive use, background factors & fertility desire

Table 2 shows that the odds that women used contraceptives varied significantly by residence, region, religion, and husbands desire for more children. The odds that women in the study used contraceptives increased significantly by level of education, wealth index and number of living children.

With respect to residence, women in the urban areas were 1.2 times as likely as their rural counterparts to use contraceptives. Women in the south-west compared to those in the north-central were more likely to use contraceptives, but those in the north-east, north-west, and south-south were less likely to use. Results also show that women who have higher level of education were 3.8 times as likely as those who have no education to use contraceptive method, and those with secondary, and primary education were 3.1 times, and 2.4 times as likely as the reference category to use contraception. Women who reported that they were Christians were at least 1.5 times as likely as those who were Muslims/traditionalists to use contraception, and women in the richest wealth category were 4.3 times as likely as those in the poorest category to use contraceptive method, while those in richer, middle or even poorer category had 3.1 times, 2.4 times, and 1.5 times odds respectively.

The results of this study show that the odds of contraceptive use for women who had 5 or more children were 17 times more than those who had no children, women who had 3 or 4 children were 12 more likely, and those who had 1 or 2 children had at least 5 times likelihood of using contraceptive

than women who did not have children. Women who want the same number of children as their spouse were 1.4 times as likely as those who don't know their husbands desire to use contraceptive methods, while women whose husband want fewer children were 1.8 times as likely as those who don't know to use contraceptive methods.

DISCUSSION & CONCLUSIONS

The aim of this study was to provide information of on husband/wife fertility desire and contraceptive use among women in Nigeria highlighting key factors. Results suggest clear regional variations with respect to the odds of using contraceptive, which should be useful information for programming these sub-groups. Future programming to cater for contraceptive needs of women should take into consideration other background factors such as residence, education, religion, wealth status index, number of living children that a woman has and husband's desire for children.

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Variable	Odd	Variable	Odd
Age		**Religion**	
15-19 (ref)	1.00	Islam-Trad (ref)	1.00
20-14	1.233	Catholic	1.703***
25-24	0.946	Other Christian	1.557***
25-29	0.923	**Wealth Index**	
30-34	1.029	Poorest (ref)	1.00
40+	0.744	Poorer	1.486**
Residence		Middle	2.329***
Rural (ref)	1.00	Richer	3.125***
Urban	1.224***	Richest	4.307***
Region		**Currently working**	
North Central (ref)	1.00	No (ref)	1.00
North East	0.344***	Yes	1.055
North West	0.383***	No of living children	
South East	0.981	**None**	1.00
South-South	0.830**	1-2	5.400***
South West	1.503***	3-4	12.537***
Educational Level		5 or more	17.414***
No Education (ref)	1.00	Husbands desire for children	
Primary	2.367***	Don't know (ref)	1.00
Secondary	3.142***	**Husband want more**	0.985
Higher	3.823***	Husband want fewer	1.831***
		Both want same	1.428***
Chi square	10441.226		
Nagelkerke	0.344		
-2log Likelihood	16485.020		
Source: NDHS, 2013.			

TABLE 2: MULTIVARIATE ANALYSIS OF FERTILITY DESIRE AND CONTRACEPTIVE USE

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Optimum Fermentation Temperature for the Protein Yield of *Parkia biglobosa* Seeds (Iyere)

Ojewumi Modupe E., Omoleye Abiodun, J.
Chemical Engineering Department
Covenant University Canaan land,
Ota, Nigeria
modupe.ojewumi@covenantuniversity.edu.ng

Ajayi Adesola, A.
Department of Microbiology
Covenant University Canaan land,
Ota, Nigeria
adesola.ajayi1@covenantuniversity.edu.ng

Abstract— African Locust Bean (*Parkia biglobosa*) seeds were fermented with the aid of a starter culture - *Bacillus subtilis* to a vegetable protein based food condiment known as 'Iru' at various temperatures between 40 °C and 70 °C. Fermentation was carried out for five days (120 hours). The maximum % protein content yield of 52.7 % was obtained after 3 days (72 hours) at an optimum fermentation temperature of 40 ^{o}C. Other parameters like % crude fibre, % ash content, % carbohydrate and % fat content decreased with fermentation temperature and duration. The physiological test carried out showed that fermented sample at the optimized condition were generally acceptable for all parameters tested. The Scanning Electron Microscope (SEM) result shows the effect of temperature on the morphological structure of both fermented and unfermented samples.

Keywords— *Parkia biglobosa; starter culture; Inoculum; SEM; Bacillus subtilis*

I. INTRODUCTION

The botanical name *Parkia biglobosa* was given to African locust bean tree (Igba in Yoruba land) by Robert Brown, a Scottish botanist in 1826. He described the tree as genus of flowering plants in the legume group which belongs to the sub - family *Mimosoideae and Leguminosae* (Abdoulaye, 2012). Other known species of the family of this plant are *Parkia bicolor, Parkia clappertoiana*, and *Parkia filicoidea*. These species can be fermented to produce an outstandingly rich vegetable protein based condiment which serves as good seasoning and aroma in food. *Parkia biglobosa* tree has application in both medicine and food additives to the indigenous people of Africa. The tree serves various medicinal purposes such as cure of diarrhea and hypertension since it contains a deposit of histamine which dilates the blood vessels and allows free flow of blood (Ojewumi, Omoleye and Ajayi, 2016). The extract of the bark of the tree is applied for the treatment of wound, bronchitis, pneumonia and malaria (Sherah, Onche, Mbonu, Olotu,

Lajide, 2014). Fermentation is the oldest technology known to man (Omafuvbe, Olumiyiwa, Falade, Osuntogun, & Adewusi. 2004). Fermentation is the biological conversion of complex substrates such as starch or sugar into simple compounds by various microorganism such as fungi and bacteria (Eze, Onwuakor, Ukeka. 2014). Diawara, Sawadogo, Amoa AMuwam (1998) and Campbell-Platt. (1980), reported fermented African locust bean seeds to have 39 - 47 % of protein, 31 – 40 % of fat of lipid and 12 – 16 % of carbohydrate. Researchers identified *Bacillus spp*. as the main microorganism involved in the fermentation of most legumes especially *P. biglobosa*. *B. subtilis* was discovered to act the biggest role in the fermentation process (predominat microorganism) others like *B. pumilus, B. megaterium, B. licheniformis* were later discovered (Ouoba, Rechinger, Barkholt, Diawara. Traore and Jakobsen (2003). Several works have been done on the fermentation of African locust bean seeds, biochemical and physiological analysis but little or no research have been carried out on the operating temperature suitable for the optimum yield of protein in this underutilized seed.

II. MATERIALS AND METHODS

A. Raw Materials Procurement

The *P. biglobosa* seeds used were purchased from the open market in Itapaji Ekiti, Ekiti state. All the chemicals used were of good quality and analytical grade. The Inoculum used was prepare in the Microbiology Laboratory of Covenant University Ota. Locally produced Iru was purchased from Ota market, Ogun state.

Laboratory Preparation of *Parkia biglobosa*
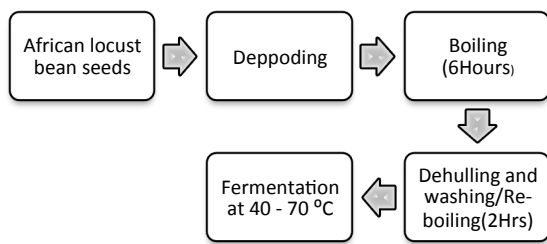
FIG. 1 - FLOW DIAGRAM OF TRADITIONAL UPGRADED PROCESSING OF AFRICAN LOCUST BEAN SEED TO FOOD CONDIMENT

B.   PREPARATION OF *BACILLUS SUBTILIS*

6.25 grams of nutrient broth was disperse in 250 litre of distilled water in a sterilized 500 litre conical flask and homogenized in water bath for 40 minutes. The homogenized clear solution was autoclaved for 15 minutes at 121 ^{0}C. Previously isolated *Bacillus subtilis* was used in solid inactive form. This was activated by taking some of the bacteria with a loop and mixing it with a freshly prepared nutrient broth and incubated for 24 hours at 37 ˚C.

C.   Inoculation of Seeds

100 g of the seed sample was inoculated using 0.005 g Bacillus subtilis broth / g seed. Five flasks labelled Day 1 to Day 5 were placed in a thermostatically controlled fermenter. At the end of each day (24 hours) a flask was removed and the sample kept in a freezer for further analysis.

III.   ANALYTICAL TECHNIQUE

A. Proximate Analysis of Fermented African Locust Bean Seeds

- The parameters determined were % crude protein, % total carbohydrate, % fat, % ash content and % crude fibre. These were determined using the AOAC analytical method (2000)

- Temperature Monitoring: This was done using the temperature probe fabricated with the fermenter.

- Physiological Analysis: This is majorly the physical qualities of the condiments such as taste, aroma, colour, texture and appearance.

IV. RESULT AND DISCUSSION

The seed underwent spontaneous fermentation to a protein based vegetable condiment identified by its appearance, aroma, and taste. The smell was prominent after the third day (72hours) of fermentation. The substrate became dark and soft with characteristics aroma similar to ammonia.

A.   The Proximate Analysis of African Locust Bean Seeds (Figure 2)

- % Fat Content: About 17.33 % and 19.33 % of fat content was recorded in the raw and cooked samples respectively. This confirmed the report of Alabi, (2005) and Omafuvbe, Olumuyiwa, Osuntogun and Adewusi. (2004).

- Although there is an increase in the % fat content with days of fermentation at each temperature, there is a slight but steady decrease in the fat content as temperature of fermentation increases which further increased to 27 % on the last day of fermentation but decreased with increase in fermentation temperature to 20.08 % at 70 ^{0}C.

The activity of lipolytic enzyme is faster with a slight increase in temperature during fermentation process but an elevated temperature above the optimum operating temperature of the fermenting microorganism- *Bacillus subtils* which is 40 -50 ^{0}C will either make the organism go dormant and reactivated when the condition is favourable or die.

- % Crude Protein: Several research works have been carried out on how fermentation enhances protein value of *Parkia biglobosa* seeds. Figure 2 also shows that at each fermentation temperature protein content increased from the first day up to the third day and declined from the fourth day. The % yield of protein from the fermentation of *Parkia biglobosa* at any given day of fermentation declines with increase in fermentation temperature from 40 to 70 ^{0}C. The protein yield at 40 ^{0}C on the third day of fermentation is 52.7 %, it reduced to 25.6 % on the third day at a temperature of 70 ^{0}C. This confirms the fact that *Bacillus subtilis* functions well at lower temperature (40 – 50 ^{0}C) (Odunfa, 1981; Antai, Ibrahim (1986) and Achi (2005). Thus maximum yield of protein is achieved at the third day of fermentation with fermentation temperature 40 ^{0}C. The low yield of protein at higher temperature is likely due to the fact that the enzymes responsible for fermentation and protein formed get denatured by heat at such a high temperature.

- % Total Carbohydrate (CHO): A decrease in total carbohydrate is expected (figure 2), this confirms that substrate is been consumed by the fermenting microorganisms. The loss in carbohydrate during soaking and boiling is attributed to the leaching of soluble carbohydrates like sugar into the cooking water. Loss in carbohydrate during fermentation may also be as a result of the fermenting organisms utilizing some of the sugar for growth and metabolic activities, Esenwah and Ikenebomeh (2008). The higher the temperature the lower the reaction since the fermenting microorganism cannot function well at high temperature, hence low conversion of carbohydrate to sugar.

- % Crude Fibre: Fermentation reduces the percentage crude fibre of the substrate (fermenting seed) with days of fermentation. Temperature seems to have minimal or no effect on the Crude fibre of *P. biglobosa* seeds during fermentation. An increase in fermentation temperature led to decrease in the percentage crude fibre. Figure 2 shows that protein has the highest composition at fermentation temperature of 40 ^{0}C.

Figure 3 shows the comparison between the proximate analyses of commercial Iru which is usually done at 30 ^{0}C and laboratory prepared samples. This figure shows that fermentation yield of protein at temperature 40 ^{0}C is higher than commercially produced condiment. Hence 40 ^{0}C is the optimum temperature for protein yield of *Parkia biglobosa* seeds.
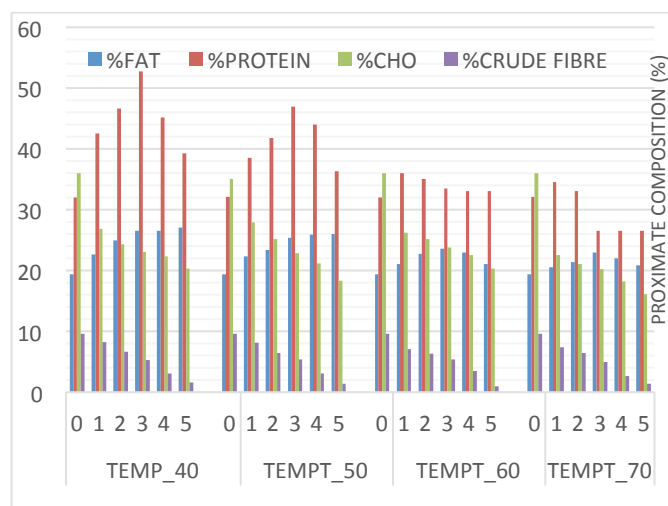
Fig. 2 - The effect of temperation variation on the Proximate analysis of African locust bean seed

Fig. 3 – Comparison between the proximate analysis of optimised and commercial sample
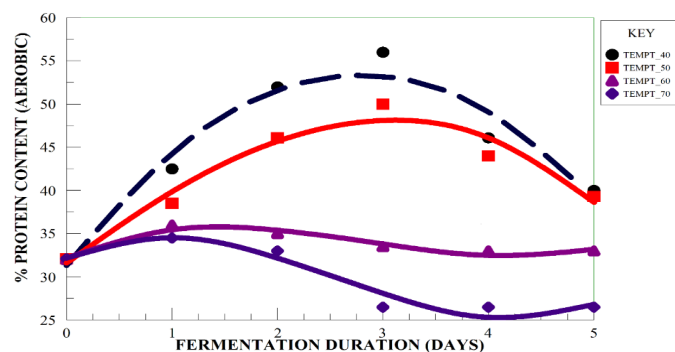
Fig. 4 – The Effect of Temperature on the Protein Content of Fermented African Locust Bean Seed

B. Physiological Test

The sample fermented for 3 days with fermentation temperature 40 ^{0}C only was most acceptable with respect to taste, colour, appearance and aroma.

C. Morphological Structure

The morphological structure revealed the differences in processing and fermentation stages

1- The morphology of the unprocessed seed revealed an agglomerated cohering image with a coarse and wrinkled corrugated surface A wider pore, compared to the raw unprocessed sample was noticed. This was due to the processing which is an evidence of structural changes as a result of deformation of structure during processing.

2- Wider agglomerated and non-cohering structure with a wider pores was noticed, this was due to the introduction of heat. Compounds were been broken down into smaller units such as carbohydrates. Granules were still visible, probably protein but adhere more to the surface of the structure.
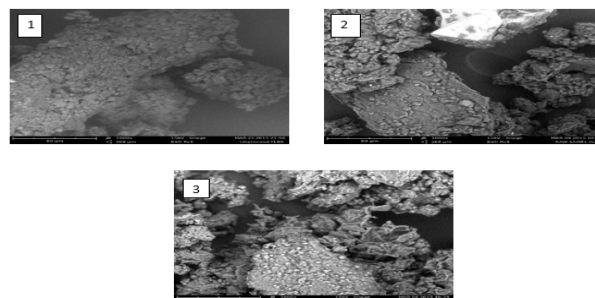
1 - The morphological structure of unprocessed African locust bean seeds
2 - The morphological structure of processed raw African locust bean seeds

3 - The morphological structure of fermented sample on the third day at 40°C.

Conclusion

The optimal operating fermentation temperature for the production of protein condiment from P. Biglobosa is 40 ^{0}C.

Since Iru was discovered to be very rich in protein, increase in its consumption will reduce the risk of nutrient deficiencies in consumers.

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Keyword Index