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Promoting Sustainable Tourism through Tourism Infrastructure Development in Nigeria

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Abstract

Tourism is appreciated globally as a major economic earner of many developed nations and acknowledged by many researchers that tourism could play a significant role in economic development of many developing countries. The Nigeria tourism sector is not left out of the several benefits Vis-à-vis economic, socio, cultural and environmental; that is associated with tourism only if the tourism infrastructures are well developed. Given the rich and diverse tourism potentials, Nigeria can transform its tourism sector through tourism infrastructure development. The paper aims to investigate the need for tourism infrastructure in Nigeria. Using the literature review and the quantitative method of data collection, the paper identified the importance of tourism infrastructure in sustainable tourism development. It appreciates tourism as an important sector that needs to be developed through the provision of tourism infrastructure if the gains from tourism are to be of immense benefit to Nigeria. The paper further sees the lack or slow pace of tourism infrastructure development as a major setback to sustainable tourism development in Nigeria. Furthermore, the paper examined the need for tourism infrastructure improvement for sustainable tourism development in Nigeria and concludes that tourism, if developed through the provision of tourism infrastructure will not only be of benefit to the Nigerian Nation as a whole but also to the individual.

Keywords: Development, Infrastructure, Nigeria, Sustainable Tourism.

1. Introduction

As acknowledged by several researcher (Aniah et al, 2009; Ebohon et al, 2009; Draghici et al, 2010; Ayeni, 2011) tourism is one of the fastest growing industry globally and a main engine for the local economy. With its benefits and importance, which ranges from economic, social, cultural and environmental, being constantly recognised worldwide, its full potentials are yet to be realised by developing countries (Ajala, 2008), with no exception to Nigeria as a developing nation.

Whilst there are 'unquantifiable' benefits from the social physical (Aniah et al, 2009), the economic benefits brings the development of local economies through agriculture, construction, transport and trading (Draghici et al, 2010). These, conversely leads to employment, and as such, through tourism infrastructure development in Nigeria, apart from generating foreign exchange, tourism will be capable of reducing unemployment and generally improving the standard of the people.

UNWTO's defines tourism as 'comprising the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes' (Ugurlu, 2010). The definition greatly implies as noted by Akeredolu and Ayoola (2010) that tourism serves as a source of pleasure, holiday and travels as well as job opportunities for many people. However, these cannot be achieved without adequate provision of tourism supporting infrastructure.

In this vein, Ajala (2008) argued that tourism environment comprises the physical component, that is, the landscape scenery, weather, climate, water and biodiversity of plants and animals; as well as the human component ranging from history, culture, to tradition. All these combine to give the tourists memorable experiences whether good or bad (Ayeni, Ebohon and Taki, 2011) as well as learning about 'new world or environment' (Aniah, et al, 2009). Furthermore, the elements which make up these components to give the tourist experience can collectively be referred to as tourism infrastructure (Hamzah, 2009; Ayeni, 2011) and noting the importance of infrastructure in tourism, Draghici et al, (2010) argued that infrastructure serves as a determinant factor for a tourists' satisfaction.

Nigeria as a nation is blessed with vast tourism potentials virtually in all the thirty-six states and the federal capital that make up Nigeria; however, these remain largely untapped and many characterised by the absence and dearth of tourism infrastructure. In spite of the awareness of its importance, tourism remains at its infancy stage (Akeredolu and Ayoola, 2010). For tourism to be sustainable in Nigeria, necessary infrastructures and social amenities such as road, electricity, water, accommodations as noted by Eja (2011) should be provided.

Thus, the objective of this paper therefore is to investigate the importance of tourism infrastructure and the need for sustainable tourism development in Nigeria.

2. Importance of Tourism Infrastructure

Tourism as noted by Ford (2010) accounts for 5-10 per cent of Gross Domestic Product (GDP), being the world's biggest economic activities. If developed properly is capable of creating jobs and economic wealth for host communities, however, Least Developed Countries (LDCs) continue to play only a minor role in global tourism, receiving a mere 1 per cent of the world's travel exports (Schiedermaier, 2011).

South Africa as averred by Ford (2010) is by far the most popular destination in sub-Saharan Africa with 9.5 million visitors a year, while the three North Africa states of Egypt, Morocco, and Tunisia collectively attract 27.1 million tourists a year. This is followed by Botswana with 2.1 million visitors a year. From this assertion, tourist visit in Nigeria is still a mirage; as Itayemi (2012) noted, with many tourist attractions, infrastructure is usually the 'sore point' as no tourist attraction whether artificial or natural can flourish without infrastructure. As such, Ford (2010) argued that the lack of infrastructure which is still a major concern still pose as a big challenge in many African countries in spite of the diverse cultural attractions and beautiful landscapes, in addition, many developing countries possess poor infrastructure which has hampered their growth and the ability to trade in the global economy (EUROPEAID, 2012). Furthermore, there cannot be effective tourism activities without major investment in infrastructure.

Infrastructures as defined by Akogun (2011) are the basic facilities and services essential to institution, economic and social development. Also, Dwyer, Fosyth and Dwyer (2010) refer to infrastructure as the basic physical and organisational structure needed for a society to function effectively. In that token, a society cannot function effectively as argued by Ayeni (2011) without infrastructure. As noted by EUROPEAID (2012), good quality infrastructure is a key ingredient for sustainable development. More so, investment in infrastructure helps to contribute to business and help improve environmental conditions. As such, efficient infrastructure is needed for any country to prosper. In the same vein, Cernat and Gourton (2011) averred that infrastructure assets are key requirements to sustainable development since accessibility to specific tourism destinations depend on the quality of the overall infrastructure.

Tourism infrastructure on the other hand, is the physical element that is created or made to cater for tourists, including the visible elements of landscape (Tress and Tress, 2003; Hamzah, 2009; Ayeni, 2011) this implies as further argued by Ayeni (2011) that every physical element seen in and around tourist environment which enhances tourism development can be referred to as tourism infrastructure. Going by the ethos of sustainable development, Boers and Cottrell (2005) defines sustainable tourism infrastructure as tourism infrastructure that 'enables sustainable tourism development' and enables visitors to realise desire and expected experiences. Furthermore, Seetanah et al (2011) stated that infrastructure play the role of determining the overall impression of a destination by the tourists, and the use, level or lack of infrastructure in a destination determines features that can enhance the tourist's trip experience.

By the definition of tourism as activities that involve moving from one place to another, Dabur (2003) noted that the tourism industry encompasses all socio-economic activities that require infrastructure which directly or indirectly provide services to tourists and include the services of 'transportation, hotels and lodging, food and beverages, cultural and entertainment, banking and finance, and promotion and publicity'. Still in line with tourism, Seetanah et al (2011) stated that the infrastructure base of a country serves as a potential determinant of the attractiveness of a tourism destination. As such, infrastructure forms an integral part of tourism package.

Akinwale (2010) and Akogun (2011) categorised infrastructure under the classes of communication, rendering services such as telephone, telex, telegraph; transportation which deal with movement of people from one place to another and made possible through airports, seaways, railways; portable water supply; drainage/sewage that is

infrastructure for disposal of waste. Also is the electricity, health facilities, educational infrastructure, sanitation and solid waste disposal through the removal of refuse; as well as social infrastructure which include recreational facilities such as play ground, parks and gardens. However, Khadaroo and Seetanah (2007) argued that transport infrastructure is an important and essential component because it 'induces the creation of new attractions and the growth of existing ones'. Summarising these various aspects in tourism, Seetanah et al (2011) stated that while transportation infrastructure enhances accessibility of tourists, the airport infrastructure ensures comfortable transition from plane to destinations. Furthermore, communication infrastructure give maximum information about destination, while electricity, waste and others give reliable services, thereby is enhancing the attractiveness of a destination. Also, Khadaroo and Seetanah (2007) argued that tourism is characterised by a process in which tourists use multiple services which include information, transportation, accommodation and recreation; in addition, infrastructure and technology are key features of a destination. As such all these in combination create the tourist memorable experience.

3. Setbacks to Sustainable Tourism Development in Nigeria

Nigeria is renowned for its beautiful scenery, natural landscapes and cultural heritage; dotting virtually across all the thirty six states and the federal capital. However, Emelike (2010), Ememou et al (2011) acknowledged that in spite of the abundance of tourism resources; and even with the fast growth and the advancement of tourism globally, the tourism sector in Nigeria is still at low ebb and operating at a slow pace and far below capacity.

Although several attempts and efforts are being made by the government to make Nigeria accessible for tourists as a way to diversify from the long dependant on crude oil as a major source of revenue; these efforts as noted by Jacobson (2012) are constantly being faced with streams of problems. And unless these problems are tackled, there cannot be any visible advancement and progress in the tourism sector; as such may not be able to serve as an alternative to boosting and diversifying the Nigerian economy.

Visible among the setback to tourism development in Nigeria are the dearth of infrastructure; and in any tourist destination, infrastructure contributes to the attractiveness of a destination. As posits by Orga (2010), attractions are the most important component in the tourism system; as they serve as motivators for tourists' choice and trip. Noting these setbacks, Jacobson (2010); Akogun (2012) stated that infrastructure is a major problem holding tourism back in Nigeria which as further argued are generally not reliable, not available or very weak where they exist. Also, Akinwale (2010) identified that infrastructure in Nigeria are meagre and improving them has not yielded desired results. Furthermore, several urban areas and even tourist destinations in Nigeria lack basic infrastructure like roads, water supply, electricity, parks, play grounds, health facilities, schools and open spaces, Akogun (2011).in addition, 'no new developments in expanding roads or railways since 1970' (Jacobson, 2010). These have caused Nigeria to be less competitive at the global level as argued by Emelike (2010).

Apart from the lack of good infrastructure, Ijasan and Oladunni (2012) identified some setback to development to include poor communication systems, poor communal facilities, shortage of staff, lack of ethnic unity, poor research facilities, as well as poor maintenance culture. Others include inadequate government intervention, lack of interest, negligence and corruption. Other setback as identified by Emelike (2010); Ememou et al

(2012); Jacobson (2012); Sanni (2009); Orga (2010) and Ibimilua (2011) include government's inconsistency in policy, short term planning, undue political interference, insufficient funds, low level man power, low safety and security measures. Above all, infrastructure seems to be the bane to sustainable tourism development in Nigeria.

Indeed, tourism cannot exist without the adequate provision of tourism infrastructure, as such, Orga (2010) opined that provision of infrastructure should be encouraged as they not only help develop tourism, but also serve the purpose of employment in order for the employed to carry out the tourism services. Conversely, this will raise the hope of tourism both now and in the future; as such, infrastructure should be provided and maintained for sustainable tourism to develop.

4. The Need for Tourism Infrastructure Improvement for Sustainable Tourism Development in Nigeria

It is a well known fact that diversifying the Nigerian economy from crude oil to tourism has immense benefit, both to the country as a whole as well as to the individual and the host communities' vis-à-vis revenue generation, employment, development, among other benefits. These are possible based on the enormous tourism potentials in several parts of Nigeria and as argued by Tunde (2012), the only way to realise the important roles tourism play is by having a well developed , packaged and promoted tourist attractions.

Again, Ayeni and Ebohon (2012) noted that the tourism development without proper planning and integration with local values and the environment can lead to socio-cultural, environmental and economic damage. Similarly, Dantata (2011) averred that, apart from the financial gains from tourism, if properly developed, would help beautify and conserve the environment as well as improve the infrastructural development for both tourists, and the locals. As such, the 'future of tourism in Nigeria is dependent on the opportunities and challenges being exploited and addressed as posit by Dantata, (2011). However, these benefits cannot be achieved without putting adequate and necessary infrastructure in place. For the sector to develop as Eboh (2009) rightly asserts, necessary infrastructure need to be put in place in order to boost the tourism sector.

Tourism as noted by Tunde (2012), is an activity that contributes to a better understanding of places, people, and their culture; and for it to be successful in Nigeria, it should adhere to the economic, social, environmental and ethnic considerations in the host communities in order to achieve a maximum benefit and visitors experience. And in achieving the experience, Sustainable Tourism Online (2012) noted that adequate infrastructure such as road, water supply, waste water system, public toilet, signage, car parks and other public utilities are critical; and need to be provided as these are central to meeting visitors' needs.

Ayeni and Ebohon (2012) stated that the problem of inadequate tourism infrastructure i Nigeria is much pronounced because of the inability to maintain the few existing ones and these has put tremendous strain on the few available (Bello and Bello, 2012). Furthermore, the lack of infrastructure is most pronounced in rural areas where most tourist sites are located. However, tourism will have its impact on economic development and positive gains maximized if the infrastructure is given adequate attention. Oyakhilome (2005) noted that tourism cannot thrive without the provision of basic infrastructural facilities, which should be the sole responsibility of government with adequate participation by the private sector and for any meaningful tourism development,

Ajadi (2012) argued that the provision of tourism infrastructure are essential because, the development of a destination is largely dependent upon the infrastructure and tourism resources available. This is because infrastructures are fundamental requirements for development which help to improve the standard of life of the individual and that of the host region as well as satisfying the tourist's experience.

Indeed, infrastructure is a basic necessity for any business or society to function properly. Hence, if tourism is to contribute significantly to the Nigerian economy, basic infrastructure must be provided and maintained to enhance and promote sustainable tourism development.

5. Methodology

The study is a part of a research carried out between 2010 and 2012 and was conducted in Nigeria, within two geopolitical zones (South-west and North-central) randomly selected from the six geopolitical zones that make up Nigeria. That is, the North-west, North-east, North-central, South-south, South-west, and South-east and explored the quantitative method of data collection.

The research population are all tourist attractions in Nigeria and the study population are tourist attractions within the two geopolitical zones randomly selected and from where the sample frame was drawn which was made up of four states; Kogi, Ekiti, Ondo and the Federal Capital Territory, Abuja.. This is because, due to the size of Nigeria and the enormous tourist attractions, it is impossible to carry out the research on all the tourist attractions at the same time. The sample chosen from the sample frame is made up of people in the tourism industry including staff of tourism board, hotels, travel agent; government offices, that is, public and civil servants; individuals and tourists from whom the questionnaires were administered in each of the study areas.

A sample size of eight hundred and fifty was estimated for accuracy and precision and a stratified sampling technique was employed in administering the questionnaires to the respondents. Data was also gathered from the secondary source using books, journals, and internet websites to appreciate previous works and identify any gaps. At the end of the questionnaire administration, seven hundred and forty five questionnaires were returned filled, making a total of about eighty seven percent response rate. Data was then analysed using the statistical packages for Social Sciences (SPSSx) and results expressed using descriptive statistics and results expressed in simple percentages.

6. Findings and Discussion

6.1 Respondents General Information

Out of a total of seven hundred and forty five responses received, about sixty three percent were male and about thirty seven percent were female; the mode is 1 and represents the male, and shows that more male participated in the survey and are likely to be interested in tourism activities than the female.

The results also showed that all the respondents that participated are matured enough to take part in the survey as those within the age bracket of 20-30 years were three hundred and thirty five representing forty five percent. One hundred and fifty two which is about twenty one percent were between the age brackets of 30-40 years. Also, one hundred and thirty six represented about eighteen percent and in the age bracket of

40-50 years, while above 50 years of age were eighty and represents about eleven percent and a total of forty two which is about six percent did not respond.

Majority of the respondents were government workers among the respondents accounted for three hundred and sixty seven, about forty nine percent and revealed in mode as 2. The unemployed were one hundred and sixty two, about twenty two percent; while the private sector employees were eighty two, about eleven percent and the self employed were a total of one hundred and thirty representing about seventeen percent and one respondent was indifferent.

The tertiary level ranked the highest in the educational level accounting for four hundred and ninety respondents, making about sixty five percent. A total of ninety four of the respondents, about thirteen percent hold secondary school certificate; while ninety one, representing about twelve percent hold the primary school certificate. Also, about sixty six respondents do not have any formal education and needed a form of assistance of interpreting and filling the questionnaires while four respondents, about one percent did not respond.

A total of four hundred and thirty nine, which is about fifty nine percent respondents were married; two hundred and ninety one were single, that is thirty nine percent, while twelve respondents were widowed and three did not respond. Furthermore, the monthly income expressed in the Nigerian Naira show that three hundred and sixty three, that is, forty nine percent receive monthly income of between N1 – N100, 000.00k, those who earn between N100, 000.00k – N500, 000.00k were one hundred and eighty seven, about twenty five percent.

6.2 Adequacy of Tourism Infrastructure in Nigeria

For a destination to satisfy the tourist experience there has to be adequate infrastructure and the infrastructure are the all the components that make up the destination which combine to give a memorable experience. Going by the literature, tourism serves as a source for pleasure and satisfies other needs. However, in many of the tourist destinations in Nigeria as noted in the literature, tourism infrastructure are either meagre or absent. The implication of this is that where the infrastructure does not exist, tourists would not be attracted to such destinations.

In a bid to find out if tourism infrastructure in many of the tourist attractions in Nigeria is adequate, respondents' opinions were sought. Analyses from the survey showed that about thirty six percent, that is, two hundred and sixty six respondents said it was fairly adequate and twenty six percent, which is one hundred and ninety four respondents believe it is adequate. Also, about nineteen percent, that is, one hundred and forty three said it is not adequate while about fifteen percent, that is, one hundred and fourteen responded that it was very adequate and about four percent did not respond. It can be seen from the analyses that about fifty five percent consider tourism infrastructure inadequate and about forty percent consider it adequate. From the results, it implies that adequate infrastructure is required to meet up the tourists expectations; conversely, other benefits would come with the provision.

6.3 Infrastructure and Tourism Development

Tourism brings growth, development and reduces unemployment as gathered from the literature and the basic infrastructure which characterise a destination determines a tourist's satisfaction. Also, a destination cannot flourish without

infrastructure and these as identified from the literature have hampered tourism growth in Nigeria.

From the analysis, respondents were asked to rate their response on whether they agree or disagree that infrastructure can enhance tourism development. The results show that about fifty nine percent which represents four hundred and forty two respondents strongly agree that infrastructure can enhance tourism development in Nigeria and about thirty two percent, that is, two hundred and forty agree. Also, about three percent representing twenty respondents strongly disagree while two percent, that is, seventeen disagree and four percent, that is, twenty six did not respond. The analysis gave a total of about ninety two percent that agree to the notion. The mean is 3.41 and reveals that the data is located around this value and the standard deviation is .932 and shows the spread and dispersion of the data.

Indeed, the value of destination is increased if there is functioning infrastructure and this implies growth and continuous visits by tourists far and near; this will enable sustainable tourism development. Unless the infrastructures of many of the attractions are improved upon, tourism growth in Nigeria will be a mirage.

6.4 Accommodation, Transportation and Electricity as Necessary Infrastructure

Also in categories of infrastructure as seen from literature are accommodation, transportation and electricity. These were also posed as questions to respondents in order to ascertain if they agree or disagree that they are necessary infrastructure in a tourist attraction.

Results from the analyses show that accommodation is considered necessary; with a total of about eighty nine percent respondents in support. From the results, about sixty percent, that is, four hundred and forty eight consider accommodation as very necessary while about thirty which is two hundred and twenty one consider it necessary. Also, about four percent, that is, thirty three respondents consider it fairly necessary while one percent as not necessary and five percent, that is, thirty nine respondents did not respond,

Likewise, about sixty nine percent which is five hundred and eleven consider transportation very necessary and twenty four percent, that is, one hundred and seventy seven consider it as necessary. Also, three percent, that is twenty one respondents said it is fairly necessary while less than one percent said it is not necessary and about five percent, that is, thirty five did not respond. The mode is 4 and reveals that very necessary occurs the most and shows its importance to respondents.

Electricity was also considered very necessary by about seventy percent respondents which came to five hundred and sixteen and about twenty four percent, that is, one hundred and one necessary. Also, about two percent, that is, thirteen respondents considers it fairly necessary, not necessary was nil and about five percent did not respond. This shows the strength of feeling regarding electricity interruptions and intermittent supply

Results from the above analyses corroborate the literature and shows the inadequacy of tourism infrastructure in Nigeria as well as the need for infrastructure development for tourism growth. Likewise, respondents support the fact that infrastructure such as electricity, accommodation, transportation to mention but a few are very necessary for sustainable tourism development in Nigeria. Whilst there is the need

for its provision, there is also the need for the maintenance in order to keep tourism going, both for the present and that of the future.

Also in dire need of attention are the various problems causing setback for the Nigerian tourism industry and unless the government tackles these problems in addition to providing infrastructure, tourism would not be able to serve as alternative to boost the Nigerian economy.

7. Conclusion

The study has identified the inadequacy of tourism infrastructure in Nigeria and confirms that tourism serves as a sector for economic diversification for Nigeria. In addition, it affirms that tourism serves as an avenue for infrastructural development; not only in tourist destinations but also in the regions and country as a whole. However, this can only be evident if adequate and necessary infrastructure is provided and maintained in many of the tourist attractions in order to attract tourists far and wide.

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Synthesis and Characterization of a Novel 1, 4-diazabutadiene (α -diimine) Complex of Palladium(II) by the in situ one-pot template reaction

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Abstract

Template reactions involving formaldehyde and amines facilitate the preparation of saturated multidentate complexes. The reactions are simple “one-pot reactions”, cheap and high yielding. DAB ligands possess different possible modes of coordination as 2-, 4-, 6-, and even 8-electron donors in terminal, chelating and bridging arrangements. As α -diimine ligands, DAB ligands have electronic structural similarities to the more extensively studied heteroaromatic chelating agents 2,2'-bipyridine and 1,10-phenanthroline. DABs are readily available from the condensation of glyoxal with primary amines. Their coordination versatility stems from the flexibility of N=C-C=N backbone and strong σ -donating and π -accepting properties. A novel α -diimine (DAB: 1,4-diazabutadiene) palladium(II)chloride complex was synthesized by the in situ one-pot template reaction of appropriate primary amine (4-Aminophtalic acid), dialdehyde (Glyoxal) and PdCl₂. The structure of the newly synthesized complex was proposed according to MALDI-TOF-MS, FT-IR and UV-VIS spectral data.

Keywords: α -diimine ligands, Palladium(II) complex, synthesis, one-pot

1. Introduction

Metal template syntheses often provide selective routes toward products that are not obtainable in the absence of metal ions. Especially, template reactions involving formaldehyde and amines facilitate the preparation of saturated multidentate complexes. The reactions are simple “one-pot reactions”, cheap and high yielding [1]. Late transition metal complexes of 1,4-diazabutadiene ligands (DABs) have lately received renewed attention, primarily due to their utility as homogeneous polymerization catalyst. As a result, the reaction chemistry of this class of diimine ligand with a variety of transition metals has become well established [2,3,4,5]. Bidentate nitrogen donor ligands have been used in many catalytic studies including the enantioselective carbonylation of olefins, hydrogenation, the borylation of alkanes and alkenes and diboration [6,7]. In particular, over the past decade cationic Ni(II) α -diimine and Pd(II) α -diimine complexes have gained considerable attention in the field of Ziegler-Natta catalysis[8]. DABs are readily available from the condensation of glyoxal with primary amines. Their coordination versatility stems from the flexibility of N=C-C=N backbone and strong σ -donating and π -accepting properties [9,10]. Herein, we report the synthesis and characterization of divalent palladium compound with an acidic 1,4-diazabutadiene ligand.

2. Experimental

4-Aminophtalic acid was obtained from the hydrogenation of 4-Nitrophtalic acid in a stainless-steel 300 mL Parr Reactor (Parr Co.) [11,12]. Other reagents were obtained from commercial sources and used as received. All of the reactions and manipulations involving transition metal compounds were performed under N₂ using standard inert atmosphere. Solvents were dried and distilled by standard procedures. Thin Layer Chromatography (TLC) was made on Silica gel type 60 plates (Merck D.64271 Germany) using chloroform/methanol as the mobile phase. IR spectra were recorded on a Shimadzu FTIR-8300 spectrophotometer. UV-Vis was recorded on a Shimadzu UV-1601 spectrophotometer. Mass spectra were measured on an Auto Flex III MALDI-TOF-MS mass spectrometer.

2.1. Synthesis of 3,4-dicarboxyaniline (4-aminophtalic acid)(a)

A 4-Nitrophtalic acid solution (21,4237 g was dissolved in 200 mL Methanol) hydrogenated in a stainless-steel 300 mL Parr reactor with equivalent amount of Pd/C (as catalyst) at a temperature of 70-80 °C and a pressure of 11 mp of H₂ gas with a residence time of 48 h. After stirring for two days in Parr reactor, the mixture was filtered and the methanol removed in vacuo. The remaining dark yellow solid was recrystallised from methanol. Yield 16,6 g, (77%). MS (MALDI-TOF) m/z [M] 181.1726; [M + Na⁺] 204.15; [M + 2Na⁺] 227.19; [M + CH₃OH] 213.53; [M + K⁺] 219.53. IR (KBr) ν (cm⁻¹) 3400 - 3500

2.2. Synthesis of PdCl₂(L)₂ (L: N,N'-(ethane-1,2-diylidene)di-(3,4-dicarboxyaniline))(b)

PdCl₂ (0,0424 g, 0,236 mmol) and 4-Aminophtalic acid (0,1571 g, 0,867 mmol) were mixed in a porcelain crucible and dissolved in DMF (25 mL). Hydrochloric acid (36.5%, 3 drops) and glyoxal (0.03 mL) (0,01524 g) were added dropwise. The resulting solution was heated to 60 °C for 24 h to complete transformation to the desired product and to evaporate the solvent. The residue was then cooled to room temperature, transferred to a beaker with THF (25 mL) and tested for the presence of any impurities by

TLC. Aluminium foil was placed over the beaker and the following day the dark brown precipitate which had formed was collected by filtration and dried under vacuum. Yield 0,2508 g (71%). MS (MALDI-TOF) m/z [M] 561,34; [M + 2CH₃OH] 625,26; IR (KBr) ν (cm⁻¹) 1000 - 750; 1599; 1701; 2924; UV-Vis (nm) λ_{max} 283 - 284

3. Results and discussion

The synthetic procedure for obtaining 3,4-dicarboxyaniline (**a**) is outlined in Figure 1, starting from commercially available 4-Nitroptalic acid. The details of each step leading to (**a**), (**b**) and pertinent spectroscopic data for each compounds can be found in the Experimental Section. The condensation reaction between 3,4-dicarboxyaniline and glyoxal was initially attempted by refluxing stoichiometric amounts of these reagents in methanol. All efforts to form the desired diimine ligand **L** by this method were unsuccessful. Using ethanol as a solvent and changing reaction conditions were also ineffective. Thus, the one-cup template reaction method employed by Niasari and Adaryani for the formation of similar complexes was used. Reaction of glyoxal with two mole equivalents of 3,4-dicarboxyaniline and stoichiometric amount of PdCl₂ in adequate amount of DMF with a catalytic amount of hydrochloric acid affords the Pd(II) complex of **L** [L: N,N'-(ethane-1,2-diylidene)di-(3,4-dicarboxyaniline)] (Figure 2.) in moderate yield. It was observed that the product obtained from the reactions was largely affected by the molar ratio of the reactants.

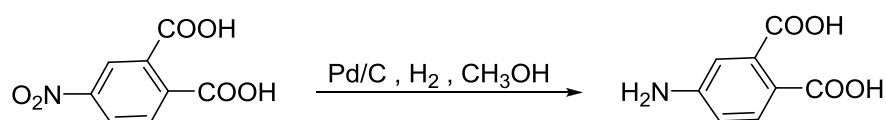


Figure 1. Synthetic scheme for the preparation of 3,4-dicarboxyaniline (4-aminophtalic acid) (**a**)

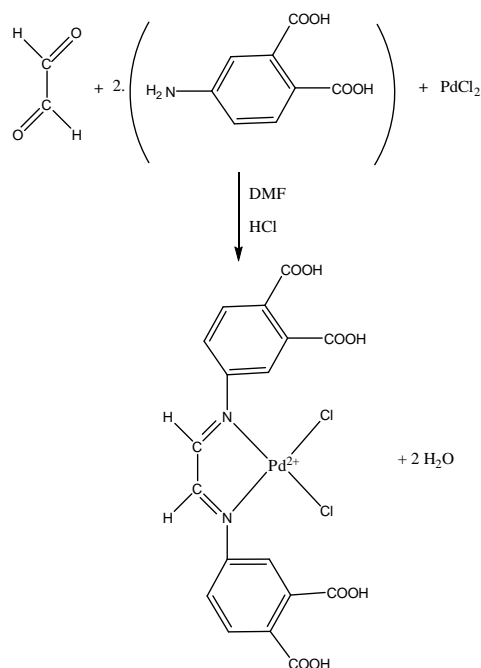


Figure 2. Synthetic scheme for the preparation of PdCl₂(L) (**b**)

The molecular formula of the compounds “4-aminophtalic acid” and “PdCl₂(L),[L: N,N'-(ethane-1,2-diylidene)di-(3,4-dicarboxyaniline)]” have been assigned on the basis of the results of their elemental analyses and the molecular ion peaks in the mass spectra (MALDI-TOF). Mass spectra showed molecular ion peaks for molecular weight of **(a)** and **(b)** and also one mole of Na⁺ cation coordinated to **(a)**, two mole of Na⁺ cation coordinated to **(a)**, one mole of K⁺ cation coordinated to **(a)** one mole of methanol coordinated to **(a)** and two mole of methanol coordinated to **(b)** (Figure 3 and Figure 4), thus supporting the proposed starting material and complex are synthesized.

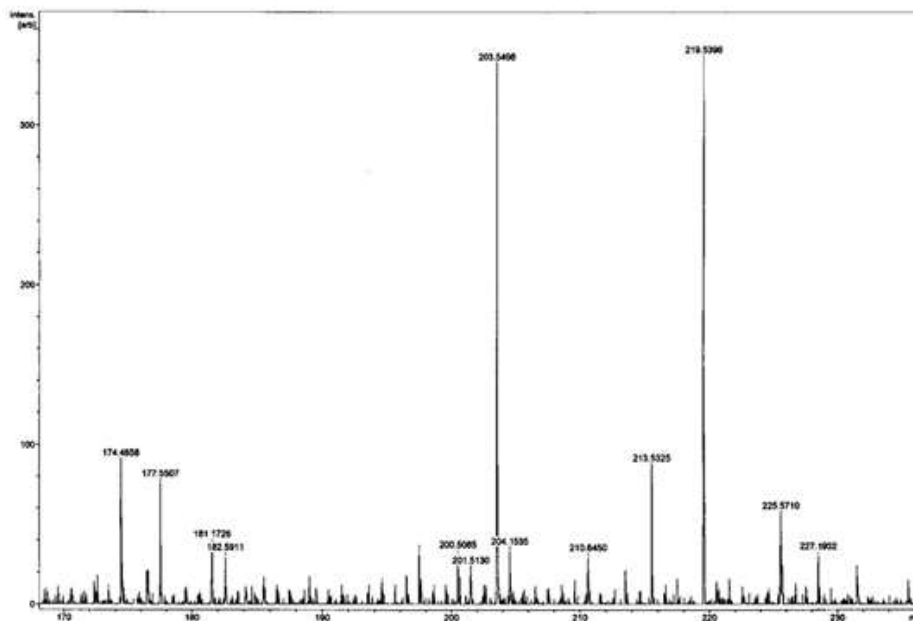


Figure 3. Mass spectra of 3,4-dicarboxyaniline (4-aminophtalic acid)(a)

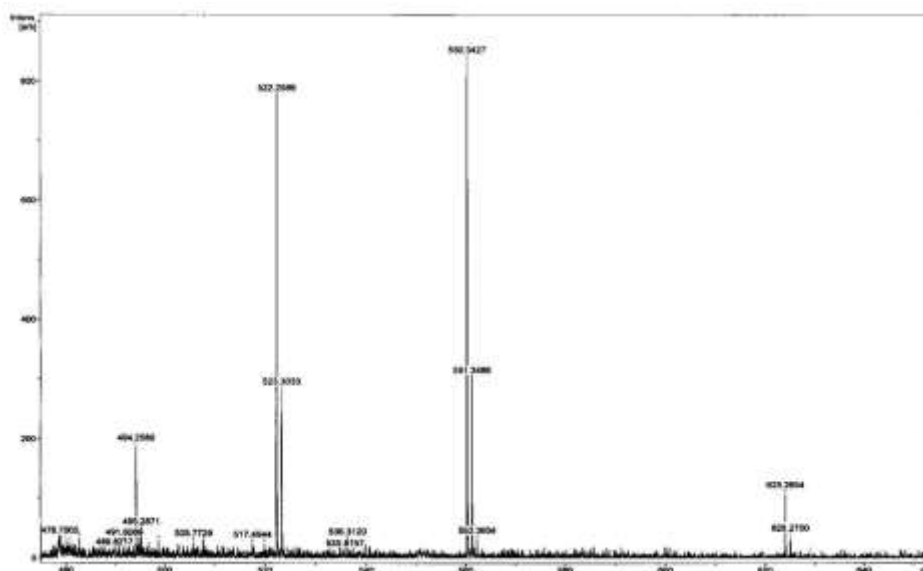


Figure 4. Mass spectra of PdCl₂(L) (b)

A preliminary identification of the primary amine and complex was made on the basis of their IR spectra. The IR spectra of 4-aminophthalic acid (Figure 5) exhibits no bands characteristics of $\nu_{\text{C-NO}_2}$ around 1300 cm^{-1} - 1370 cm^{-1} and 1500 cm^{-1} - 1570 cm^{-1} when compared with the IR spectra of starting material 4-nitrophthalic acid (Figure 6) and also showed a single sharp absorption around $\sim 3400\text{ cm}^{-1}$ which may arise from a primary amine, $\nu_{\text{N-H}}$, thus supporting the proposed compound. The single absorption around $\sim 2924\text{ cm}^{-1}$ in IR spectra of the complex “PdCl₂(L),[L: N,N'-(ethane-1,2-diylidene)di-(3,4-dicarboxyaniline)]” (Figure 7) indicates the C=O functional groups and C=O stretching frequency, 1701 cm^{-1} . Also C=N stretching frequency of this complex is 1599 cm^{-1} as seen in spectra. The absorption bands in the $750\text{-}1000\text{ cm}^{-1}$ regions observed in the complex may reasonably correspond to =C-H stretching and =C-H bending vibrational modes. However, a medium intensity band at $403\text{-}415\text{ cm}^{-1}$ may unambiguously be assigned to the M-Cl stretching mode in complex.

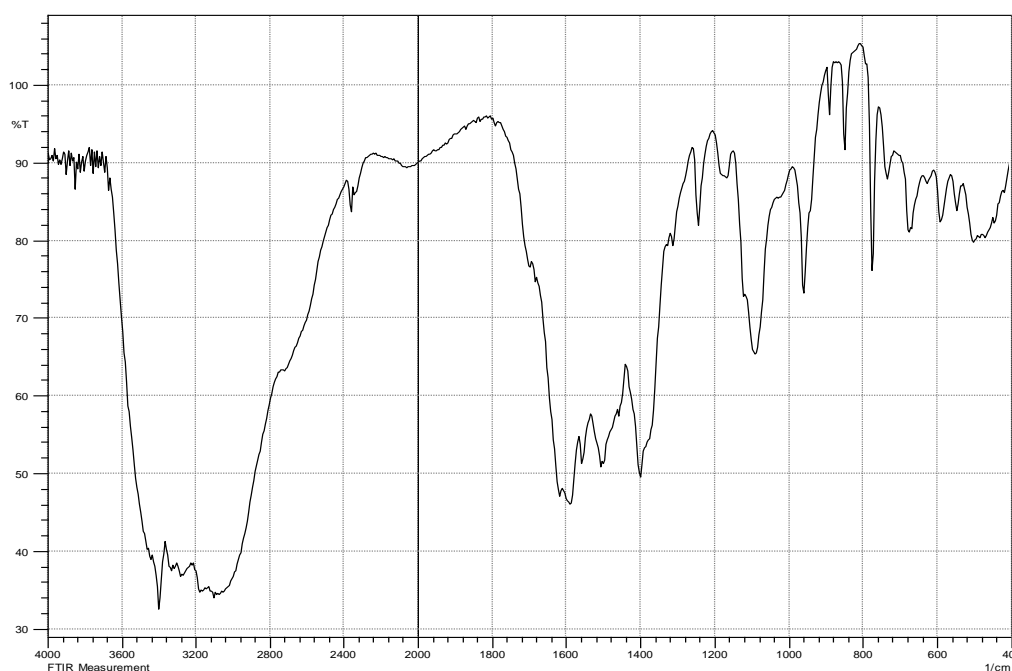


Figure 5. IR spectra of 3,4-dicarboxyaniline (4-aminophthalic acid)(a)

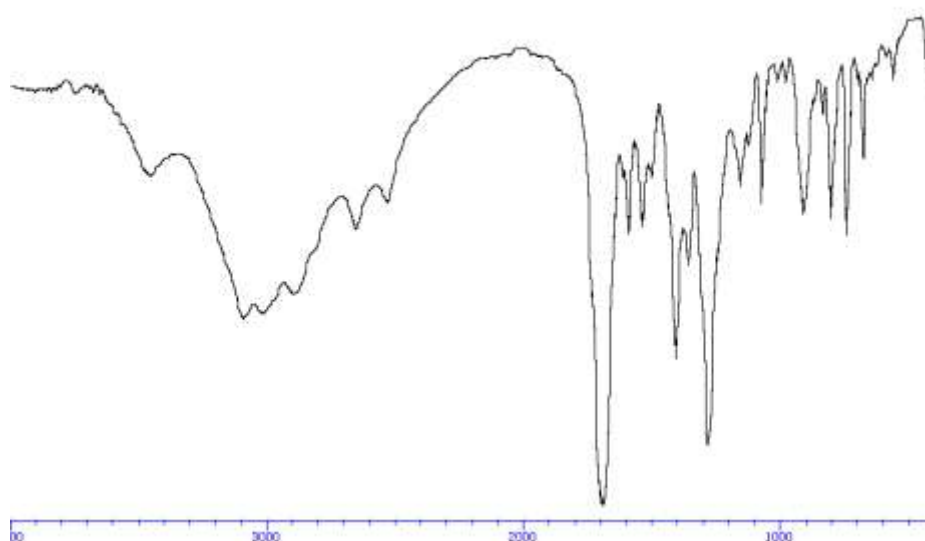


Figure 6. IR spectra of 4-nitroptalic acid

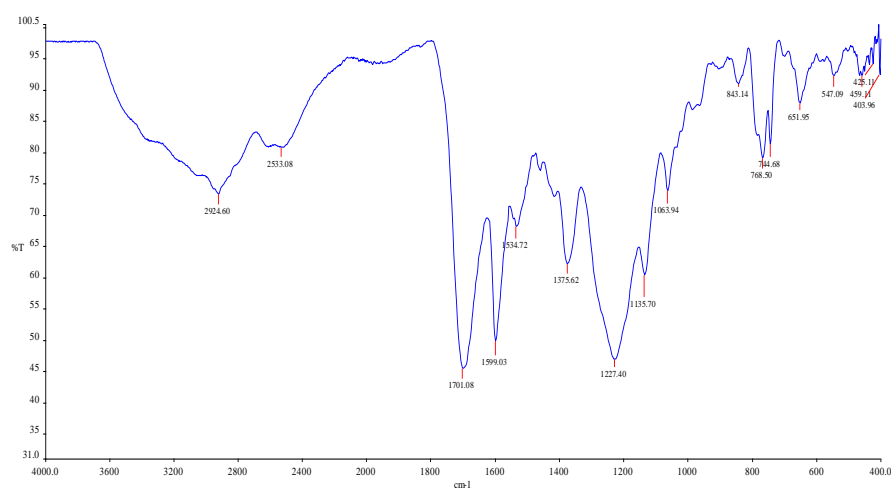


Figure 7. IR spectra of PdCl₂(L) (b)

The UV-Vis spectrum of this dark brown colored complex is dominated by intense charge-transfer absorptions in the visible and UV portions of the spectra. The spectrum is tabulated for identification purpose only; no detailed assignment will be made due to the overlap of ligand field and charge-transfer absorptions. Generally, the lowest energy bands of the spectra for Pd(II) complexes are $d \rightarrow \pi^*$ charge-transfer bands

which have been extensively studied and characterized in other α -diimine complexes [13,14].

4. Conclusion

First, DAB ligands possess different possible modes of coordination as 2-, 4-, 6-, and even 8 - electron donors in terminal, chelating and bridging arrangements. Second, as α -diimine ligands, DAB ligands have electronic structural similarities to the more extensively studied heteroaromatic chelating agents 2,2'-bipyridine and 1,10-phenantroline. In 2005, for example, Vimal K. Jain and Leela Jain [14] showed that square planar Ni(II) diimine dithiolate complexes containing 1,10-phenantroline and DAB ligand biacetetyl bis(anil) (R= Ph, R'= Me) were spectroscopically similar with common low-energy charge transfer to diimine absorption. Third, Palladium (II) complex of "N,N'-(ethane-1,2-diylidene)di-(3,4-dicarboxyaniline)" (α -diimine) can be prepared by the simple in situ one-pot template reaction by using 4-Aminophtalic acid, glyoxal and PdCl₂. The spectra of the complex show that two nitrogen (α -diimine) atoms are coordinated to the palladium(II) ion.

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The Challenges of Public Housing in a Democratic Nigeria: a case study of the Presidential Mandate Housing Scheme

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Abstract

This study examined the challenges of public housing in a democratic Nigeria using the Presidential Mandate Housing Scheme as a case study. Data were derived from purposively selected members of staff of public institutions charged with the responsibility of implementing this scheme in urban areas of Southern Nigeria through interview enquiries and participant observation. These were analyzed using content analysis. The result shows that the scheme was implemented in very few States in Southern part of Nigeria with miniscule number of housing units constructed in those States. Poor programme conception and planning, funding inadequacies and the dearth of preferred building materials were identified as the key challenges that led to the failure of this scheme. The paper argues that despite the return of democratic rule in 1999 and subsequent adoption of the New National Housing and Urban Development Policy in 2002, low organizational capacity of public housing agencies, the lack of collaborations between these agencies and private sector organizations and the none availability of reliable local building materials constitute serious impediments to smooth and successful implementation of public housing programmes in Nigeria. It therefore suggests that the prospects of public housing in democratic Nigeria are contingent upon addressing these challenges.

Keywords: Public Housing Agencies; Public Housing; Urban Areas; Presidential Housing Mandate; Nigeria

1. Introduction

In the hierarchy of human needs, housing is ranked next to food as a basic necessity of life. This is because housing has a profound impact on the quality of life, health, productivity and proper socio-economic status of man (Bashir, 2002; Aliu and Adebayo, 2010) and plays a vital role in security, physical development and natural disaster mitigation in the community (UN-HABITAT, 2006a). To this end, access to adequate housing is one of the fundamental human rights entrenched in the constitution and policy documents in different countries across the world (Thiele, 2002) and thus, making the need for housing one of those that should be fulfilled by the state. Unfortunately, in most urban centers in sub-Saharan Africa, governments have not been able to discharge this obligation satisfactorily as access to decent and affordable housing has continued to elude many middle- and low-income earners in urban areas in this region (Tipple, 1994; UN-HABITAT, 2010; Basorun and Fadairo, 2012). For instance, in Nigeria, the period between October 1960 when she gained political independence from Britain and May 1999 when the current democratic experience commenced was devoted to the struggle for freedom from autocratic military rule. As Katsina (2011) and Olu-Adeyemi (2012) rightly observed, the 29 years of military rule after political independence was characterized by massive decay of urban infrastructure, unemployment, crime, deprivation, poverty, corruption and stunted economic growth in Nigeria. Consequently, the resources that should have been invested in securing and sustaining the economic, social and cultural rights of the people; including the right to access to adequate housing were massively diverted to political struggle.

In addition to the long period of military rule, studies have also established that among other factors, rapid urbanization, high cost of building materials, ineffective housing policies, (Adejumo, 2010), housing finance inadequacies (Ajanlekoko, 2001; Basorun and Fadairo, 2012) and corruption (Mba, 1992; Ayodele, 2010; Oloyede et al., 2011) have marred smooth implementation of public housing programmes, and by extension contributed to exacerbating urban housing crisis in Nigeria (Awotona, 1987, Olotuah and Bobadoye, 2009). Therefore, the return of democratic rule in May 1999 was expected to usher in the era of good governance and improvement in the social welfare of most urban residents through proper implementation of social intervention programmes in the housing, health and educational sectors in Nigeria. It was therefore not surprising that in April 2004, the government of President Olusegun Obasanjo initiated the Presidential Mandate Housing Scheme (PMHS) as the first national housing programme under the current democratic dispensation. Etim et al (2007) noted that this was a commendable effort of the government to embark on social housing programme in favour of the less privileged Nigerians after a long time of neglect. However, looking back eight years after the PMHS was initiated; it thus appears that much has not been achieved in the implementation of this scheme in urban areas in Nigeria. Although, there is a dearth of reliable data on the number of housing units constructed under the PMHS across this country, available statistics suggest that no State has yet achieved the minimum set target of 500 housing units in the scheme. Hence, contrary to all expectations, the goal of the PMHS has not been achieved despite the prevailing democratic atmosphere; and thus urban housing crisis has continued to escalate unabated in Nigeria. This is no doubt a striking paradox as democracy is associated with the delivery of the dividends of democracy, including safe guarding fundamental human rights (Abdullahi, 2012), good

governance, effective and efficient use of resources and rapid economic growth (Dellapiane-Avellaneda, 2009; UNDP, 2007; Ude and Coker, 2012).

A reflection of the above calls to question certain issues that stand as challenges of effective public housing delivery system in urban areas in a democratic Nigeria. Therefore, the aim of this study was to investigate the challenges of public housing in a democratic Nigeria using the Presidential Mandate Housing Scheme as a case study. The study attempted to answer two main research questions; firstly, what are the possible explanations to the failure of the PMHS to achieve its goal? Secondly, why has public housing continued to lag behind in urban areas in a democratic Nigeria? In order to provide answer to these questions, the succeeding sections of this paper have been structured to provide an overview of relevant literature, explain the research methodology used, present and discuss study findings and make concluding remarks.

2. Urban Housing Crisis and Public Housing Provision in Nigeria: an Overview

The recent statistics released by the United Nations Population Funds (UNPF) in 2012 shows that Nigeria with a population figure of about 160 million people is the most populous country in Africa; contributing about 3.6 percent of the world's total population of about 7 billion people. Although she is the sixth largest producer of crude oil in the world, the World Bank (2010) classified Nigeria as a low-middle income country with a gross national income (GNI) of US\$175.6 billion. Politically, before independence in 1960, Nigeria operated a regional structure of government, but it currently operates a federal system of government with a three-tier of government structure consisting federal, state and local government. There are presently 36 States and 774 local government areas in Nigeria with Abuja as the administrative capital.

Nigeria's experience in public housing provision has witnessed significant changes over the last fifty years as documented by several authors (Onibokun, 1985; Awotona, 1990; Ikejiofor, 1999; Omole, 2001; Mustapha, 2002; Ademiluyi, 2010). It is however interesting to note that over 90 percent of the housing stock in Nigeria can be traced to the ingenuity of her people (UN-HABITAT, 2006b), who despite the constraints of low income, high cost of building materials and economic hardship have struggled to put roof over their heads. On the part of the government, a number of policies and programmes have been underway to facilitate access by Nigerians to decent housing. Although, this appears to be in line with the submission by Sykora (1999) that government can use housing as a development instrument to reduce unemployment, improve public health and productivity and mitigate the impact of market forces that tend to exclude the less-privileged people from enjoying the benefits of decent housing; Ogu and Ogbuozobe, (2001) and Adejumo (2010) have observed that some of the public housing programmes in Nigeria have remained mere intentions while others were implemented haphazardly. As a result, most of the previous schemes have not contributed much to reducing exclusion, urban poverty, and improvement of public health in this country (Ikejiofor, 1999).

Balchin et al. (2000) argued that the different ways in which government intervenes in promoting access to adequate housing by citizens depend on the scale of need, operational welfare regime and housing policy systems in a country. In the context of Nigeria, government intervention in the housing sector which began in the colonial era has taken varying forms, including direct construction of housing units (Awotona, 1990; Ibe, 2011a), creation of institutional structures (Omole, 2001) and financial

mechanisms; restructuring of the finance framework (Ajanlekoko, 2001) and policy formulation (Aribigbola, 2008). A number of strategies and approaches, including direct construction of housing units, urban renewal and slum clearance, site and services and public-private-partnerships have also been adopted (Ali, 1996; Ademiluyi, 2010; Ibem, 2011b; Aribigbola and Ayeniyo, 2012). Despite all these, it is observed that quantitative and qualitative inadequacies, housing affordability challenges and homelessness have remained common features in urban areas in Nigeria (Ajanlekoko, 2002; UN-HABITAT, 2006b; Olotuah and Bobadoye, 2009). In fact, public housing in this country has been associated with low productivity (Akinmoladun and Oluwoye, 2007), poor quality and expensive housing units (Mba, 1992). Consequently, most low-income people have been denied access to decent housing at affordable cost (Awotona, 1987; Bana, 1991; Olotuah and Bobadoye, 2009) leading to the proliferation of urban slums and shanties, which constitute serious threat to sustainable urban growth and development in Nigeria.

It has been established in the literature that a number of factors have precluded full realization of government housing policies and programmes in Nigeria in the past few decades. Indeed there is a substantial agreement in the literature that rapid urbanization, the absence of proper monitoring and evaluation of public housing policies and programmes (Awotona, 1990; Federal Republic of Nigeria, 1991; Akinmoladun and Oluwoye, 2007), the lack of easy access to land and high cost of building materials and other housing inputs (Federal Republic of Nigeria, 1991; UN-HABITAT, 2006b), low capacity of public housing agencies (Ibem and Solanke, 2011); high incidence of corruption (Mba, 1992; Ayodele et al., 2011; Oloyede et al., 2011); politicisation and poor implementation of housing programmes (Ali, 1996; Ademiluyi 2010; Ibem et al., 2011) and adoption of unrealistically high housing standards (UN-HABITAT, 2006b) are responsible for the high rate of failure of public housing programmes and current urban housing crisis in Nigeria. Ndubueze (2009) was of the view that in the face of increasing urban population, the real challenge is how to ensure adequate supply and access to land, housing finance, infrastructure, and building materials within a framework that guarantees the supply of decent housing at costs affordable to all households. The implication of this is that government in Nigeria is faced with two key challenges. First, is how to improve the quality of housing in existing urban slums and squatter settlements; and secondly, ways and means to assist those with critical housing need to gain access to urban land and housing.

From the foregoing, it is obvious that rapid urbanization, bureaucracy, political upheavals and gross economic mismanagement at all levels of government are at the root of urban housing crisis in Nigeria. Under the current democratic dispensation, a number of steps have been taken by the government to address these problems. Chief among them include the formulation and adoption of the New National Housing and Urban Development Policy (NNHUDP) in 2002; and restructuring of the housing finance sub-sector to include secondary mortgage institutions. It is important to mention that the NNHUDP which seeks to address the inadequacies of previous policies and ensures that Nigerians have access to decent and sanitary housing through private sector-led initiatives (Aribigbola, 2008) is instrumental for the adoption of Public-Private-Partnerships (PPPs) in public housing delivery in Nigeria. Another step taken was to encourage the use of local building materials in the provision of mass housing. It was in pursuant to this objective that the then president - Chief Olusegun Obasanjo in April 2004 mandated three key agencies in the housing sector, namely, Association of Housing Corporations,

(AHCN), Nigerian Building and Road Research Institute (NBRRI) and the Federal Mortgage Bank of Nigeria, (FMBN) to commence the construction of at least 500 housing units in each State of the federation and in the Federal Capital Territory-Abuja using local building materials. This gave birth to the Presidential Mandate Housing Scheme, which was originally intended to provide at least 18,500 housing units across the country in its introductory stage before the end of 2006 (Etim et al., 2007).

To achieve the target of this scheme, the AHCN, which is the umbrella organization of all State government-owned housing agencies in Nigeria, was expected to provide land in their respective States for the scheme and be directly involved in the actual construction of the housing units. The NBRRI, which is the foremost federal government-owned research institute established in 1978 to undertake integrated research and development in building and road construction was to provide relevant technology in the production of interlocking laterite bricks for walling and walkway paving stones for landscaping; while the FMBN- the apex mortgage institution in Nigeria, which currently manages the National Housing Fund (NHF) was to provide financial backing for the scheme. Therefore, the scheme was expected to contribute to sustainable urban housing development by circumventing most of the challenges associated with access to land, finance and building materials that hitherto contributed to the failure of previous public housing schemes in Nigerian cities. Although, there are no published works on the performance of this scheme; evidence around us today suggests that this scheme has performed below expectations. Hence, the current study is justified as it attempted at examining the key challenges surrounding the conception and implementation of the PMHS as a feedback to public sector managers and programme designers of the challenges confronting public housing under current democratic milieu in Nigeria; and to highlight the need for improved performance in the planning and implementation of public housing programmes in this country.

3. Methods

Data used in this paper were derived using qualitative research method. Primary data were obtained through a survey of public housing agencies in States within Southern Nigeria, and participant observation. Extensive review of literature and official records was used in sourcing secondary data. It would be of interest to know that Nigeria is divided into six geo-political zones, three in the North and three in the South. Since the current study is focused on States in the Southern part of Nigeria; Ogun, Rivers and Abia States, representing Southwest, South-south and Southeast geo-political zones, respectively, were chosen as the study area. Lagos was however added to this list by virtue of its strategic importance as the host State of the national headquarters of the AHCN and its peculiar housing situation in Nigeria. Table 1 shows the public housing institutions that participated in this study. These agencies were purposively selected because they were the agencies charged with the responsibility of implementing the PMHS.

The field work involved the use of purposive sampling technique in selecting key informants from these institutions. We adopted this sampling technique because of its advantage in allowing the selection of informants to be narrowed down to specific group(s) of people who can provide the desired information on the subject investigated. The principal data gathering instrument used in extracting data from the respondents was the interview guide prepared by the researchers. To reduce variation and provide

flexibility in the interviews, the interview guide contained both structured and open-ended questions related to the subject investigated. Before the interviews were conducted, visits were made to the selected agencies, and subsequently, telephone calls were put across to the officers to book convenient dates and time for the interviews. A total of seven officers of grade levels 14 and above drawn from each of the agencies listed in Table 1 were interviewed between December 2011 and June 2012. Some of the interviews were on one-on-one basis, while others were through telephone conversations. The officers were asked questions related to the key challenges associated with the implementation, and outcome of the PMHS in the study area. The interviews were recorded manually and electronically, with the former later transcribed in preparation for the analysis.

Table 1: Government Agencies Selected for the Study

| Agencies | Locations |
|--|-----------------------|
| Association of Housing Corporations of Nigeria (AHCN) | Lagos National Office |
| Ogun State Housing Corporation (OSHC) | Abeokuta |
| Nigerian Building and Road Research, (NBRRI) | Ota |
| Federal Mortgage Bank of Nigeria (FMBN) | Lagos |
| Abia State Housing Corporation (ASHC) | Umuahia |
| Rivers State Housing & Property Development Authority (RSHPDA) | Port Harcourt |
| Lagos State Property Development Corporation, (LSPDC) | Ikeja, Lagos |

Data from the interviews were complimented by the records of involvement of the second researcher in NBRRI when this housing scheme was initiated. The key type of analysis data were subjected to was content analysis. This involved coding and organizing of the information gathered from the interviews and secondary sources into common themes and ideas. This helped in identifying patterns and highlighting crucial issues expressed by the informants. Result of the analysis is presented in the subsequent section of the paper.

4. Study Findings

4.1. Implementation of the Presidential Housing Mandate Scheme

From the interviews, it was found that prior to the implementation of this scheme, the Chief Executive Officers of the three aforementioned agencies that were given the mandate to implement the scheme held series of high-level meetings. These meetings culminated in the setting up of a Technical Committee comprising representatives of these organizations, and the committee was charged with the responsibility of examining the mandate and making recommendations to the Chief Executives. This was followed by three separate workshops held in three strategic locations of Ota in Ogun State (South West), Kaduna in Kaduna State (North) and Umuahia in Abia State (South East). The main thrust of the workshops was to train the potential team leaders of the scheme in the production and use of the preferred local building materials. It was expected that the team leaders so trained would go back to their respective organizations and replicate the training for their team members. The workshops focused on two of the local construction materials, namely; the interlocking laterite bricks for walling and walkway paving stones

for landscaping, respectively. In addition to these workshops, the AHCN organized series of sensitization forums during which its members were further educated on the new technology and materials to be used in the scheme and the need to embrace them. It may be noted here that the proposed technology and materials were quite different from the conventional construction technology and materials currently used across Nigeria.

On the number of housing units constructed at the time of the survey, available data from the national office of the AHCN in Lagos, show that none of the States in the study area has yet achieved the minimum set target of 500 housing units. However, at the national level, it was reported that States like Ekiti, Eboinyi, Ogun, Osun, Jigawa and Kwara implemented the PMHS with different degrees of result. In Ekiti State Southwest Nigeria for example, the first phase of the scheme comprising 250 housing units was completed and commissioned by the then President Obasanjo before leaving office on May 29, 2007. The second phase of another 250 units had commenced and was at different levels of completion at the time of the survey. In Ebonyi State Southeast Nigeria, construction of the 500 housing units had commenced but was at varying levels of completion. Ogun State Southwest Nigeria was also found to have completed 88 housing units with a number of them occupied. The scheme in Ogun State is located at Kemta Extension Housing Estate Olokota-Abeokuta and 2-bedroom and 3-bedroom flats housing units were constructed and sold for ₦4 million and ₦4.5million, respectively. Figure 1 and Figure 2 show the floor plan and the pictorial view of a 3-bedroom unit in this housing scheme.

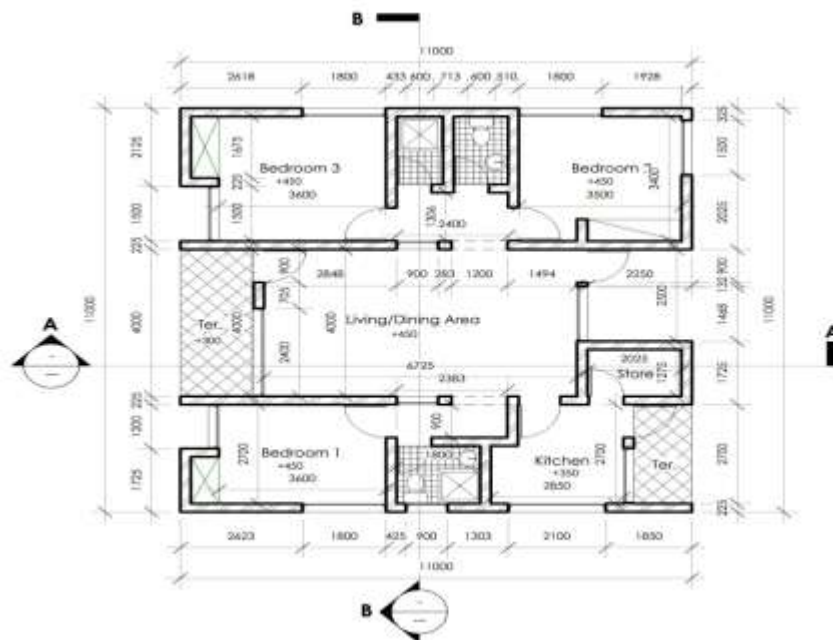


Figure 1: Floor Plan of 3-Bedroom Housing unit in the PMHS, Abeokuta, Ogun State: Source: Ibem (2011a)



Figure 2: Pictorial view of the 3-bedroom housing unit constructed in PHMS, Abeokuta, Ogun State Source: Ibem (2011a)

It can be deduced from the foregoing, that the setting up of a Technical Committee by the agencies to examine the mandate and make recommendations to the Chief Executive Officers was a step in the right direction in ensuring successful implementation of this scheme. However, findings of the study suggest that this is not all it takes to implement a nationwide programme of this nature. It thus appears that the agencies did not have a well articulated plan of action on the implementation strategies for this scheme. This assertion is based on a number of observations. In the first instance, we view the organization of the training workshops in only three locations as not proper and inadequate. Considering the fact that the scheme was a national housing programme, and given the geographical spread of Nigeria, one would have expected that the training workshops be held initially in the six geo-political zones and later in every State capital and Abuja to create enough awareness on the scheme. Secondly, given the number of stakeholders in the building construction industry, the sensitization forums should also have included tradesmen and artisans who will be directly involved in the new technology and materials at the building construction sites. Unfortunately, these were not done; and thus it is not surprising the result achieved in this scheme.

4.2 Challenges of the PMHS

Looking at the rate of success in the implementation of the PMHS, as discussed in the preceding paragraph, it is obvious that there were a number of challenges in the conception and implementation of the scheme. In the context of this study and for the purpose of clarity, these challenges are classified into two groups: challenges related to the conception, and those related to the implementation of the scheme.

4.2.1 Challenges Related to the Conception of the PMHS

It is evident from our introduction section of this paper and discussions with the officers interviewed that the PMHS came into existence through a presidential directive and not as a well articulated housing programme. This suggests that this scheme was not well conceived. Consequently, the agencies in a bid to obey a presidential order hastily jump-started the scheme without adequate planning and preparations. Most worrisome is the fact that in the conception of the scheme, there was no clear definition of what

constituted 'local building materials', and thus it was assumed that laterite bricks was the most appropriate local material; perhaps because it requires less cement compared with the sandcrete blocks, which is the conventional walling material used in Nigeria. Another aspect of ill-conception in the scheme was the assumption that the NBRRI was the only research and development outfit in the housing sector in Nigeria to warrant the kind of responsibility given to it under this scheme. On the contrary, there are several institutions engaged in research and development in the housing sector in Nigeria. In the light of the above, we argue that it would have been better if the NBRRI had been given the role of a co-ordinating agency or clearing warehouse for the local material content of the scheme. In such a capacity, NBRRI would have been able to collate information on available local building materials and technologies; and assess their viability and appropriateness for the scheme. This is in view of the fact that some materials, for instance, may be more suitable for use in certain parts of the country due to their availability, prevailing local weather condition and socio-cultural practices. These ambiguities, among others, surrounding the conception of the scheme may explain why there seems to have been unrealistic expectations from the three participating agencies, and the subsequent failure of the scheme to realise its goal.

4.2.2 Challenges related to the Implementation of the Scheme

(a) Pre-Commencement Activities

During the pre-commencement training workshops for the participating agencies, it was observed that only one machine was used for the training per location. This no doubt was grossly inadequate for the number of participants. It was also observed that the training duration was just few days, which was insufficient for participants to acquire enough skills and develop the level of confidence they needed to transfer the knowledge to their team members on returning to their stations. Indeed, the trainings appeared to be more like demonstration sessions, which had very low hands-on component. As a result, staff members of the organizations under AHCN were not adequately equipped technically and otherwise to manage the huge housing development envisaged in the scheme using a new technology and materials. One of the manifestations of this was that the housing units were designed without due regard to the peculiar demands of the technology. For example, the lack of consideration for the dimensions of the bricks meant that bricks had to be cut. Apart from the difficulties in cutting the bricks; it resulted to material wastage and exposure of cut surface to water, thereby impacting negatively on the quality and durability of the walling materials. This goes to suggest that adequate technical information was not given to those who were supposed to implement the scheme in the field before the programme took-off.

(b) Funding

In support of previous studies, the dearth of funds was identified as one of the critical constraints to successful implementation of the scheme. With a capital base of only N2.5billion, the FMBN appears not to have the required capital base to support the scheme, given its other commitments as the apex mortgage institution in Nigeria. The study found out that as at the end of 2010, FMBN could only fund the construction of 500 housing units in this scheme across the country. The interviewees noted that accessing funds from this apex mortgage bank was further constrained by stringent requirements which members of the AHCN were expected to meet. For instance, the FMBN insisted on

a 'standing order' which would empower it to deduct loan repayments from the office of the Accountant General of the Federation for any State whose housing corporation defaulted in repayments. This implies a reduction in the monthly allocation to such State from the Federation account. It was for this reason many of the State governments who were supposed to stand as guarantors for their housing corporations were very uncomfortable with this condition and therefore reluctant and in some cases were unwilling to endorse the contract agreement. To worsen the funding situation, disbursement of funds by the FMBN was in phases. Going by the bureaucratic bottlenecks in the administration of housing finance by the FMBN, there were usually delays in the release of funds. Consequently, the implementation of the housing scheme by members of the AHCN was delayed and negatively affected by inflationary trends in this country. In some States where the scheme was implemented, this resulted in upward review of project costs leading to cost overrun and a hike in the cost at which completed housing units were sold to the interested members of the public.

In Ogun State for example, where a number of 88 housing units were completed, it was found that only 15 housing units were occupied at the time of the survey. This was because a key service such as water supply was yet to be provided in the housing estate. Although, work was in progress in the housing estates as more housing units were planned for construction, according to the Director of Estate in the Ogun State Housing Corporation (OSHC), the agency had to slow down the pace of work on the scheme due to the challenge of accessing funding from the FMBN. It is noteworthy that the use of local materials was to make the houses affordable to low- and middle-income earners, but going by the cost of the housing units constructed in this scheme in Ogun State, which was between ₦4 million and ₦4.5million, it is clear that the scheme did not benefit low-income people, who were the target population. As pointed out in the preceding paragraph, in addition to the funding challenge, other issues related to the administration of the scheme could have contributed to the cost of housing provided in this scheme as observed in Ogun State.

(c) Building Materials and Technology

Interestingly, the availability of land was not identified as having posed a challenge to the smooth implementation of this scheme. However, the inability of the NBRRI to deliver on its own aspect of the mandate was identified as one of the key challenges that prevented full implementation of the PMHS across the country. The study revealed that the promised technology that was to be provided by the NBRRI had apparently not gone through the full circle in the process of development prior to its deployment for use in the scheme. It was observed that during the workshops and trainings sessions at the NBRRI's National Laboratory and Production Complex in Ota, Ogun State, the machines used were different from those developed by the Institute. This was really a source of concern to the participants on the ability of the NBRRI to fulfil its obligation. This apprehension eventually became real when members of the AHCN needed the machines to commence the production of the building materials, and they were not available. Consequently, the organizations had to wait for a long time, even after payments were made to the NBRRI. It was obvious that the NBRRI did not have funds to finance the production of the machines; hence, money paid to the Institute by members of AHCN was used to finance the production of the machines. On the other hand, members of the AHCN whose machines were delivered reported frustrations and delays in the

production of the building materials due to frequent breakdowns and recurrent need for repairs. Apart from these difficulties, there were also reported cases of dimensional variations in the walling material (laterite bricks), not only from different machines but also from the same machine. This led to some constraints in using the resulting bricks as the walling material; and thus slowed down the rate of construction work on the project sites.

Specifically, the failure of the NBRRI to deliver the machines as was expected might be due to obvious reasons. Notably, the mandate setting up the Institute did not empower it to handle the level of responsibilities given to it in the PMHS. As a research and development organization, the NBRRI did not have the capacity to venture into commercial production of its research findings. This is because it lacks the financial, personnel and infrastructural capacity to produce brick making machines for the scheme. In fact, it was found out that the few machines produced were contracted out and fabricated by other organizations outside the Institute. In some cases, these organizations failed to deliver the machines due to inadequate funding and unrealistic delivery time frame given to them.

Generally speaking, it is evident from findings of this study that government may have had a good intention for initiating this housing scheme, but the implementation did not record reasonable success due to avoidable lapses at the conception, planning and implementation stages. The PMHS failed at the conception and design stages as little or no feasibility studies were carried to examine whether or not the scheme was in line with the operational National Housing Policy- the NNHUDP of 2002 mentioned earlier. In fact the scheme was not in line with the goal of this policy, as private sector organizations were not officially recognised as part of the institutional framework for the implementation of the scheme. The inclusion of the private organizations as partners by the three agencies at the training workshops before the took-off of this scheme could have produced better result. At least, the private sector could have been involved in the fabrication of the bricks making machines, the actual production of bricks and provision of funds for the scheme, and perhaps injected its resources in boosting the performance of the public-sector agencies in actualising the goal of the scheme. Another aspect that contributed to the failure of the scheme was the lack of understanding of the capacity of the three agencies entrusted with responsibility of delivering the mandate to produce the designed result. As a result, the agencies went into the scheme unprepared in swift response to the directive of the then President. This goes to suggest that the lack of adequate organizational capacity contributed to the dismal performance of this scheme; and that this explains why public housing has continued to lag behind in Nigeria in most recent times.

5. Conclusions

This study examined the challenges of public housing in democratic Nigeria using the Presidential Mandate Housing Scheme as a case study. It is evident from this study that even in the democratic era a number of challenges militate against the smooth implementation of public housing schemes in Nigeria. These include poor conception and design of housing programmes, poor implementation strategies, funding difficulties and poor organizational capacity of public housing agencies.

One of the lessons from this study is that political leaders, policy makers and managers in the public sector should know that social intervention programmes are not

political programmes that are based on mere proclamations and directives; but are rather based on proper conception and design based on reliable data on the prevailing situation. This call for proper conception and designing, as well as adequate planning of public housing projects programmes to take-off to avoid or minimise project failure. The study has also shown that for effective performance of public housing schemes in the democratic era, capacity building is required in public housing agencies in the areas of information management, manpower development and funding. This can be achieved through partnership with private sector organizations in these areas. Another lesson from this study is that only materials and technologies that have been perfected and tested should be used in executing a nationwide scheme that has the capacity to generate multiplier effect on the life of people and national economy. Lastly, in the spirit of democracy, which thrives on popular participation, it has become imperative that public housing programmes be conceived based on the inputs of all the stakeholders in both the public and private sectors to ensure better implementation and performance of such programmes in addressing current needs of the people.

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Depth-area stratification of groundwater quality in part of Lagos State, Nigeria.

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Abstract

This work presents depth-area stratification of groundwater quality within Lagos metropolis, Nigeria. The hydrochemical data were checked for validity via ionic balance to ensure an acceptable 5 % error limit. Spatially, two major hydrogeochemical regimes, namely Na-Cl and Na-HCO₃⁻ facies types were identified in the study area. Also, depth-dependent geochemical facies transformation from Cl-SO₄²⁻ type at shallow horizons, through Cl-SO₄²⁻-HCO₃⁻ at the lower horizons, and to HCO₃⁻-Cl-SO₄²⁻ at the deep horizons were observed. Results of the algebraic-graphical analysis of the observed salinity suggest an ancient water origin entrapped by marine sediments rather than recent salt water intrusion. The pH values indicate higher (5.3) acidity in the northern part as compared with the central (5.9) and the southern (6.0) regions of the study area. The major ionic concentrations viz: Ca²⁺, Mg²⁺, Na⁺, K⁺, SO₄²⁻, HCO₃⁻, and Cl⁻, generally fall below the W.H.O. suggested desirable limits. The SAR limits of between 3.08 and 14.0 were observed for the water samples in the area, and this suggests excellent to good water type for irrigation purposes. Regular routine chemical analysis is recommended to monitor possible ingress of salinity into the aquifers.

KEYWORDS: Hydrochemistry; groundwater quality; hydrochemical regimes; statistical approach

Introduction

The success of the global efforts in the development of groundwater resources potential depends largely on the ability to adequately protect this subterranean water from the increasing threat of subsurface pollution. However, the compelling desires to reduce surface environmental pollution has caused some practitioners in the waste management fields to covet the subsurface environment as a waste disposal unit, thereby aggravating the potential for groundwater pollution. Hence, the interest on the geochemistry of groundwater is increasing as a result of a large number of groundwater pollution cases resulting from incidents like underground liquid waste storage, accidental contaminant of groundwater bodies by lethal substances, leakages from sanitary landfills, ponds and lagoons, as well as leaching of animal wastes, fertilizers and pesticides from agricultural soils (Adekunle, *et. al.*, 2007; Olayinka and Alo, 2004; Ikem *et. al.*, 2002).

Generally, the results of the chemical analysis of a large number of samples usually yield a clumsy mass of data where quick visual comparison is difficult (Asiwaju-Bello and Oladeji, 2001). Easily comprehensible techniques of analyzing these data are the graphical methods. Examples of these are the spatial variational maps, bar charts, circular diagrams, and Stiff diagrams. Others include trilinear diagrams developed by Piper (1953), with similar design by Hill (1940), and the semi-logarithmic diagram developed by Scholler (1962). Consequently, it is apparent that the combination of the different types of graphical techniques will be useful in extracting obscured facts from water analytical results.

Reports on geochemical characteristics of groundwater within some parts of the basement (Ako *et al.*, 1990; Malomo *et al.*, 1990; Gbadebo, 2012), as well as some sedimentary basins of Nigeria (Tijani and Uma, 1998; Ekwere and Ukpong, 1994; Akujieze *et al.*, 2003), are available in the literature. However, within Lagos State, there have been few published works, with the exception of consultant reports which are not freely accessible. Few authors, e.g, Longe *et al.*, (1986), provided little details on the water quality in the areas within the framework of their hydrogeological study. However, the depth of sampling could not be related to the samples analyzed. Therefore, this paper intends to study water quality depth stratification by integrating statistical enquiry and graphical techniques so as to utilize the advantages of the individual methods in the analyses of the hydrochemical results obtained from the study area. The Piper and Schoeller graphical techniques are favoured in this work because of their ability to reflect differences or similarities among different water samples, and their limited space requirement.

The study area

Lagos State is located along the coastal region of south-western Nigeria, and bounded by longitudes 3°00' – 4°15' E and latitudes 6°15' – 6°45' N (Figure 1). The area of investigation is generally low-lying with several points virtually at the sea level, and is therefore prone to flooding. Jones and Hockey (1964) recognized three distinct topographical forms which include the northern uplands, the Ewekoro depression and the low-lying marshy belt at the southern part. The area is drained by four major river systems, namely Ogun in the centre, Ona and Osun in the east, and the Yewa in the west. Two climatic seasons exist in the area. These are the dry season, spanning from November to March, and wet season, which extends from April to October, with an

average annual rainfall of 1700 mm (Akintola, 1986). The rainfall serves as a major source of groundwater replenishment in the area.

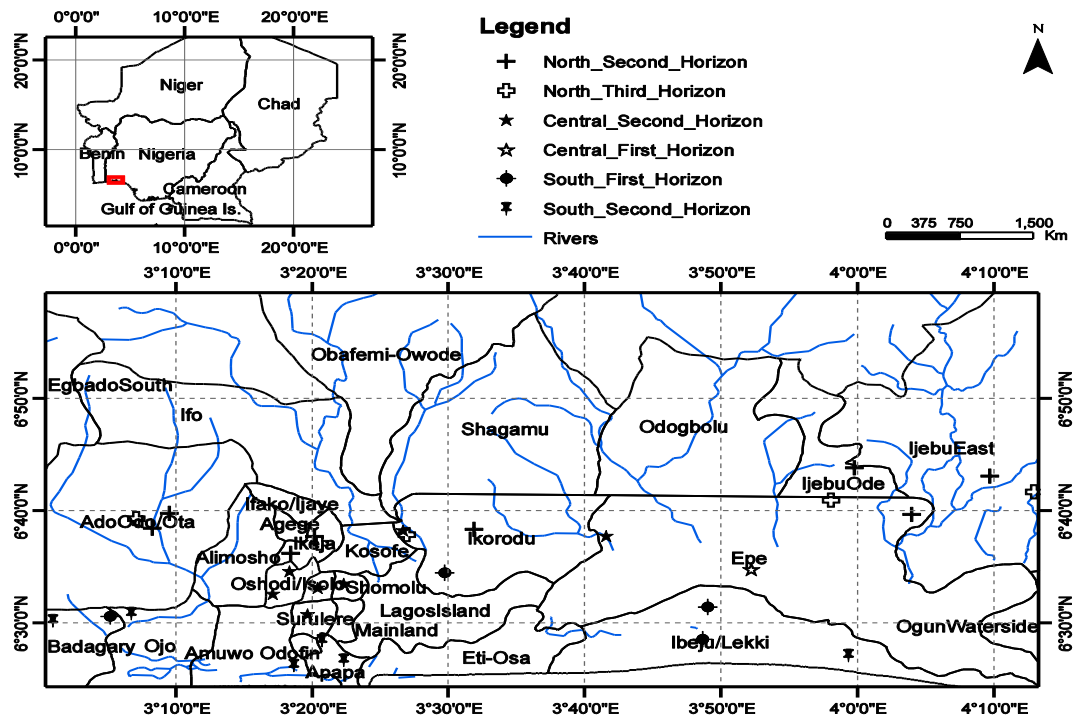


Figure 1: Description of the study area

Geology and Hydrogeology

The geological map of the study area is presented in Figure 2. The area forms the eastern part of the regional Dahomey basin, and extends from Accra in Ghana to Benin hinge line in Nigeria, where it is separated from the Niger Delta by the Okitipupa ridge. The basal portion of Dahomey basin consists essentially of sandstones and gravels devoid of fossils. This is overlain by marine shales, sandstones and limestones of Albian to Santonian ages. Generally, the geosequence of the Dahomey basin covers Pre-Cambrian to Recent. The Recent sediments occur as alluvial deposits along the major rivers and coastal belts. It consist essentially of unconsolidated coarse to poorly sorted sands, clay lenses and mud, with presence of pyritic fragments and traces of lignites in sediments within the area.

The aquifers within this horizon are unconfined (Asiwaju-Bello and Oladeji, 2001). The Coastal Plains Sands consist of poorly sorted clays with traces of lignites and pyritic fragments and thicknesses increasing from north to south. Kampsax and Sshwed (1977) subdivided the Coastal Plains Sands into the upper and lower portions separated by impermeable argillaceous materials. Details about the geology of the basin can be found in reports by Jones and Hockey (1964), Omatsola and Adegoke (1981), and Fayose (1970).

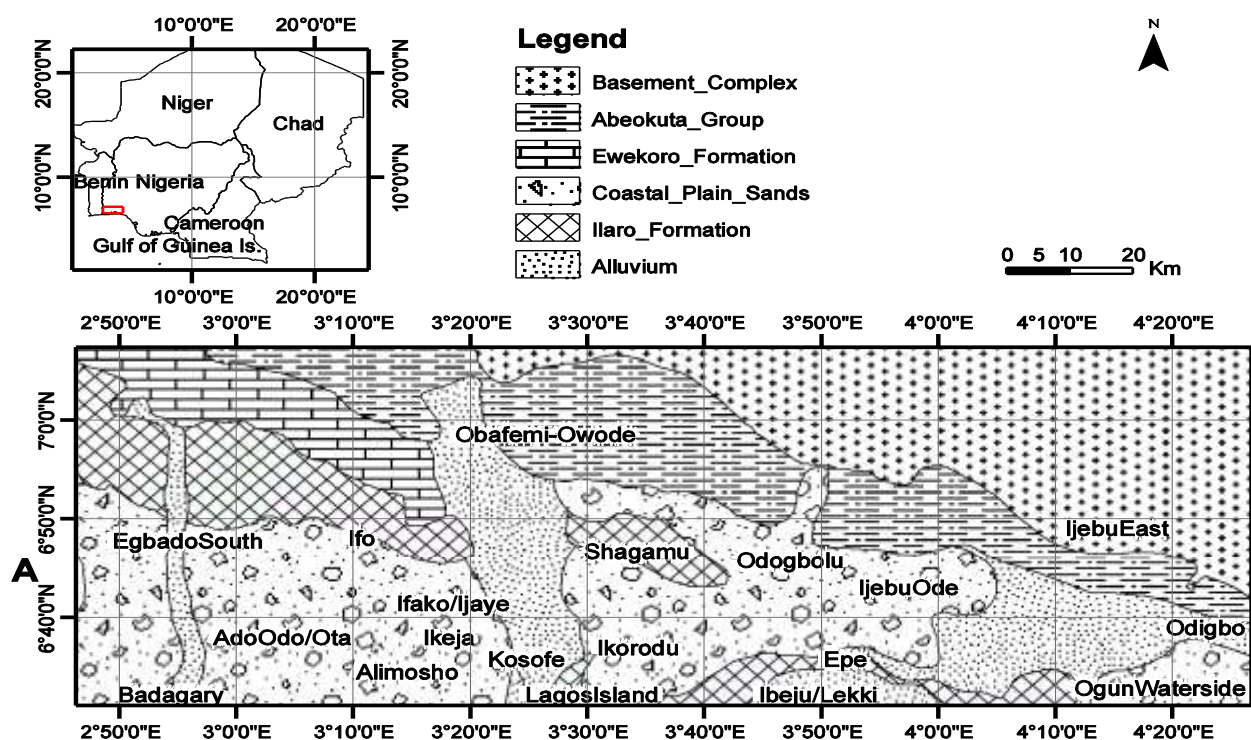


Figure 2: Geology of the study area

Methodology

This study utilizes geochemical results of groundwater samples obtained from the study area (see Figure 1). The analyses include the following physical parameters namely, the temperature, conductivity, pH, and colour. The major ionic concentrations included in the analyses are Ca^{2+} , Mg^{2+} , Na^+ , K^+ , SO_4^{2-} , HCO_3^- , Cl^- , total Fe, Si, NO_3^- , and NH_4^+ . The physical parameters which include temperature, conductivity, and the pH were measured on the field using mercury thermometer, HANNA pH meter, and Mettler-Toledo EC/TDS meter, respectively. The cations and the anions were determined using Perkin-Elmer 305B model of atomic adsorption spectrophotometer and titration methods (PerkinElmer, 1996), respectively. The hydrochemical data were checked for validity via ionic balance and the data that fall outside the acceptable percentage error of 5 % (Freeze and Cherry, 1979) were discarded.

The data were sorted out based on the area and depth stratification. The study area was subdivided into the northern, the central and the southern parts. The geographical areas that constitute the northern part in this study are Ikeja, Ipaja, Shasha, Ilupeju, Ikorodu, Itoikin, Eredo, and Epe. The central part of the study area is occupied by Igando, Oshodi, Mushin, Isolo, Shomolu, Badore, Lakowe, and Bariga. Also, the southern part consist of Festac, Ijanikin, Apapa, Ojoo, Amuwo, Lekki, Kirikiri, Akodo, Victoria Island, Ikoyi and Badagry. The depth stratification range used for each of the area based on the available data on the depths of completed boreholes are <100 m, 100 – 200 m, and > 300 m, and these hereafter are referred to as the first, second and third horizons, respectively.

The statistical parameters used for the descriptions of the hydrochemical data include the mean, measure of central tendencies, degree of dispersions and correlation. These helped to reduce the mass of data to a smaller representative collection that

adequately summarizes the entire set of data, measure consistencies and aid in its comprehension. The water samples were classified in terms of the water types, based on the concept of hydrochemical facies, and correlated using integrated graphical techniques developed by Piper (1953) and Schoeller (1962). Possible mixtures of water were tested by observations within the three fields of the trilinear diagrams, and by the application of the graphical-algebraic criteria suggested by Piper (1953). Comparisons were made between the ionic ratios from various water sources in order to establish the origin of anomalous chemical concentrations. Finally, the suitability of the waters for irrigation purposes was tested using Sodium Adsorption Ratio (SAR) formula proposed by the US Salinity Laboratory (1954).

Results and discussions

The arithmetic mean, range of values, standard deviations and coefficient of variations for the specific electrical conductivity (SEC), temperature, pH, colour, total dissolved solids (TDS) and the major ionic concentrations of the samples obtained from the northern, central and the southern parts of the study area are presented in Tables 1 – 3, respectively. The tables indicate important similarities and differences between the various depth horizons. In all the horizons within the study area, the values of coefficient of variations are considered to be low, and therefore suggest a high degree of consistencies in the hydrochemical data obtained from the study area. Also, in all the horizons, the hydrochemical data indicate a good correlation between the SEC and TDS, with the average ratio of the latter to the former being 0.6. The concentration of other ions in the samples correlated favourably well with the observed trends of the TDS and SEC. The highest values of the TDS are observed at the central area, probably due to more intense anthropogenic activities. The temperature shows an increase with depth and also increases from the north towards the south. The pH value is highest in the north and decreases towards the south. The relatively high pH in the north is perhaps due to the presence of pyritic fragments and traces of lignites in sediments within the area. The colour indicator measured on the Hazen unit increases towards the south which suggest increasing turbidity.

Table 1: Analytical results of depth stratification of water quality for the northern area

| Parameter | Northern Sub area | | | | | | | | | | | | | | |
|---|-------------------|-------------|----------|---|------------|----------------|-------------|----------|---|------------|---------------|-------------|----------|---|------------|
| | First Horizon | | | | | Second Horizon | | | | | Third Horizon | | | | |
| | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 |
| Conductivity ($\mu\text{S/cm}$) | 150 | 0 | 0 | 1 | 0 | 51 | 53 | 20 | 5 | 0.4 | 360 | 156 | 78 | 2 | 0.4 |
| Temperature ($^{\circ}\text{C}$) | - | - | - | - | - | 29 | 2.4 | 0.8 | 5 | 0 | 30 | 22 | 10 | 3 | 0.2 |
| pH | 5.5 | 0 | 0 | 1 | 0 | 5.3 | 0.9 | 0.4 | 5 | 0.1 | 6.1 | 0.7 | 1.3 | 2 | 0.2 |
| Colour | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0.6 | 5 | 0.6 | 7 | 10 | 5 | 2 | 0.7 |
| TDS (mgL^{-1}) | 101 | 0 | 0 | 1 | 0 | 34 | 44 | 16 | 5 | 0.5 | 249 | 339 | 142 | 3 | 0.6 |
| Ca ²⁺ (mgL^{-1}) | 14 | 0 | 0 | 1 | 0 | 5.1 | 4.9 | 1.7 | 5 | 0.3 | 31 | 58 | 24 | 3 | 0.8 |
| Mg ²⁺ (mgL^{-1}) | 1.2 | 0 | 0 | 1 | 0 | 0.4 | 0.3 | 0.1 | 4 | 0.3 | 4.5 | 8.3 | 3.4 | 3 | 0.8 |
| Na ⁺ (mgL^{-1}) | 11 | 0 | 0 | 1 | 0 | 5.1 | 6.3 | 2.1 | 5 | 0.4 | 44 | 53 | 22 | 3 | 0.5 |
| K ⁺ (mgL^{-1}) | 3.8 | 0 | 0 | 1 | 0 | 1.3 | 4 | 1.5 | 5 | 1.2 | 15 | 23 | 9.8 | 3 | 0.6 |
| Total Fe (mgL^{-1}) | - | - | - | - | - | 0.2 | 0.5 | 0.2 | 3 | 1 | 3.2 | 3.4 | 1.6 | 3 | 0.5 |
| Si (mgL^{-1}) | 8 | 0 | 0 | 1 | 0 | 8 | 17 | 6.9 | 4 | 0.9 | 21 | 35 | 15 | 3 | 0.7 |
| Cl ⁻ (mgL^{-1}) | 22 | 0 | 0 | 1 | 0 | 8.8 | 14 | 4.7 | 5 | 0.5 | 15 | 11 | 4.5 | 3 | 0.3 |
| HCO ₃ ⁻ (mgL^{-1}) | 9.6 | 0 | 0 | 1 | 0 | 8.1 | 12 | 4 | 5 | 0.5 | 183 | 255 | 111 | 3 | 0.6 |
| SO ₄ ²⁻ (mgL^{-1}) | 5 | 0 | 0 | 1 | 0 | 2.3 | 0.5 | 0.3 | 5 | 0.1 | 3 | 2 | 1 | 2 | 0.3 |
| NO ₃ ⁻ (mgL^{-1}) | 33 | 0 | 0 | 1 | 0 | 11 | 13 | 5.2 | 4 | 0.5 | 5.6 | 7.7 | 3.2 | 3 | 0.6 |
| NH ₄ ⁺ (mgL^{-1}) | 0.5 | 0 | 0 | 1 | 0 | 0.5 | 0.1 | 0.1 | 4 | 0.2 | 1.6 | 2.6 | 1.1 | 3 | 0.7 |

\bar{Y} : Arithmetic mean; $Y_n - Y_1$: Data Range; σ : Standard deviation; n: Number of data; σ^1 : Coefficient of deviation.

Table 2: Analytical results of depth stratification of water quality for the central area

| Parameter | Central Sub area | | | | | | | | | | | | | | |
|---|------------------|-------------|----------|---|------------|----------------|-------------|----------|---|------------|---------------|-------------|----------|---|------------|
| | First Horizon | | | | | Second Horizon | | | | | Third Horizon | | | | |
| | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 |
| Conductivity ($\mu\text{S/cm}$) | 318 | 502 | 146 | 7 | 0.5 | 60 | 7.8 | 5.3 | 2 | 0.1 | 199 | 0 | 0 | 1 | 0 |
| Temperature ($^{\circ}\text{C}$) | 29 | 2 | 0.6 | 7 | 0 | 30 | 0 | 0 | 1 | 0 | 31 | 0 | 0 | 1 | 0 |
| pH | 5.9 | 2.7 | 0.9 | 7 | 0.2 | 5.9 | 0.2 | 0.1 | 2 | 0 | 6.7 | 0 | 0 | 1 | 0 |
| Colour | 2 | 3 | 1 | 5 | 0.5 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| TDS (mgL^{-1}) | 210 | 372 | 125 | 6 | 0.4 | 45 | 0 | 0 | 1 | 0 | 135 | 0 | 0 | 1 | 0 |
| Ca ²⁺ (mgL^{-1}) | 23 | 39 | 13 | 7 | 0.6 | 3.7 | 0.9 | 0.5 | 2 | 0.1 | 17 | 0 | 0 | 1 | 0 |
| Mg ²⁺ (mgL^{-1}) | 2.4 | 4.4 | 1.4 | 7 | 0.6 | 0.2 | 0 | 0 | 1 | 0 | - | - | - | - | - |
| Na ⁺ (mgL^{-1}) | 50 | 85 | 29 | 7 | 0.6 | 6.8 | 3.4 | 1.7 | 2 | 0.3 | 32 | 0 | 0 | 1 | 0 |
| K ⁺ (mgL^{-1}) | 8.1 | 16 | 5 | 7 | 0.6 | 1.9 | 1.2 | 0.6 | 2 | 0.3 | 4.9 | 0 | 0 | 1 | 0 |
| Total Fe (mgL^{-1}) | 0.6 | 2.2 | 0.8 | 5 | 1.3 | 4.4 | 2.4 | 1.2 | 2 | 0.3 | 3.5 | 0 | 0 | 1 | 0 |
| Si (mgL^{-1}) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cl ⁻ (mgL^{-1}) | 65 | 13 | 45 | 7 | 0.7 | 19 | 0 | 0 | 1 | 0 | 13 | 0 | 0 | 1 | 0 |
| HCO ₃ ⁻ (mgL^{-1}) | 24 | 51 | 17 | 7 | 0.7 | 19 | 7.1 | 3.5 | 2 | 0.2 | 109 | 0 | 0 | 1 | 0 |
| SO ₄ ²⁻ (mgL^{-1}) | 8 | 0 | 0 | 1 | 0 | 3 | 2 | 1 | 2 | 0.3 | 2 | 0 | 0 | 1 | 0 |
| NO ₃ ⁻ (mgL^{-1}) | 63 | 125 | 38 | 7 | 0.6 | 18 | 0 | 0 | 1 | 0 | 8.8 | 0 | 0 | 1 | 0 |
| NH ₄ ⁺ (mgL^{-1}) | 3.4 | 9.7 | 3.8 | 5 | 1.1 | - | - | - | - | - | - | - | - | - | - |

Table 3: Analytical results of depth stratification of water quality for the southern area

| Parameter | Southern Sub area | | | | | | | | | | | | | | |
|---|-------------------|-------------|----------|---|------------|----------------|-------------|----------|---|------------|---------------|-------------|----------|----|------------|
| | First Horizon | | | | | Second Horizon | | | | | Third Horizon | | | | |
| | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 | \bar{Y} | $Y_n - Y_1$ | σ | n | σ^1 |
| Conductivity ($\mu\text{S/cm}$) | 226 | 223 | 96 | 3 | 0.4 | 127 | 172 | 67 | 4 | 0.5 | 90 | 134 | 48 | 11 | 0.5 |
| Temperature ($^{\circ}\text{C}$) | 30 | 0.8 | 0.3 | 3 | 0 | 31 | 1.5 | 0.6 | 4 | 0 | 33 | 5.1 | 1.9 | 4 | 0.1 |
| pH | 6.5 | 1 | 0.5 | 3 | 0.1 | 6 | 1.4 | 0.5 | 4 | 0.1 | 6.1 | 1.3 | 0.5 | 6 | 0.1 |
| Colour | 7 | 13 | 4.8 | 4 | 0.7 | 6 | 21 | 7.3 | 6 | 1.2 | 2 | 7 | 1.8 | 11 | 0.9 |
| TDS (mgL^{-1}) | 166 | 158 | 66 | 4 | 0.4 | 65 | 63 | 20 | 6 | 0.3 | 54 | 77 | 28 | 11 | 0.5 |
| Ca ²⁺ (mgL^{-1}) | 29 | 39 | 15 | 4 | 0.6 | 6.3 | 8.1 | 3.5 | 6 | 0.6 | 5.3 | 10 | 2.9 | 11 | 0.5 |
| Mg ²⁺ (mgL^{-1}) | 1.2 | 1.3 | 0.5 | 4 | 0.4 | 0.9 | 2.1 | 0.7 | 6 | 0.8 | 0.6 | 1.5 | 0.4 | 8 | 0.7 |
| Na ⁺ (mgL^{-1}) | 29 | 41 | 1.6 | 4 | 0.6 | 12 | 13 | 4.4 | 6 | 0.4 | 15 | 27 | 8.3 | 11 | 0.6 |
| K ⁺ (mgL^{-1}) | 6.8 | 16 | 5.8 | 4 | 0.9 | 2.9 | 4 | 1.7 | 6 | 0.6 | 2.7 | 6.3 | 1.9 | 10 | 0.7 |
| Total Fe (mgL^{-1}) | 1.5 | 1.5 | 0.7 | 3 | 0.5 | 12 | 37 | 12 | 6 | 1 | 3.7 | 9.3 | 2.8 | 11 | 0.8 |
| Si (mgL^{-1}) | 8.3 | 4.5 | 2.3 | 2 | 0.3 | 12 | 12 | 4.4 | 4 | 0.4 | 7.7 | 9.8 | 3.5 | 4 | 1.5 |
| Cl ⁻ (mgL^{-1}) | 22 | 28 | 10 | 4 | 0.5 | 12 | 21 | 7.6 | 6 | 0.7 | 11 | 23 | 7 | 10 | 0.6 |
| HCO ₃ ⁻ (mgL^{-1}) | 73 | 147 | 57 | 4 | 0.8 | 36 | 41 | 14 | 6 | 0.4 | 33 | 64 | 21 | 11 | 0.7 |
| SO ₄ ²⁻ (mgL^{-1}) | 13 | 18 | 7.7 | 4 | 0.8 | 2.3 | 3 | 0.9 | 6 | 0.4 | 2.4 | 3.5 | 0.8 | 11 | 0.3 |
| NO ₃ ⁻ (mgL^{-1}) | 18 | 20 | 9.4 | 3 | 0.5 | 12 | 11 | 4.5 | 5 | 0.4 | 10 | 7.4 | 3 | 9 | 0.3 |
| NH ₄ ⁺ (mgL^{-1}) | 1.5 | 2.9 | 1.2 | 4 | 0.8 | 1.1 | 1 | 0.4 | 4 | 0.4 | 0.8 | 0.5 | 0.2 | 4 | 0.3 |

Within the third horizons in the north and central areas, HCO_3^- is the dominant anion, followed by Cl^- ions. The average ratio of the latter to the former within these horizons is approximately 10. The Cl^- and NO_3^- ions dominate the first horizons of the north and the central parts. The relative concentrations of the alkaline and alkali earth metals within the horizons are similar in these areas. The patterns of the chemical characteristics of the water samples from all the horizons as shown by the Schoeller's semi-logarithmic diagrams are presented in Figure 3. Generally, in all the areas and the horizons, the pH values of 5.3 - 6.7 obtained indicate slight acidity when compared with the WHO (2011) recommended guideline of 6.5 – 9.2. However, the pH values observed in this study agrees with the work of Edet, *et. al.*, 2011, where it was observed that most groundwater samples in Nigeria have pH values of between 4.86 and 7.05. The average values obtained for TDS ($34 - 305 \text{ mgL}^{-1}$), Mg^{2+} ($0.2 - 4.5 \text{ mgL}^{-1}$), Na^+ ($5.1 - 50 \text{ mgL}^{-1}$), Cl^- ($8.8 - 65 \text{ mgL}^{-1}$) and SO_4^{2-} ($2.0 - 13 \text{ mgL}^{-1}$) fall below the recommended highest desirable limits of 500, 30, 100, 200, and 200 mgL^{-1} , respectively.

Also, Si, HCO_3^- , Ca^{2+} , and NO_3^- ions fall largely below the W.H.O. (2011) recommended limits. The average total iron concentration within the study area is generally high. In the south, high iron concentration was observed in all the three horizons with average values of 1.5, 12, and 3.7 mgL^{-1} , in the first, second and third horizons, respectively. These iron concentrations exceed the WHO (2011) maximum permissible level of 1.0 mgL^{-1} . The suitability of the waters for irrigation purpose is dependent on the types of plant, soil and the climate. The replacement of Ca and Mg ions by sodium ions which could cause reduction in the soil permeability and hardening of the soils is measured by the SAR formula (US Salinity Laboratory, 1954), given as:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}} \quad (1)$$

The SAR values have been computed for the waters in all the horizons of the study area and the results are presented in Table 4, and the range of the SAR values is 3.08 – 14.00. According to the classification presented by Etu-Efeotor (1981), all the water samples in the study area are described as 'Excellent to Good', and therefore are suitable for irrigation purposes.

On the Piper's trilinear diagram (Figure 4), the water samples are categorized based on the classification proposed by Piper (1953). In the northern area, samples from the second horizon plotted at sub-area 4 of the diamond-shaped field, and this suggests that the strong acids exceed the weak acids.

Table 4: Values obtained for the SAR

| Horizon | SAR Values | | | Water Class (after Etu-Efeotor, 1981) |
|---------|------------|---------|-------|---------------------------------------|
| | North | Central | South | |
| First | 3.98 | 14 | 7.8 | Excellent - Good |
| Second | 3.08 | 4.87 | 6.06 | Excellent |
| Third | 10.46 | 11.04 | 8.5 | Excellent - Good |

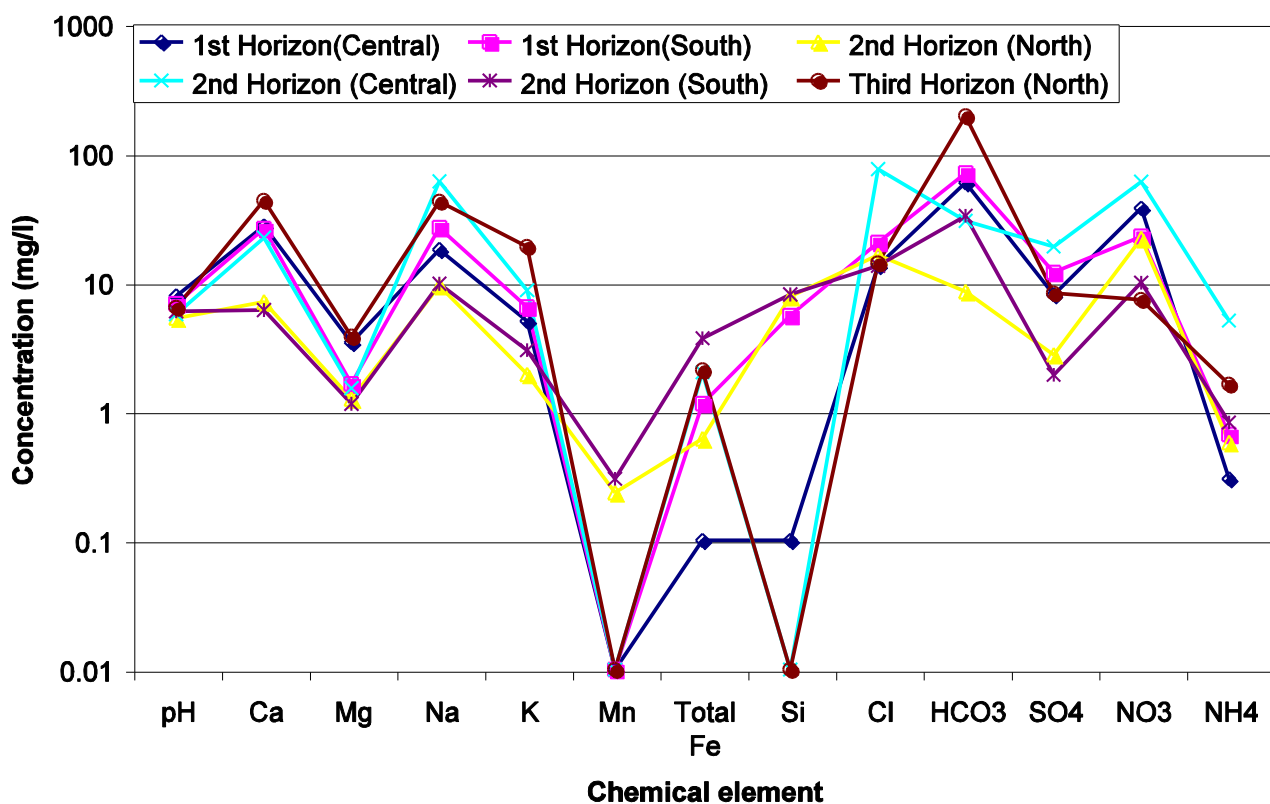


Figure 3: Scholler semi-logarithmic diagram

The relatively high pH value earlier observed in this horizon agrees with this deduction. The third horizon in the north falls into the sub-area 3 of the diamond field, and this suggests the prevalence of weak acids as compared to strong acids. The first and the second horizons in the central part fall within the sub-area 7 of the field, and this suggests primary salinity where the chemical properties of the waters are dominated by the alkalis and strong acids, typifying the oceanic waters and brine.

In order to demonstrate conclusively that certain water is a quantitative mixture of two other waters, Piper (1953) suggested that the apparent mixture must plot on a straight line between the plotting of its two inferred components in each of the three fields of the trilinear diagram. In addition, the following equations should also be satisfied:

$$(a/b) = V_b E_b / V_a E_a \quad (2)$$

$$(V_a / V_b) = b E_b / a E_a \quad (3)$$

$$E_m = E_a E_b (a + b) / (a E_a + b E_b) \quad (4)$$

$$V_a = b E_a / (a E_a + b E_b) \quad (5)$$

$$V_b = a E_a / (a E_a + b E_b) \quad (6)$$

where

a, b: distances measured on the diamond field of the Piper's diagram
 E_a, E_b, E_m : concentrations in the samples a and b, and mixture m, respectively.
 V_a, V_b : Proportionate volume of samples a and b in the mixture m.

Therefore, with reference to Figure 4, the samples which show a degree of alignment with the plotting of the inferred components of rain water and sea water concentrations are the samples from the first and second horizons in the central parts. The compliance of these samples with equations 2 – 6 was further tested and the results indicate a percentage difference of 50.5 and 25, respectively, between the empirically determined and computed concentrations. This suggests that the salinity of the two samples earlier observed is not due to the sea water intrusion. Furthermore, Table 5 presents the ionic ratios of the major chemical parameters of the samples obtained from the central and southern areas, as well as similar ratios for the sea water constituents in the same area. Similarities exist in the values of the ionic ratios between the two sea water samples obtained from Akodo and Bar Beaches. However, there are large discrepancies between the set of the two sea water samples and those obtained from the horizons (Table 5). This further supports the deduction that the observed salinity is not due to sea water intrusions.

The summary of the hydrofacies classification of the water samples obtained from the study area in all the horizons is presented in Table 6. With the exception of the third horizons in the north and central parts that are dominated by the HCO_3^- facies type, all the remaining horizons within the study area are dominated by Cl^- facies type. In the north and the central parts, transformation of the water facies type from $\text{Cl}^- \text{-SO}_4^{2-}$ type at the first horizon through $\text{Cl}^- \text{-SO}_4^{2-} \text{-HCO}_3^-$ type at the second, and to $\text{HCO}_3^- \text{-Cl}^- \text{-SO}_4^{2-}$ at the third horizon was observed. In the southern area, the observed water facies is $\text{Cl}^- \text{-SO}_4^{2-} \text{-HCO}_3^-$ in all the horizons.

The chemical composition of dissolved salts can be used to characterize the origin of salinity in water samples. Shale consists essentially of clay minerals that have capacity for ionic exchange. Also, the high porous aquifers in the horizons where relatively high chloride values are observed are likely to be composed of an appreciable percentage of colloidal sizes particles which have the capability to exchange ion constituents that are adsorbed on the particle surfaces. Hence, it may be concluded that the major sources of these relatively high chloride values observed are the ionic exchange and dissolution of minerals within the strata. Other probable sources could be the presence of the remnants of marine water trapped through ancient transgression episodes, with subsequent chemical alteration by interaction with the aquifer materials and differential dilution caused by the infiltrating fresh water, though this is not substantiated in this study.

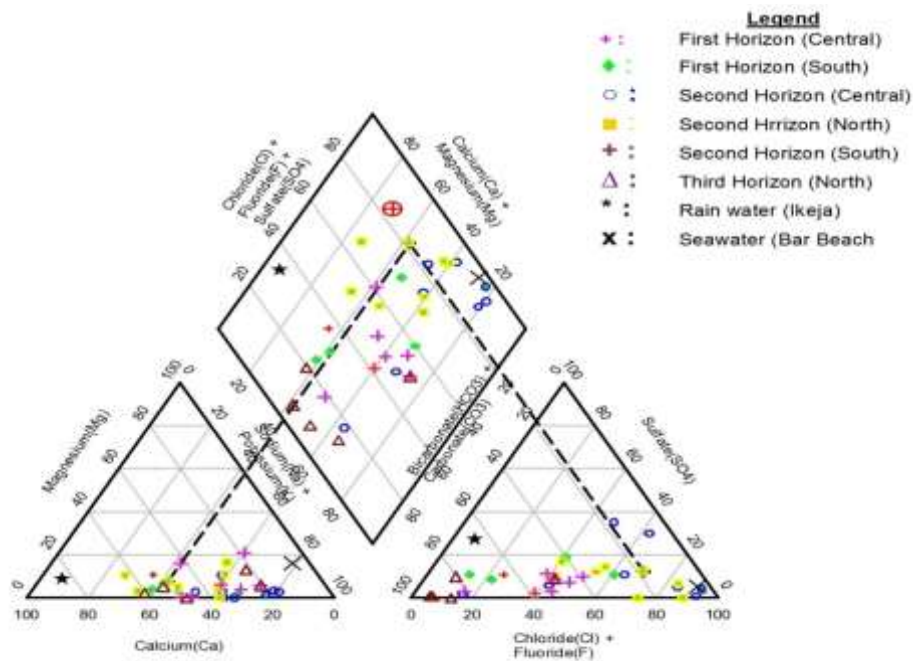


Figure 4: Trilinear Piper plot for the chemical characters of the water samples.

Table 5: Calculated ionic ratio of some of the chemical parameters.

| Sample source | $r_{Na/K}$ | $r_{Na/Cl}$ | $r_{(Na+K)/Cl}$ | $r_{HCO_3/Cl}$ |
|--------------------------|------------|-------------|-----------------|----------------|
| First Horizon (Central) | 6.15 | 0.77 | 0.89 | 0.37 |
| Second Horizon (Central) | 3.58 | 0.35 | 0.45 | 0.95 |
| First Horizon (South) | 4.21 | 1.29 | 1.6 | 3.29 |
| Second Horizon (South) | 3.97 | 0.99 | 1.24 | 2.99 |
| Third Horizon (South) | 5.4 | 1.3 | 1.54 | 2.9 |
| Akodo sea water | 24.57 | 0.52 | 0.56 | 0.01 |
| Bar Beach sea water | 32.12 | 0.55 | 0.57 | 0.01 |

Table 6: Hydrochemical facies classification of waters with the horizons

| Horizon | North | | | Central | | | South | | |
|---------|------------------|--------|--------------------------------------|------------------|--------|--------------------------------------|-------|--------|--------------------------------------|
| | Anion | Cation | Total | Anion | Cation | Total | Anion | Cation | Total |
| First | Cl | NDT* | Cl-SO ₄ | Cl | Na-K | Cl-SO ₄ | NDT* | Na-K | Cl-SO ₄ -HCO ₃ |
| Second | Cl | NDT* | Cl-SO ₄ -HCO ₃ | Cl | Na-K | Cl-SO ₄ -HCO ₃ | NDT* | Na-K | Cl-SO ₄ -HCO ₃ |
| Third | HCO ₃ | Na-K | HCO ₃ -Cl-SO ₄ | HCO ₃ | Na-K | HCO ₃ -Cl-SO ₄ | Cl | Na-K | Cl-SO ₄ -HCO ₃ |

*: No dominant type

Conclusion

Two hydrochemical regimes are revealed by the analyses carried out in this study. The first regime is found within the three horizons in the south, as well as in the two

upper horizons in the north and the central parts. This regime is dominated by $\text{Na}^+\text{-Cl}^-$ facies type, with relatively high iron concentrations. The second hydrochemical regime, dominated by $\text{Na}^+\text{-HCO}_3^-$ facies type, is found within the third horizon of the north and central parts of the study area. The results of the analyses of the relatively high chloride values observed within the first hydrochemical regime support a non-sea water intrusion source but rather, believed to be due to ionic exchange, ionic precipitation and dissolution of the host geologic materials. Other probable sources that are not substantiated in this work could be the presence of water of ancient origin, trapped by marine sediments or concentrated by shale membrane. The spatial variation observed may be due to differential dilution by the infiltrating precipitates. The pH values indicate high acidity in the northern part, and this may be due to the presence of pyritic fragments in this sub-area. However, within the central and the southern parts, the pH values fall within the WHO recommended maximum permissible limits. The SAR values of the waters in the study area vary between 3.08 and 14.0 and hence described as excellent to good for irrigation purposes.

Arising from the above, it can be suggested that waters from the first hydrochemical regime require some amount of treatment to achieve wholesomeness, among which is aeration for the removal of iron. The waters within the second hydrochemical regime can be said to be of better quality. However, in order to ensure regular and continuous supply of wholesome waters for public uses, regular routine chemical analysis is recommended to monitor possible spread of contaminant into the aquifers.

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Effects of Global Economic Recession on Foreign Private Capital Inflows and Economic Growth in Nigeria

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Abstract:

The paper examined the effects of global economic recession on both the foreign private capital inflows and growth of the Nigeria's economy. Data were sourced from the Statistical Bulletin published by the Central Bank of Nigeria and UNDP Human Development Reports published while cointegration and error correction mechanism (ECM) were employed in analyzing the data. Granger causality tests were also used in determining direction of causation between measures of global economic recession indicators, foreign private capital inflows, foreign reserves, trade openness and Nigeria's real GDP growth series. The paper found that global economic crisis portended a significant negative effect on the Nigerian economy. Indeed, global economic recession dampened the inflows of foreign private capital inflows into the country which in turn resulted in the poor growth of the economy. The paper confirmed that Keynes' advocacy was still relevant in addressing the negative effect of global economic recession on the growth of the Nigeria economy indicating the effective use of fiscal stimulus to stimulate effective demand and reduction in income and corporate taxes. The paper, however, concluded that the present economic situation in the country permits the use of policy mixture of both monetary and fiscal measures to counter the effect of global economic downturn.

Key words: global economic recession; foreign private capital; economic growth; granger causality; time series; fiscal stimulus. JEL Classification: C32, G21

I Introduction:

No country lives in autarky; countries interact with one another, as no country is an island or self-sufficient. Globalization; the integration of world economies, manifests in the greater movement of people, goods, capital and ideas, due to increased economic integration, which in turn is propelled by increased trade and investment. However, integration is multifaceted; it can be financial, trade, political, cultural and what have you. Indeed, it has to do with the sharing of goods, services, knowledge and cultures among people and countries. Today, improvement in technology and the dismantling of various barriers between countries have made the speed of these exchanges much faster. Globalization has consequently occasioned a global market built on an international financial system. The integration is expected to bring about accelerated development in all countries and also bridge the gap between the rich and poor countries.

Evidence of development across the globe is, however, contrary to the expectation. Now, with globalization, ripples in the economy of any part of the world can easily spread to other parts. For instance, according to UNDP Human Development Report for 2011 reported in Table 1, most countries in Africa and Nigeria in particular belong to low human development, life expectancy and GNI index group. Table 1 clearly shows that development index in Nigeria is still far behind countries in other regions of the world; it ranked 156th among 187 countries. While few countries in Africa appear to have developed their economies above average, many, including Nigeria, are still suffering from low expectancy rate, low calorie intake, poor housing, low and poor level of education, high level of corruption and low per capita GNI.

The issue of whether or not the global village is in recession is not controversial. World output growth as reported in Table 2 fell from 3.8 per cent in 2007 to 2.2 per cent in 2008 and experienced a negative growth of – 0.6 per cent in 2009 and 2.1 per cent in 2010 marking the lowest rates so far since World War II. Despite wide-ranging policy actions, financial strains remain acute, pulling down the real global economy. The most affected countries facing the current economic depression are the advanced economies (including the USA where it all emancipated from) and the countries whose financial institutions heavily invested in buying debt bonds from the US financial system especially countries like the UK, Germany, Canada, Spain etc. The output growth records for Africa, Sub-Sahara Africa and emerging and developing economies from 2007 to 2010, though not negative, followed the same trend with that of the global trend.

Global output and trade plummeted from 2007 to 2009 as reported in Table 2 which is an indication of global recession. The crisis ravaging the global economy is naturally a serious issue for concern to investors all over the world, hence the concern for countries, like Nigeria, facing poor and sluggish economic growth, high unemployment rate and high level of inflation. Some measures have been made already by the regulatory authorities to forestall the spill over of the crisis into the Nigerian economy, how effective are these measures in combating the negative effect of the global economic crisis in the country? The major issue for investigation is whether global economic recession affects the Nigerian economy and canvass for appropriate policy measures to be adopted to arrest the unwanted effect of the ugly scenario in the country. The paper fills these gaps.

Given that economic recession is synonymous with slow growth, the paper argues that global economic downturn portends negative effect on the Nigeria's macroeconomic

variables. The paper therefore determines the effects of the current global economic crisis on foreign capital inflows into the country and economic growth in the country. The remaining part of the paper is organized as follows: Section II overviews the meaning and provides the synopsis of the global economic downturn while section III focuses on the review of both the theoretical and empirical literature. Section IV presents the model specifications and methodology adopted. While section V focuses on the discussion of major findings, section VI concludes the study.

II Meaning and Synopsis of Global Economic Recession:

Today, the world has created a lot of problems for itself and it is doubtful if the world could find just enough solutions to the myriad of problems it has created for itself. Why? This is simply because in a capitalist system, which the global world has now embraced and which Nigeria is also aspiring to build, productive resources are owned and controlled by private economic agents. Such an economy is therefore driven by the private sector. In such a system, it is assumed that scarce productive resources would be efficiently allocated through the interplay of market forces of demand and supply. The allocation and adjustment during period of distortions is assumed, therefore, to be automatically carried out by price mechanism (i.e., through the invisible hand). This view has, however, been refuted with the global economic recession experienced in recent times.

a) Meaning of Global Recession:

There is so much confusion about what scholars mean when they talk about a “global recession”. Recession is seen as a period of general economic decline; specifically, a decline in GDP for two or more consecutive periods (quarters or years). Gross Domestic Product is the total market of all final goods and services produced in a country in a given year, which is equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports $\{C + I + G + (X - M)\}$. However, growth in GDP is what matters, and if there is negative growth for 2 consecutive quarters, the economy enters recession. The developed countries; America, Britain, and other European countries and Japan are almost certainly already in recession according to the popular rule of thumb of two successive quarters of falling GDP. But is the recession in these countries really justified for the world as a whole?

The IMF in World Economic Outlook (2008) predicted that world GDP growth would fall to 2.2% in 2009, based on purchasing-power parity (PPP) weights, from 5% in 2007 and 3.7% in 2008. In the past, the IMF has said that global growth of less than 3% implied a world recession, so its latest forecasts would push the world over the edge. Some forecasts by private-sector firms are even gloomier, with several now predicting global GDP growth rates of no more than 1.5% in 2009.

But why does the IMF think that a world economy growing by less than 3% a year is in recession? To many people, growth of 2.9%, say, sounds pretty robust. Surely a drop in output is required? The trouble is that there is no agreed definition of a global recession. The popular benchmark used in developed economies—two successive quarters of decline—is not helpful when looking at the world as a whole, because many emerging economies do not report seasonally adjusted quarterly GDP figures. Also, downturns are rarely perfectly synchronized across countries, so even if most countries contract at some stage during a two-year period, global GDP growth may not turn

negative. Indeed, global GDP has never fallen in any year since the 1930s Depression. Its worst years since then were 1982 and 1991, with growth of 0.9% and 1.5% respectively (see left-hand chart of Fig. 1).

It is only the developed world that faces severe recession (see right-hand chart of Fig. 1). The IMF's revised figures now forecast that the advanced economies will shrink by 0.3% in 2009, which would be the first annual contraction since the war. The IMF has become markedly more bearish on emerging economies since October, revising its forecasts downward by an average of a percentage point. But emerging economies are still tipped to grow by around 5%. This is a sharp slowdown from recent growth of 7 – 8%, but still above their average growth rate over the past three decades and considerably higher than their typical growth in previous global downturns.

When tracking such diverse economies, it does make much more sense to define a global recession not as an absolute fall in GDP, but as when growth falls significantly below its potential rate. This can cause anomalies, however. Using the IMF's definition (i.e., growth below 3%), the world economy has been in recession for no fewer than 11 out of the past 28 years. This sits oddly with the fact that America, the world's biggest economy, has been in recession for only 38 months during that time, according to the National Bureau of Economic Research (the country's official arbiter of recessions), which defines a recession as a decline in economic activity. It is confusing to have different definitions of recession in rich and poor economies.

Before proclaiming global recession, it is also important to consider the extent to which a downturn has spread around the world. As stock markets and currencies have slumped in emerging economies and some governments have had to knock on the IMF's door, it might appear as if these economies are being hit harder than rich countries. Even in China, growth seems to be slowing sharply, prompting the government to lift its quotas on bank lending at the start of this month. Yet most emerging economies are still widely expected to hold up much better than in previous global downturns.

The repeated sequence of sustained decline in output followed a longer interval of rising output is classified as a business cycle. A sustained decline in real GDP for two or more consecutive period (usually quarter) is seen as recession and it is a short run phenomenon. The case of Nigeria can be examined from the real GDP trend shown in Fig.2. The Fig.2 clearly shows that there no evidence of recession in recent time going by the conventional definition of recession except in the first half of 1980s. The recession witnessed from 1980–1985 then called for the implementation of the Structural Adjustment programme as the Nigerian economic experienced major distortions in macroeconomic variables. The Nigerian economy was therefore deregulated to allow for the of market forces of demand and supply to determine prices in all markets. The recession in the Nigeria economy (measured by the negative growth in real GDP) during this period could be attributed the global recession of that time. However, the question that readily comes to mind is to determine whether the recent global economic recession has any effect on the Nigerian economy.

b) Synopsis of Global Economic Recession:

So far, there had been three major economic crises in the history of the United States of America, which more or less, had spread to other countries. The earliest we can remember occurred in the 1830s. The global spread of the 1830s depression was largely restricted due to limited communication and globalization. However, that depression still

sneaked across the US borders to some European countries. One hundred years later, in the 1930s, another economic crisis struck the USA. The 1930s economic crisis was regarded as the most vicious, and therefore referred to as the Great Depression. The 1930s depression was more global in spread, partly because the world was more closely knit through advancements in communication technology. In 2008, nearly another one hundred years, another economic crisis has hit the United States, which is fast spreading to other parts of the world, again, because the world has become, more than ever before, a 'global village' as predicted by Marshall Mac Luhan. "The current economic crisis, more dramatically than ever before exposed the true nature of global interdependence", says British Prime Minister, Gordon Brown.

The Developed or rich countries faced the effect of the global recession experienced in the 1930s mostly while for many developing or poorer countries the effect was still relatively mild. Many economists are now predicting the worst global recession since the 1930s. Indeed, as depicted in Fig. 1, global recession has also been reported for the 1970s, second half of 1980s, and also the second half the 2000s. Warnings of the future global economic recession continue unabated in the literature. Such grim warnings discourage spending by households and businesses, depressing output even more.

This decline in the growth of world output reflects a weakening of the three major engines of growth of the global economy; US manufacturing sector faltered, Japan's economy entered into another recession resulting from contraction of the economy with its ripple effect on the EU economies coupled with the September 11 attack on the World Trade centre in America. The simultaneous weakening of the three major engines of global output growth represents a distinguishing feature of the current global economic slowdown if one compares it with similar downturns in recent years. In 1998, for example, the decline in world output growth was caused mainly by the Asian economic crisis; and as the economies of USA as well as EU countries were continuing their strong growth, recovery of the Asian economies was easier. Similarly, when the US economy was in recession in the early 1990s, the EU countries and Japan were still growing. And so were the emerging economies of Asia. Thus, when certain parts of the world suffered declines in economic growth while others continued to grow, the former could ride out of the difficulties by utilizing the benefits of linkage with the latter.

The current global crisis started as a 'financial crisis' in US in August 2007 but now a 'global economic crisis'. The crisis is unprecedented in severity of credit contraction (credit crunch and capital crunch). The roots are in banking rather than in securities market or foreign exchange and the crisis started in the U.S (due to certain laxities in the US financial system) which later spread to Europe, and has now become global. Even countries not affected by the financial crisis are now affected by 'second-round effects' as the crisis now becomes 'economic'.

The financial crisis in US started with sub-prime mortgage crisis as households faced difficulties in making higher payments on adjustable mortgages. By the first quarter of 2008, there was widespread "credit contraction," as financial institutions in the US tightened their credit standards in light of deteriorating balance sheets. By the fourth quarter of 2008, increased delinquency rates affected not only sub-prime loans but also spilled over into consumer and other credits. The effect of this crisis is credit squeeze leading to reduction in lending to the real sector (supply side) and reduction in household demand (demand side). The wealth effect is the decrease in asset values such as stocks

and real estate leading to a loss of consumer confidence and a precipitous decline in consumption. These events translated into sharp decline in economic activities which resulted in massive job losses in most sectors of the economy the US economy.

III Review of the Theoretical and Empirical Literature:

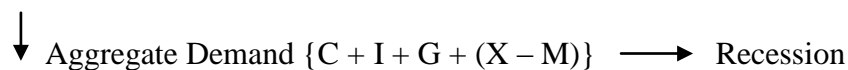
a) Theoretical Literature on the Causes of Economic Recession

Economic depression can be explained from the Classical and Keynesian perspective. The Classical school attributes recurrent recessions to changes in the labour market and/or adverse aggregate supply shock. i.e., decrease in real aggregate output which might be as a result of an adverse supply shock and/or a change in the supply of labour. Simply put, causality runs from decline in real output to recession which leads to further decline in real output if not checked.



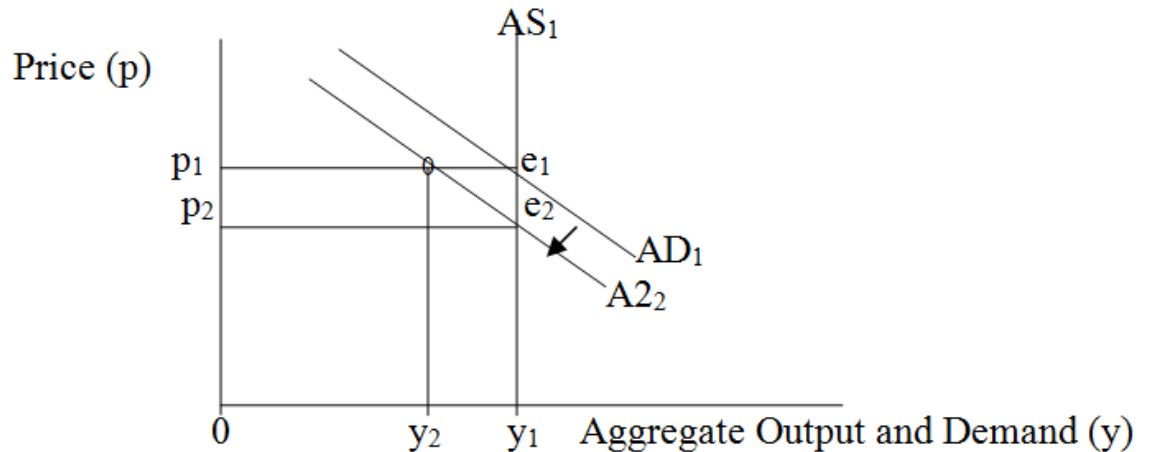
Given the Cobb-Douglas production function $Y = AL^\alpha K^\beta$ (where Y is aggregate output, L is the supply of labour input, K is the supply of capital input and A is the scale parameter), a drastic fall in labour supply and decline in investment (which is define as a change in capital stock) results in decline in aggregate supply which dovetailed into a recession as a final result.

The Keynesians, on the other hand, attribute a recession to a slow wage and/or price response to a decline in aggregate demand. i.e., output decline where there is a decrease in aggregate spending and insufficient decline in prices in response to the lower spending level. Simply put, price rigidity during decline in aggregate demand is the cause of economic downturn. This negates the classical assumption of price flexibility in both direction and the validity of Say's law that "supply creates its own demand". The implication of the Keynesian proposition is that the predictable outcome of a decline in aggregate demand is economic recession and thus, causality runs from decline in aggregate demand to recession.



In Fig. 3, the initial aggregate demand (AD_1) represent the amount of good and services that individuals, business and government plan to purchase at different price levels. The initial aggregate supply (AS_1) represents potential output and therefore the economy's ability to produce. The initial equilibrium is e_1 with y_1 and p_1 clearing the market. Suppose a decline in spending shifts aggregate demand (AD_1) downward to AD_2 which causes disequilibrium in the economy. With output remaining at y_1 , it is expected that price will fall from p_1 to p_2 to achieve equilibrium at e_2 . Lower price (p_2) will cause output to fall to (y_2). However, with price stickiness, retaining price at (p_1), an economy enters a recession in short run when aggregate demand declines, but the response of price is insufficient to keep spending levels at their full employment level.

Fig 3: Economic Recession by the Keynesian



From all indication, Keynesian and neo-Keynesian see recession as being caused by the failure of the market system in which price flexibility is assumed to restore equilibrium in case of distortions in the market. Hence, the call for government intervention through increased fiscal spending or stimulus (i.e., canvassing for mega-deficit spending by governments). It is expected that this short-term increase in the public debt will retard the rise in unemployment, limit the impact and duration of the economic recession and in the long run lead to overall better economic performance, with limited effect on the ratio of public debt to GDP. Though advocates and opponents can offer differing views on the historical validity of Keynes and his counter-cyclical concepts of sovereign intervention in the economy, there is no doubt that his theory is intellectually cogent and based on a serious analysis of economic problems, particularly in regards to the Great Depression of the 1930s and of our time.

A recession normally takes place when consumers lose confidence in the growth of the economy and spend less. This leads to a decreased demand for goods and services, which in turn leads to a decrease in production, lay-offs and a sharp rise in unemployment. Investors spend less as they fear stocks values will fall and thus stock markets fall on negative sentiment. The economy and the stock market are closely related. The stock markets reflect the buoyancy of the economy.

b) Empirical Literature on the Effect of Global Economic Recession

The effect of global recession on any economy is usually being examined from different perspectives. The review of the literature is, however, focused on the growth effect it portends through foreign inflow of capital {either foreign private capital (FPC) or foreign direct investment (FDI)} on an economy. Macroeconomic studies generally suggest that FDI exerts a positive impact on economic growth. For example, Balasubramanyam *et al.* (1996) found that the effect of FDI on growth is more significant in the presence of trade openness, and Borensztein *et al.* (1998) argued that FDI is an important channel for the transfer of technology and contributes to economic growth when the country has a highly educated workforce. In turn, Alfaro *et al.* (2003) found that FDI was beneficial for economic growth when the country had sufficiently developed financial markets. However, Carkovic and Levine (2002) conducted a Generalized Method of Moments (GMM) panel analysis on pooled data from 72 countries in the

period 1960-1995 and found that FDI flows do not exert a positive impact on economic growth.

Very few studies examined the growth effect of portfolio equity flows. Bekeart and Harvey (1998) found that portfolio equity inflows increase economic growth in 14 out of 19 lower-income countries under study. Durham (2004) suggested that portfolio equity flows promote economic growth in countries with relatively large equity markets and limited corruption. Carkovic and Levine (2002), instead, found that portfolio inflows have no impact on economic growth.

There is very little specific literature on the effects of debt flows on economic growth. This category of capital inflows is more often taken into account in recent studies investigating simultaneously the growth impact of different types of capital flows. For example, Reisen and Soto (2001) measured the independent growth effect of bond flows as well as FDI, portfolio equity flows, official flows and short-term and long-term bank lending on a sample of 44 developing countries around the world over the period 1986-1997. Using GMM panel data analysis, they find that FDI and portfolio equity flows exerted a significant impact on growth, whereas bonds and official flows did not have any significant effect on growth. Furthermore, short- and long-term bank lending was found to negatively affect economic growth in the recipient country, except when local banks are sufficiently capitalized.

Durham (2004) examined the impact on growth of bond foreign portfolio investment (BFPI) as well as total foreign portfolio investment (FPI) and other foreign investment (OFI), which includes cross-border bank lending, using a sample of 88 countries from 1977 through 2000. Most of the results suggested that FPI, BFPI and OFI had no effect on economic growth. However, there was some evidence that OFI might have a negative impact on economic growth depending on the level of financial and legal development of the recipient country.

On the other hand, Gheeraert and Mansour (2005) used a structural econometric model and found a significantly positive relationship between growth and various measures of capital flows (i.e. FDI, equity investment, debt investment and flows in financial derivatives). More recently, de Vita and Kyaw (2009), using a dynamic panel model on a large sample of 126 developing countries for the period 1985-2002, examine the impact of FDI and portfolio investment flows on the economic growth of low, lower middle and upper middle income countries. They found that only developing countries that have reached a minimum level of economic development and absorptive capacity are able to capture the growth-enhancing effects of both forms of investment inflows.

Macias and Massa (2009) used a panel cointegration analysis to examine the long-run relationship between economic growth and four different types of private capital inflows (cross-border bank lending, foreign direct investment (FDI), bonds flows and portfolio equity flows) on a sample of selected sub-Saharan African countries over the period 1980-2007. The results showed that FDI and cross-border bank lending exert a significant and positive impact on sub-Saharan Africa's growth, whereas portfolio equity flows and bonds flows had no growth impact. The estimates suggested that a drop by 10% in FDI inflows might lead to a 0.5% decrease of income per capita in sub-Saharan Africa, and a 10% decrease in cross-border bank lending might reduce growth by up to 0.7%. The paper concluded that the global financial crisis was likely to have an important

effect on sub-Saharan Africa's growth through the private capital inflows channel (half a percent of growth is worth around \$5 billion in lost output).

Kumo (2009) reviewed Keynesian business cycle theory and identifies the cause of economic crisis to blind investment and lack of demand. The paper also indicated that fundamentally, the 1939 Great Depression and current global economic recession are the inevitable outcomes of capitalist mode of production. It also demonstrated that the strategy of trying to develop public economy as well as increasing its influences and controls over investment and consumption was the only way to limit vicious expansion of capitalist mode of production and prevent future economic crises.

Studies on Nigeria revealed that there is no consensus on the effect of global economic recession on the economy. For instance, Lynch (2009) declared Nigeria as one of the safest economies in the world. The author argued that the Nigeria's economy was highly insulated from the global financial crisis experienced in recent time. Many economic scholars and researchers were quick to challenge the finding. The critics opine that most Nigerian banks failed to disclose critical data for assessing their operations thus warned that Lynch's finding should be taken with caution.

Conde (2009) examined the background of the recession, including the conception of recession, as well as the causes of recession, and the Current crisis in the US. The paper then discussed the relationship between the US and Nigeria, and the role of oil industry of Nigeria in her economy. The author concluded the influence of the US recession to the oil industry of Nigeria. Some other authors claimed that global economic crisis will definitely affect Nigeria though the level of severity is not yet determined. The review of the exiting studies by authors and Central Bank of Nigeria (2009) indicates that global recession will have seven major effects on the Nigerian economy ranging from aggravation of the ongoing stock market crisis, dwindling petroleum prices, deficit national budget, reduction in development funds, reduction in absolute and net capital flows, lower growth and worsen poverty in the country.

It was reported that foreign portfolio investors have withdrawn some US\$15 billion from our capital markets while lower fuel prices had led to a severe reduction in foreign exchange earnings. Due to lower oil revenue, it is expected that there will be less funds available for much-needed investment in infrastructures. All these effects portend slow growth of the economy which dovetailed into a slowdown in the fight against poverty.

The controversy on the effect of global economic crisis on Nigeria's economic growth is not yet resolved. In order to empirically resolve the issue, the paper examine whether or no the global economic crisis has significant effect on the Nigeria's economic growth. Measures identified in the literature to effectively address the possible slowdown of the Nigerian economy include, the implementation of cost-cutting measures such as e-governance by the Nigerian government, addressing the severe infrastructure constraints and supply-side issues, and effective anti-monopolies regime which put a halt to the symmetry of cartels that are feeding fat on the Nigerian economy and defrauding customers by charging exorbitantly for poor services and products.

IV Model Specifications and Analytical Techniques:

The global recession affect countries through a variety of mechanisms, or channels, including a decline in global trade, a drop in foreign direct investment, falling

external reserves, and possible cuts in foreign aid. These channels are largely connected to Nigeria's "real" economy, rather than its financial sector. It is therefore pertinent to examine the effects of these variables on the growth of the Nigerian economy. The examination of the effects of global recession on growth is preceded the determination of causal relationship between the series. The paper employs the standard Granger-causality test by examining whether past changes in one variable (say X) help to explain the current changes in another variable (say Y) over and above the explanation provided by past changes in variable Y. If otherwise, then one concludes that X does not Granger-cause Y. To determine whether causality runs in the opposite direction, i.e., from Y to X, one repeats the test with Y and X interchanged (Granger, 1969; Folorunso, 2000). Causal relationship models in a Granger causality sense are expressed as thus:

$$\Delta Y_t = \sum_{i=1}^k \alpha_i \Delta Y_{t-i} + \sum_{j=1}^k \beta_j \Delta X_{t-j} + e_t \dots \dots \dots (1)$$

$$\Delta X_t = \sum_{i=1}^k \delta_i \Delta X_{t-i} + \sum_{j=1}^k \gamma_j \Delta Y_{t-j} + \varepsilon_t \dots \dots \dots (2)$$

Y and X stand for the pair-wise series under consideration and **k** is the appropriate lag length to be determined by Akaike (1969)'s Final Prediction Error (FPE) criterion. If $\sum \beta_j = 0$ and $\sum \gamma_j = 0$, then X does not Granger cause Y in equation (1) and Y does not Granger cause X in equation (2). This then implies that X and Y are assumed to be independent. The study performs pair-wise Granger causality tests between world GDP growth rate, foreign private capital inflows, trade openness, external reserves and economic growth series.

If the causality tests confirm that world GDP growth rate (wgdp), trade openness (open), foreign private capital (fpc) and foreign reserves (res) series cause economic growth, the effects they portend on economic growth are then examined using the endogenous growth model. The model specification involves economic growth (rgdp) as the dependent variables while world GDP growth rate (wgdp), foreign private capital (fpc), foreign reserves (res) and trade openness (open) are the explanatory variables. In order to avoid omitting variables bias, macroeconomic variables such as gross fixed capital formation (gfcf), a proxy for domestic investment, inflation rate (inf), monetary variable (m2) and fiscal variable (gexp) are included into the model. Several attempts have also been made to incorporate different measures of uncertainty in growth equation (Servén, 2002). In order to avoid the problem of autocorrelation, only exchange rate uncertainty (uexr) is employed. When the measure of macroeconomic uncertainty is included, the basic aggregate foreign private capital inflows and economic growth model specifications considered in this paper thus become:

$$\mathbf{rgdp}_t = \alpha_0 + \alpha_1 \mathbf{wgdp}_t + \alpha_2 \mathbf{fdi}_t + \alpha_3 \mathbf{open}_t + \alpha_4 \mathbf{res}_t + \alpha_5 \mathbf{gfcf}_t + \alpha_6 \mathbf{m2}_t + \alpha_7 \mathbf{gexp}_t + \alpha_8 \mathbf{inf}_t + \alpha_9 \mathbf{uexr}_t + \varepsilon_t$$

$$\alpha_1 > \text{or} < \mathbf{0}, \alpha_2 > \mathbf{0}, \alpha_3 > \mathbf{0}, \alpha_4 > \mathbf{0}, \alpha_5 > \mathbf{0}, \alpha_6 > \mathbf{0}, \alpha_7 > \mathbf{0}, \alpha_8 < \mathbf{0}, \alpha_9 < \mathbf{0} \dots \dots \dots (3)$$

$$\mathbf{fdi}_t = \beta_0 + \beta_1 \mathbf{wgdp}_t + \beta_2 \mathbf{rgdp}_t + \beta_3 \mathbf{open}_t + \beta_4 \mathbf{res}_t + \beta_5 \mathbf{gfcf}_t + \beta_6 \mathbf{m2}_t + \beta_7 \mathbf{gexp}_t + \beta_8 \mathbf{inf}_t + \beta_9 \mathbf{uexr}_t + e_t$$

$$\beta_1 > \text{or} < \mathbf{0}, \beta_2 > \mathbf{0}, \beta_3 > \mathbf{0}, \beta_4 > \mathbf{0}, \beta_5 > \mathbf{0}, \beta_6 > \mathbf{0}, \beta_7 > \mathbf{0}, \beta_8 < \mathbf{0}, \beta_9 < \mathbf{0} \dots \dots \dots (4)$$

All series except for world real GDP growth rate (wgdp), inflation rate (inf), trade openness (open) and exchange rate uncertainty (uexr), are measured in natural logarithmic form.

The study employed Error Correction Mechanism (ECM) econometric method to capture both the short and the long run effects of global economic downturn measures on economic growth and foreign investment. The time series properties of series were first examined using Augmented-Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests. These were then followed by testing for possible cointegration among the series using ADF test. Granger causality tests were also performed on pairs of global economic recession measure and economic growth, foreign private capital inflows, foreign reserves and trade openness; pairs of economic growth, foreign private capital inflows, foreign reserves and trade openness measures; pairs of foreign private capital inflows, foreign reserves and trade openness measures; and pair of foreign reserves and trade openness measures. Annual time series were employed in the estimation of the equation (3) and (4) and time series data were gathered mainly from Central Bank of Nigeria's Statistical Bulletin (2009) and IMF publication for various years. The sample period is from 1970 to 2009.

V Presentation and Discussion of Results:

Except for world GDP (wgdp), inflation rate (inf), real interest rate (rir) and exchange rate uncertainty (uexr) indicators, the results in Table 3 clearly show that all macroeconomic variables are non-stationary; they are indeed I(1) series at 5 per cent level of significance using both the ADF and Phillips-Perron unit root tests. Log of real GDP (lrgdp), nominal GDP (lngdp), gross fixed capital formation (lgfcf), foreign private capital (lfpc), foreign reserves (lres), broad money (lm2), public expenditure (lgexp) and trade openness (open) indicators are I(1) series which implies that they need to be differenced once before they attain stationarity. The unit root test results were then applied in testing for causality and the estimations of growth and FDI models specified in equation (3) and (4) respectively. Evidence of long run relationships were also confirmed for equation (3) and (4).

The Granger causality results reported in Table 4 reveal causality runs one direction from Nigeria's real GDP to foreign private capital inflows at 1 per cent level of significance while it runs to foreign reserves at 5 per cent level of significance. The opposite causation was not confirmed. Causality also runs from foreign private capital inflows to trade openness at 5 per cent level of significance with no evidence of reverse causality. However, causality runs from both directions from foreign reserves and trade openness which indicate a bi-directional causal relationship at 5 per cent level of significance. Also, foreign reserves Granger caused trade openness while world output growth rate and other variables failed to cause each other.

The result of the estimated economic growth model is reported in Table 5. The result reveals a well-defined error correction term with a feedback effect of 0.85 of the previous year's disequilibrium from the long run elasticity of identified explanatory variables in the estimated economic growth model. The effect of the error correction is not only large but also has significant *a-priori* negative sign. The result clearly supports the finding that the identified explanatory variables are indeed cointegrated with economic growth series.

The result also shows that the coefficient estimate for the catch-up term or the existing economic growth level, i.e., lagged real GDP (RGDP(-1)), is significantly positive at 5 per cent level of significance. The result implies that the immediate past level of economic growth portends positive effect on the current level of economic growth in Nigeria. This finding is in harmony with both theory and empirical evidence from most countries of the world.

The cause-effect relationship revealed that the Nigerian economy is not insulated from global economic recession while the magnitude of the effect might be substantial given the degree of vulnerability of the Nigeria economy. The effect of global economic crisis is, however, of different dimensions. For instance, the results presented in Table 5 reveals a significant negative influence of current world GDP growth at 1 per cent level of significance but positive lagged effect on Nigeria's economic growth at 5 per cent level of significance.

Both current levels of foreign private capital (LFPC) and trade openness (OPEN) portend insignificant negative effect on economic growth in the country. The implication of the result is that global economic recession negatively affected inflows of foreign capital and degree of trade openness which in turns retards economic growth. However, the current and lagged values of foreign reserves {(RES) and RES(-1)} show significant positive effect in the short run at 1 per cent and 10 per cent level of significant.

The current level of domestic investment (GFCF) portends a significant positive effect while both the current levels of broad money supply (M2) and government expenditure (GEXP) portend insignificant negative effect of the Nigeria's economy growth. The results further support the view that money has macroeconomic real effect while government expenditure is dominated by the recurrent expenditure which had been confirmed to have to positive effect on the economic growth in Nigeria. Inflation rate (INF) portends significant positive effect on economic growth at 1 per cent level of significance while its lagged value (INF(-1)) portends significant negative effect also at 1 per cent level of significance. The coefficient of lagged value of the measure of macroeconomic uncertainty (UEXR(-1)) is negative as expected but not significant.

The result of the estimated foreign private capital inflows model is reported in Table 6. The result also reveals a well-defined error correction term with a feedback effect of 0.86 of the previous year's disequilibrium from the long run elasticity of identified explanatory variables in the estimated foreign private capital inflows model. The effect of the error correction is not only large but also has significant *a-priori* negative sign. The result clearly supports the finding that the identified explanatory variables are indeed cointegrated with foreign private capital inflows series.

The result also indicates that the coefficient estimate for the catch-up term or the existing FPC level, i.e., lagged foreign private capital (FPC(-1)), is insignificantly positive at 5 per cent level of significance. The cause-effect relationship revealed that the foreign private capital into the country is negatively influenced by the global economic recession (WGDP) but not significant at 5 per cent level of significance. The effect of real GDP of Nigeria on foreign capital inflow is significantly negative which indicate that the poor growth of the Nigerian's economy has discouraged inflows of foreign private capital into the economy. The results presented in Table 6 reveals a significant negative influence of current real GDP at 10 per cent level of significance but insignificant negative lagged effect on Nigeria's foreign private capital inflows.

Trade openness (OPEN) bears a significant negative effect on foreign private capital inflows while the lagged value of foreign reserves (RES(-1)) bears significant positive effect at 5 per cent level of significance. The implication of the result is that foreign reserves determines the level of capital inflows into the country and when global economic recession raises its ugly head, it depletes foreign reserves which in turns discourage foreign private investors in flowing capital into the country.

Both the current and lagged levels of domestic investment {GFCF and GFCF(-1)} portend significant positive effects at 1 per cent and 10 per cent respectively. The effect of money supply is mixed. While the current level of broad money supply (M2) bears significant positive effect, its lagged value portends a significant negative effect. Also, lagged value of government expenditure (GEXP) portends significant negative effect on foreign capital inflows into the country. Inflation rate (INF) portends significant positive effect at 10 per cent level of significance while effect of macroeconomic uncertainty is mixed. The coefficient of lagged value of the measure of macroeconomic uncertainty (UEXR(-1)) is significantly negative at 1 per cent level of significance while its current level (UEXR) portends significant positive effect at 5 per cent level of significance.

VI Conclusion:

Many economic analysts have described the global economic crisis as imposing serious greatest threat to the world economy since the end of World War II. Most analysts view past global economic and financial turmoil been confined to some particular regions with little or no effect on other economies of the world. However, the effect of the current global economic crisis, as being experienced in America and Europe is far spreading to other regions of the globe. Indeed, if urgent remedy is not proffered to address the ugly scenario and restore confidence in the global economy, the whole world will face a deep and prolonged recession.

Nigeria faces poor and uncertain macroeconomic situations both in the near and far future as a result of the global economic recession. In the country at moment, prices are unstable, financial market remained unorganized as banks are struggling while foreign private capital inflows dwindle. Low level of capital formation and dominance of oil sector continue to bedevil the country, calling for the need to adjust public expenditure and upcoming budget accordingly while the foreign reserves situation remains an enigma wrapped in a mystery for now.

The appropriate policy measure to address the effect of global economic recession on Nigerian economy would be the adoption of the demand-side management measures by implementing an expansionary policy in order to stabilize the macro-economy. The paper suggests that the government through fiscal and monetary control measures can stabilize and promote long term economic prosperity in Nigeria. The paper therefore advocates for the expansion of government spending to stimulate consumption, reduce the interest rate and increase effective aggregate demand, in order to achieve long-term full employment, price stability and sustainable economic growth in the country.

The paper concluded that a sustained economic recovery will not be possible until the whole financial sector's functionality is restored and credit markets are unclogged. Both monetary and fiscal policies need to become even more supportive of aggregate demand and sustain this stance over the foreseeable future, while developing strategies to ensure long-term fiscal sustainability. Macroeconomic environment has to stable and international cooperation is critical in designing and implementing these policies.

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Appendix I:

Table 1: Human Development Index (HDI) for Nigeria and Regions of the World (2011)

| Country | HDI Value | Life Expectancy at Birth (Years) | Expected Years of Schooling (Years) | GNI Per Capita (Constant 2005 PPP\$) | Non-Income HDI Value |
|------------------------------------|-----------|----------------------------------|-------------------------------------|--------------------------------------|----------------------|
| VHHD (Very High Human Development) | 0.889 | 80.0 | 15.9 | 33,352 | 0.918 |
| HHD (High Human Development) | 0.741 | 73.1 | 13.6 | 11,579 | 0.769 |
| MHD (Medium Human Development) | 0.630 | 69.7 | 11.2 | 5,276 | 0.658 |
| LHD (Low Human Development) | 0.456 | 58.7 | 8.3 | 1,585 | 0.478 |
| Arab States | 0.641 | 70.5 | 10.2 | 8,554 | 0.643 |
| East Asia and the Pacific | 0.671 | 72.4 | 11.7 | 6,466 | 0.709 |
| Europe and the Central Asia | 0.751 | 71.3 | 13.4 | 12,004 | 0.785 |
| Latin America and the Caribbean | 0.731 | 74.4 | 13.6 | 10,119 | 0.767 |
| South Asia | 0.548 | 65.9 | 9.8 | 3,435 | 0.569 |
| Sub-Saharan Africa | 0.463 | 54.4 | 9.2 | 1,966 | 0.467 |
| Least Developed Countries | 0.439 | 59.1 | 8.3 | 1,327 | 0.467 |
| Small Island Developing States | 0.640 | 69.6 | 10.8 | 5,200 | 0.675 |
| Nigeria | 0.459 | 59.1 | 8.9 | 2,069 | 0.471 |
| World | 0.682 | 69.8 | 11.3 | 10,082 | 0.683 |

Source: UNDP Human Development Report (2011)

Table 2: Overview of the World Economic Output ((Percent change)

| | 2007 | 2008 | 2009 | 2010 |
|--|------|------|------|------|
| World output growth based on market exchange rates | 3.8 | 2.2 | -0.6 | 2.1 |
| World trade volume (goods and services) | 7.2 | 4.1 | -2.8 | 3.2 |
| Advanced economies | 2.7 | 1.0 | -2.0 | 1.1 |
| United States | 2.0 | 1.1 | -1.6 | 1.6 |
| Euro area | 2.6 | 1.0 | -2.0 | 0.2 |
| Germany | 2.5 | 1.3 | -2.5 | 0.1 |
| France | 2.2 | 0.8 | -1.9 | 0.7 |
| Spain | 3.7 | 1.2 | -1.7 | -0.1 |
| Japan | 2.4 | -0.3 | -2.6 | 0.6 |
| United Kingdom | 3.0 | 0.7 | -2.8 | 0.2 |
| Canada | 2.7 | 0.6 | -1.2 | 1.6 |
| Other advanced economies | 4.6 | 1.9 | -2.4 | 2.2 |
| Newly industrialized Asian economies | 5.6 | 2.1 | -3.9 | 3.1 |
| Emerging and developing economies | 8.3 | 6.3 | 3.3 | 5.0 |
| Africa | 6.2 | 5.2 | 3.4 | 4.9 |
| Sub-Saharan | 6.9 | 5.4 | 3.5 | 5.0 |

Source: World Economic Outlook (2010)

APPENDIX II:

Fig.1: Global Economic Recession

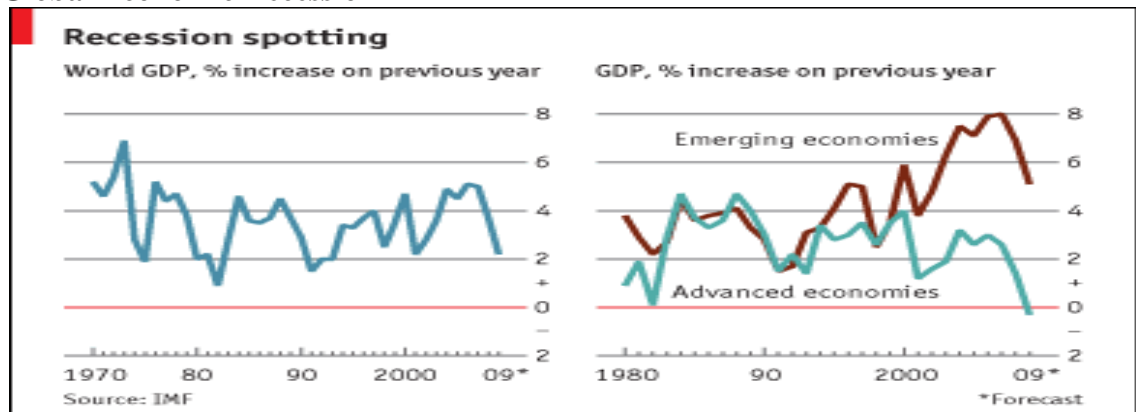
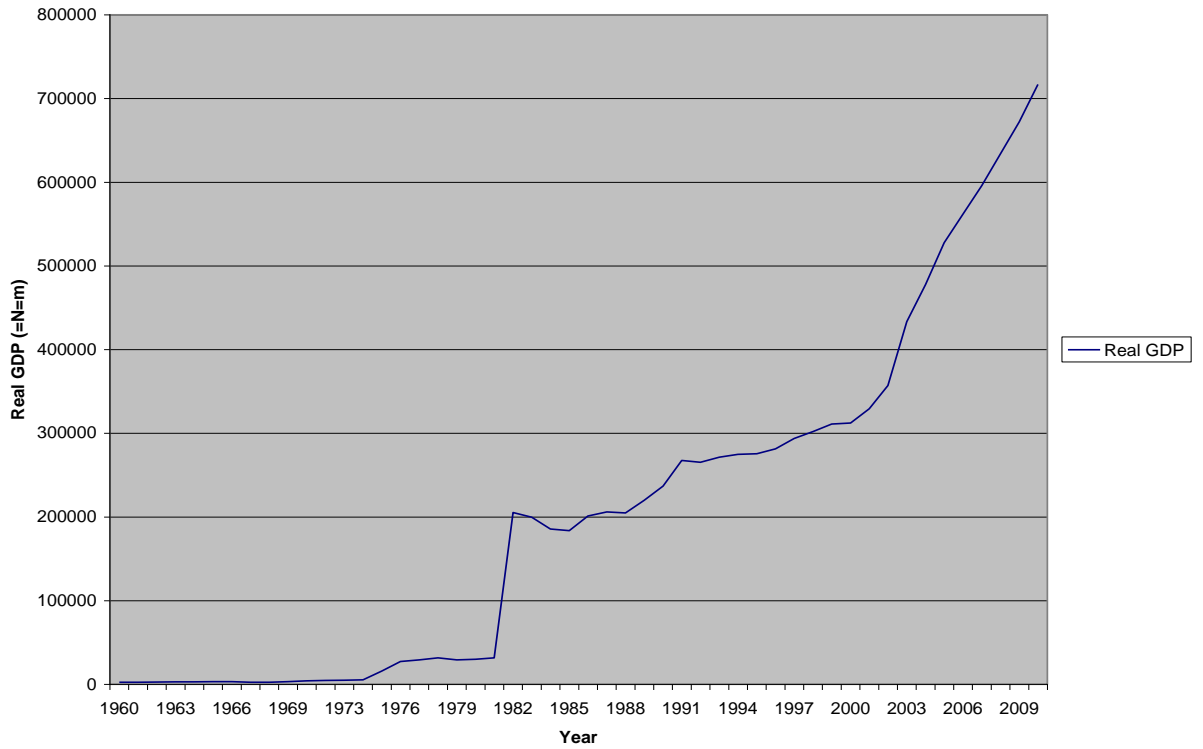


Fig.2: Nigeria's Real GDP Trend (1960 – 2009)



APPENDIX III:

Table 3: Unit Root Test Results (1970-2009)

| Series | Level | | First Difference | | Order of Integration |
|--|----------------|----------------|------------------|---------------|----------------------|
| | ADF | PP | ADF | PP | |
| World GDP growth rate (wgdp) | -3.7454** | 3.0118** | = | = | I(0) |
| Log of Real GDP (lrgdp) | -2.4668 | -2.5861 | -4.5172** | -5.7400** | I(1) |
| Log of Nominal GDP (lngdp) | -0.2063 | -0.1901 | -3.9209** | -5.3234** | I(1) |
| Log Gross Fixed Capital Formation (lgfcf) | -0.3093 | -0.6341 | -4.3555** | -4.7485** | I(1) |
| Log of Foreign Private Capital (lfpc) | -0.7993 | -1.5619 | -7.7917** | -9.2345** | I(1) |
| Log of Foreign Reserves (lres) | -1.6521 | -1.6190 | -5.3146** | -6.5346** | I(1) |
| Log of Broad Money (lm2) | -0.1769 | -0.4894 | -3.8445** | -3.9753** | I(1) |
| Log of Public Expenditure (lgexp) | -0.6051 | -0.5497 | -5.4868** | -9.6400** | I(1) |
| Trade/Nominal GDP (open) | -1.8976 | -2.7247 | -5.4530** | -9.8961** | I(1) |
| Inflation rate (inf) | -3.7999** | -3.2632** | = | = | I(0) |
| Nominal Interest Rate (int) | -1.6228 | -2.0344 | -8.2440** | -9.7489** | I(1) |
| Naira/Dollar Exchange rate (exr) | 0.6446 | 0.7566 | -3.9089** | -5.4775** | I(1) |
| Exchange rate uncertainty (uexr) | -4.1511** | -6.0113** | = | = | I(0) |
| Real Interest Rate (rir) | -3.8784** | -3.6381** | = | = | I(0) |
| 5% Critical Values for the rejection of hypothesis of unit root | -2.9399 | -2.9378 | -2.9422 | 2.9399 | |

Source: Estimates from E-View Econometric Package

** significant at 5% level

Table 4: Pairwise Granger Causality Tests (Sample 1970 to 2009)

| Null Hypothesis: | Obs | F-Statistic | Probability |
|-----------------------------------|-----|-------------|-------------|
| WGDP does not Granger Cause LRGDP | 39 | 0.00029 | 0.98648 |
| LRGDP does not Granger Cause WGDP | | 0.79140 | 0.37958 |
| LFPC does not Granger Cause LRGDP | 39 | 0.08144 | 0.77699 |
| LRGDP does not Granger Cause LFPC | | 11.3496 | 0.00181 |
| OPEN does not Granger Cause LRGDP | 39 | 0.52150 | 0.47487 |
| LRGDP does not Granger Cause OPEN | | 1.71905 | 0.19812 |
| LRES does not Granger Cause LRGDP | 39 | 0.00264 | 0.95930 |
| LRGDP does not Granger Cause LRES | | 6.39525 | 0.01597 |
| LFPC does not Granger Cause WGDP | 39 | 0.68236 | 0.41422 |
| WGDP does not Granger Cause LFPC | | 0.00110 | 0.97372 |
| OPEN does not Granger Cause WGDP | 39 | 1.25222 | 0.27054 |
| WGDP does not Granger Cause OPEN | | 0.54066 | 0.46692 |
| LRES does not Granger Cause WGDP | 39 | 1.70386 | 0.20006 |
| WGDP does not Granger Cause LRES | | 0.18951 | 0.66593 |
| OPEN does not Granger Cause LFPC | 39 | 0.05894 | 0.80955 |
| LFPC does not Granger Cause OPEN | | 3.96524 | 0.05408 |
| LRES does not Granger Cause LFPC | 39 | 5.83478 | 0.02091 |
| LFPC does not Granger Cause LRES | | 4.01330 | 0.05271 |
| LRES does not Granger Cause OPEN | 39 | 2.96035 | 0.09392 |
| OPEN does not Granger Cause LRES | | 0.02801 | 0.86802 |

Appendix IV:

Table 5: Modeling Nigeria's Economic Growth

Dependent Variable: D(LRGDP)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|----------|
| C | -0.086613 | 0.255633 | -0.338819 | 0.7380 |
| D(LRGDP(-1)) | 0.596424 | 0.277150 | 2.151993 | 0.0426 |
| WGDP | -0.109363 | 0.040436 | -2.704559 | 0.0129 |
| WGDP(-1) | 0.122778 | 0.054063 | 2.271032 | 0.0333 |
| D(LFPC) | -0.069017 | 0.064170 | -1.075537 | 0.2938 |
| D(OPEN) | -0.269379 | 0.539840 | -0.498998 | 0.6227 |
| D(LRES) | 0.196214 | 0.071733 | 2.735358 | 0.0121 |
| D(LRES(-1)) | 0.157419 | 0.088139 | 1.786042 | 0.0879 |
| D(LGFCF) | 1.100171 | 0.276194 | 3.983328 | 0.0006 |
| D(LGFCF(-1)) | -0.144432 | 0.239834 | -0.602216 | 0.5532 |
| D(LM2) | -0.567511 | 0.446982 | -1.269651 | 0.2175 |
| D(LGEXP) | -0.130842 | 0.100498 | -1.301937 | 0.2064 |
| INF | 0.013430 | 0.004537 | 2.960098 | 0.0072 |
| INF(-1) | -0.011864 | 0.003848 | -3.082927 | 0.0054 |
| UEXR | -0.000215 | 0.000155 | -1.384473 | 0.1801 |
| ECM1(-1) | -0.851424 | 0.334738 | -2.543549 | 0.0185 |
| R-squared | 0.593014 | Mean dependent var | | 0.132214 |
| Adjusted R-squared | 0.315523 | S.D. dependent var | | 0.348446 |
| S.E. of regression | 0.288281 | Akaike info criterion | | 0.645796 |
| Sum squared resid | 1.828325 | Schwarz criterion | | 1.335306 |
| Log likelihood | 3.729870 | F-statistic | | 2.137061 |
| Durbin-Watson stat | 2.025957 | Prob(F-statistic) | | 0.051407 |

Table 6: Modeling Nigeria's Foreign Private Capital Inflows

Dependent Variable: D(LFPC)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|----------|
| C | -0.040425 | 0.360721 | -0.112066 | 0.9118 |
| D(LFPC(-1)) | 0.108681 | 0.174688 | 0.622144 | 0.5402 |
| WGDP | -0.060005 | 0.063137 | -0.950401 | 0.3522 |
| D(LRGDP) | -0.473194 | 0.255614 | -1.851203 | 0.0776 |
| D(LRGDP(-1)) | -0.295746 | 0.283284 | -1.043991 | 0.3078 |
| D(OPEN) | -2.765046 | 1.047866 | -2.638740 | 0.0150 |
| D(LRES(-1)) | 0.350957 | 0.166548 | 2.107244 | 0.0467 |
| D(LGFCF) | 1.991702 | 0.615284 | 3.237045 | 0.0038 |
| D(LGFCF(-1)) | 0.716450 | 0.391306 | 1.830921 | 0.0807 |
| D(LM2) | 1.558635 | 0.779329 | 1.999971 | 0.0580 |
| D(LM2(-1)) | -2.683587 | 0.793199 | -3.383246 | 0.0027 |
| D(LGEXP(-1)) | -0.384672 | 0.177153 | -2.171413 | 0.0410 |
| INF | 0.010871 | 0.005909 | 1.839801 | 0.0793 |
| UEXR | 0.000631 | 0.000254 | 2.488119 | 0.0209 |
| UEXR(-1) | -0.001270 | 0.000231 | -5.496056 | 0.0000 |
| ECM2(-1) | -0.860105 | 0.262062 | -3.282073 | 0.0034 |
| R-squared | 0.834325 | Mean dependent var | | 0.117977 |
| Adjusted R-squared | 0.721365 | S.D. dependent var | | 0.885290 |
| S.E. of regression | 0.467308 | Akaike info criterion | | 1.611905 |
| Sum squared resid | 4.804290 | Schwarz criterion | | 2.301415 |
| Log likelihood | -14.62620 | F-statistic | | 7.386028 |
| Durbin-Watson stat | 2.110485 | Prob(F-statistic) | | 0.000018 |

Examination of the Effect of Job Satisfaction on Burnout of University Teaching Staff with Structural Equation Model

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Abstract:

The main purpose of the present study is to investigate the relationship between and job satisfaction (JS) and burnout of academician by a structural equation model (SEM). For this reason with the assistance of LISREL 8.54 was used to try to develop a model, and fitness of the model has been discussed considering goodness-fit measures. The other purpose of the study is to test for the factorial validity of the Maslach Burnout Inventory (MBI) and JS, for this purpose surveyed 312 university teaching staff. First, we determined the factors MBI and JS by means of the explanatory factor analysis (EFA), then utilizing confirmatory factor analyze (CFA) we showed the validity of those factor.

Keywords: Job satisfaction, Burnout, University Teaching Staff, Structural Equation Model

Introduction

If the beliefs and attitudes, regarding a specific subject, of the employees working for a particular corporation are foreknown, their behaviors could be also estimated and corrected. For example, if the beliefs and attitudes of the employees toward workplace arrangement, behaviors of managers and wage policy are already known, particular measures could be taken for operating the corporation at a better social environment and in more efficient manner. This enables company managers to develop a program that would be satisfactory to employees. An individual involved in a family, school, several associations and other organizations relating to business life will strive at satisfying his/her needs whether easily or hardly, depending upon availability or unavailability of such fields. A person, who has any means and tackles his/her needs, would be satisfied and become tranquil in psychological sense. Otherwise, specific adverse psychological cases called dissatisfaction and burnout may arise (Eren, 2001).

In this study, an effort was made to examine the existence of a causal relationship between JS and burnout of academicians, by proposing a SEM. In this study, the statistical units are defined as assistant professors, executive lecturers, and researchers working for Eskişehir Osmangazi University (ESOGU) and Anadolu University (AU) during April-May 2007. Questionnaire was taken through website and 312 academicians who responded to the whole questionnaire constitute the sampling group. At the first stage of the study, the data obtained from 312 academicians was subjected to CFA with LISREL 8.54 to define the dimensions of MBI, and then EFA and CFA were done to examine the factor structure of JS inventory comprised of 37 items. Cronbach's Alpha, Split-Half Method, Parallel Technique, and ANOVA were used to try to determine the reliability of inventories. Finally, A SEM was proposed for the relationship between JS and burnout, and the convenience of the model was tested fit considering goodness-of-fit measures.

JS and Burnout

JS is the sign of emotions developed by employees towards their physical and mental health as well as their work and institution for which they work. JS connotes the material benefits gained from work, the colleagues with whom you enjoy working and the happiness from doing work. Therefore, JS signifies the enjoyment or positive emotional state of an employee as a result of the evaluation of his/her own business life (Samadov, 2006). JS depends on two main components. The first component is an individual's structure, emotions, thoughts and wishes as well as needs and their intensity, while the second component is the working conditions. This comprises the physical and mental conditions of the work as well as to what extent such conditions respond to an employee's expectations. JS will be as much as the magnitude of meeting those expectations. Such wishes and needs that remain unmet may cause mental stress and balance disorders as time passes, creating a burnout emotion and reducing productivity. Akman et. al. (2006) researched the factors affecting JS of university lecturers. Sampling group is a total of 488 lecturers from 24 universities in Turkey, who responded to a questionnaire sent through electronic mail. Chi-square analysis shows that some opinions of the academicians concerning JS have significant differences depending on their gender, seniority, and academic status. Özyurt et. al. (2006) suggested that the physicians in Istanbul have a JS above average and a lower level in terms of burnout, according to the study on the level of JS and burnout performed on 598 physicians by applying the

MBI and Minnesota Satisfaction Questionnaire (MSQ). A strong, negative, and statistically significant relation was found between JS and burnout, and this finding has been assessed as an anticipated result. Ok (2002) examined the burnout level of bank employees in terms of JS, role conflict, role similarity and certain individual properties. 999 persons were involved in the study, on a voluntary basis. MBI was used to gain the data, while in order to collect the data concerning independent variables MSI was carried out to determine JS of employees and "role conflict and role ambiguity questionnaire" to define role conflict and role ambiguity. According to the findings of the study, when trying to find out the effect of gender on the emotional burnout level of bank employees, the contribution of gender to satisfaction of emotional burnout level is significant if JS, role conflict and role ambiguity of those employees are kept under control. Koustelios and Tsigilis (2005) examined the multivariate relationship between job satisfaction and burnout, experienced by Greek physical education school-based teachers. The sample consisted of 175 physical education teachers, from primary and secondary education. The MBI and the Employee Satisfaction Inventory used to assess burnout and job satisfaction respectively. Canonical correlation analysis revealed a negative multivariate relationship between the two constructs ($r = -0.61$). Canonical loadings indicate that job satisfaction is primarily affected by 'job itself' followed by 'supervision' and 'working conditions', whereas burnout is affected by 'personal accomplishment' and 'emotional exhaustion'. Intrinsic aspects of job satisfaction seemed to correlate stronger to burnout than the extrinsic. Tsigilis et. al. (2006) was to examine perceived levels of burnout and job satisfaction of Greek early educators, across public and private sector. One hundred and seventy eight childhoodeducators participated in the study. Participants were administered the Employees Satisfaction Inventory and the emotional exhaustion subscale of the MBI. They found that early educators experienced moderate levels of emotional exhaustion. Public sector early educators were more satisfied from the job itself and their immediate supervisor than their counterparts in the private sector.

Method and Material

Factor analysis is a statistical process used to investigate relationships among observed and latent variable sets. Two basic factor analyses are EFA and CFA. EFA, the researcher is not aware of the number of factors measured through the measurement tool. When attempting to obtain information on the nature of factors detected a priori, instead of examining a specific hypothesis, the researcher uses exploratory factor analysis. In case of examining a theory developed by the researcher to test a hypothesis, CFA is used (Sharma, 1996; Wlash and Betz, 1995; Yılmaz and Çelik, 2008). The linear structural relation (LISREL 8.54) analysis program was used for CFA, with the aim of examining the fit of the factor models carried out by the exploratory analysis. In determining the fit of the model, multi-fit measures are used. In this study, adjusted goodness-of-fit index (AGFI), goodness-of-fit index (GFI), normed fit index (NFI), nonnormed fit index (NNFI), root mean square error of approximation (RMSEA) and Standardized Root Mean Square Residual (RMR). Data were analyzed in two stages. Responses were assigned to two data sets and these two data sets were subjected to a two-stage factor analysis. The first data set ($n_1 = 145$) was used to explore the underlying factor structure of the scale using EFA. The second data set ($n_2 = 167$) was used to confirm the factorial structure derived from the EFA procedure using CFA. The research also used Bartlett's Test of Sphericity (BTS) which test the hypothesis 'correlation matrix = unit matrix. The rejection of the hypothesis shows that correlation between the variables is different from

1.0 and the factor analysis is appropriate for the variables (Hutcheson & Sofroniou, 1999). Both the Bartlett test of sphericity and the Kaiser–Meyer–Olkin measure of sampling adequacy indicated that there were sufficient inter-item correlations within the data for performing factor analysis.

In the study, first, original 3-factor model of MBI was handled and the factor structure for Turkish academicians discussed by examining it with CFA. Then, unidimensionality of JS structure was studied with EFA and CFA. Finally, JS was defined as exogenous latent and burnout as endogenous latent variable and a SEM recommended in order describing the relationship between them.

Measurement Tools

Attitude scales are the foremost and most widely used method to measure the attitudes. Attitude scales are called those questionnaires that are designed for an individual to respond to a series of propositions prepared to unveil the interior of that individual. By this method, the response of individuals to a series of propositions relating to a particular subject is investigated. In these studies, such accepted scales as previously verified in terms of reliability and validity may be used; or, sometimes researchers may change such existing scales after verifying validity thereof for different occupational groups, and use these scales as changed. Sometimes those scales developed for different countries, cultures and occupational groups may not be verified on every country, or a difference may occur in the size of a scale (or in the number of propositions). JS attitude items used in the study were created using the scale developed by Spector (1985), the MSQ (Minnesota Satisfaction Questionnaire) and the study of Akman et. al. (2006), while the burnout items using the MBI. Factor structures of the scales were reexamined. As a result of the analyses some propositions were not even analyzed. This questionnaire contains attitude items concerning relations with management, award, and opportunity for promotion, and loyalty to company as well as attitude items belonging to the MBI. Academicians' responses to attitude items were measured on a 5-point Likert-type scale.

Sample

The universe of this study includes the researchers, executive lecturers, and assistant professors working for Eskişehir Osmangazi University and Anadolu University during the academic year of 2006-2007. The study sample is 312 academicians, who have worked for the said universities during the same period and completed the questionnaire through website. 167 academicians from Eskişehir Osmangazi University (58 Women, 109 Men; 110 Researchers, 25 Executive Lecturer, 32 Assistant Professors) and 145 academicians from Anadolu University (58 Women, 75 Men; 85 Researchers, 32 Executive Lecturers, 28 Assistant Professors) filled-in the questionnaire.

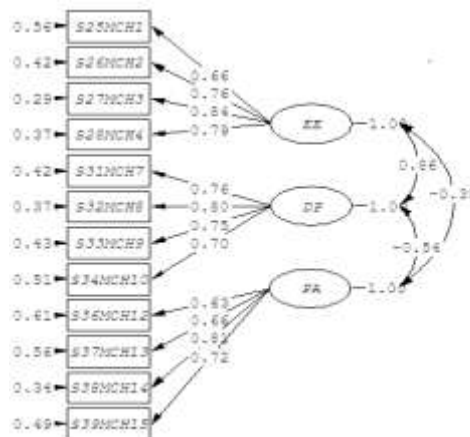
Data Analysis

EFA and CFA for Burnout Measurement Model

MBI developed by Maslach and Jackson (1981 and 1986) was used to determine the burnout of academic staff. Inventory burnout comprised of a total of 22 items is considered in three sub-dimensions: Emotional Exhaustion (EE), Depersonalization (DP), and Personal Accomplishment (PA). Subscale EE describes feeling of emotionally overextended and exhausted by one's work. This subscale includes 9 items relating to fatigue, boredom, and decrease of emotional energy. Depersonalization has 6 items and

refers to a set of callous and sensitive behaviors displayed by an individual toward his/her clients. Subscale PA refers to feelings of qualification and accomplishment and includes 8 items. Some authors have investigated about three-dimensionality of burnout inventory since EE and DP dimensions have higher correlation with each other and suggested that it would be more appropriate to express this inventory with two dimensions (Cordes and Dougherty, 1993; Boles et. al., 2000). Lee and Ashforth (1996) found a correlation of 0.64 between EE and DP. These authors claimed that the said two factors are laid on a single factor. Byrne (1991) investigated the validity of factor structure in MBI with CFA over primary education 163, secondary education 162, and university lecturers. When investigating the three-factor structure, he expressed that 4 items should be cancelled. In the study, the burnout inventory comprised of 22 items was reduced to 12 items by the help of reliability and EFA results. Then, fit was investigated using three-factor model CFA. From Figure 1, the correlation is 0.86 between EE and DP, -0.39 between EE and PA, while 0.54 between DP and PA. As understood from the correlation values, the correlation between EE and DP factors is too high. This indicates that these two factors may be handled in one single factor, indeed.

Figure. 1. CFA Results of MBI CFA

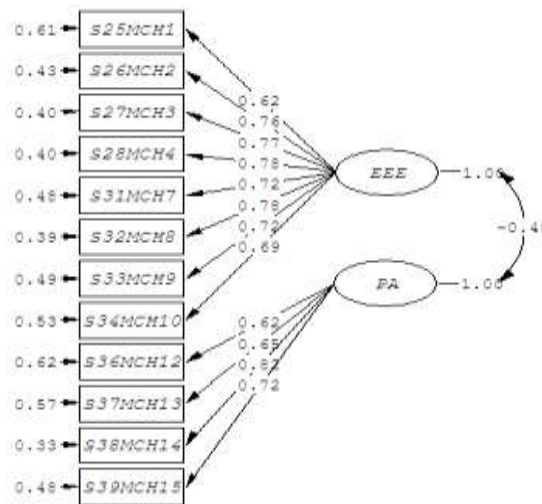


When the items concerning such factors are investigated, it may be claimed that all of them has a negative meaning and are comprised of similar items. According to interpretation of the correlation coefficients calculated as a result of the analysis: DP will increase as EE increases (or vice-versa), PA will decrease as EE increases, while PA will decrease as DP increases. These results are consistent with those seen in the literature.

At a later stage EFA and then CFA were performed in order to find out whether MBI could be explained in two factors (by combining EE and DP). EFA was implemented for 145 data obtained from Anadolu University. As a result of the analysis was reached two factors with eigenvalue 4.68 and 2.67 and explained variance 38.97(%) and 22.27(%) , respectively. For the two factors, Emotional Exhaustion Exertion (EEE): s27 mch3 (0.83); s26mch2 (0.80); s28mch4 (0.79); s32mch8 (0.77); s31mch7 (0.71); s33mch9 (0.70); s25mch1 (0.70); s34mch10 (0.69), and PA: s37mch13 (0.84); s38mch14 (0.77); s36mch12 (0.75); s39mch15 (0.72). KMO was found 0.88 and Bartlett Test Chi-

Square=1853.98, $p=0.000$. As a result of EFA, it was suggested that the two factors explains 61% of the total variance and their factor loads vary between 0,69 and 0,84. If these findings are also verified with CFA results, it would be possible to express that the two-factor burnout model is more appropriate. CFA verification of two-dimension case found by EFA was done using 167 data obtained from Eskişehir Osmangazi University. As understood from the Figure 2, the correlation between two factors is -0.48 . Detection of a negative relation between two factors is reasonable as PA items have positive while EEE items, combination of EE and DP, have negative meaning.

Figure 2. CFA Results of Two-Factor Burnout Model



Multi-fit measures calculated for compliance of two-factor model were found as: RMSEA=0.09; NFI=0.93; CFI=0.94; RMR=0.07; GFI= 0.87. According to these measures the fit of the model is within reasonable limits. Reliability analysis of the burnout inventory comprised of 12 attitude items suggested the following results: 1. Cronbach Alpha=0.88; 2. Split-Half Method, $\alpha_1=0.90$ (6 items) ; $\alpha_2=0.70$ (6 items); correlation=0.58; 3. Guttman Split-Half Method, Reliability Coefficient=0.70; 4. Parallel Technique, Chi-Square=521.02 (df=151), $p=0.000$; 5. Tukey’s Test for Additivity $F=0.213$ (df=11;1), $p=0.645$; 6. ANOVA, $F=10.13$; (df=166;11), $p=0.000$.

Development of Structural Equation Model

This stage, a SEM was suggested to test the hypotheses indicated herein-below. The suggested model is given in Figure 3. In order to test the relations as set out the model in Figure 3 the following hypotheses may be developed: H1: *EEE will decrease as JS of academicians increases*; H2: *PA will increase as JS of academicians increases*; H3: *EEE will decrease as PA of academicians increases*.

Figure. 3. Model Suggested for the Relationship between JS and Burnout

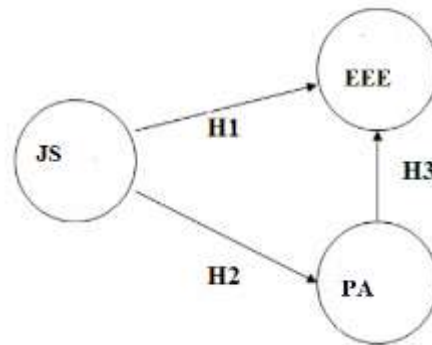
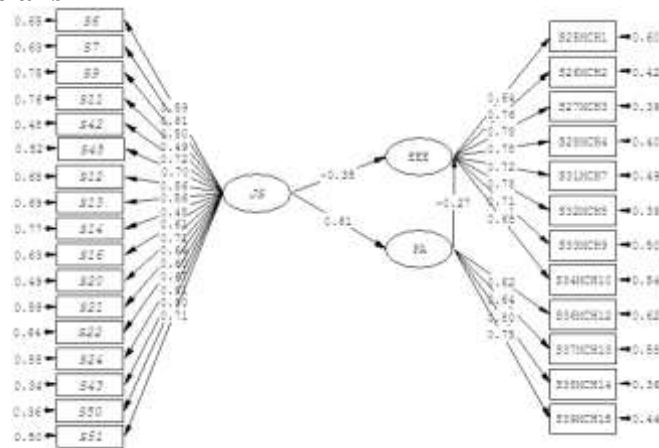


Figure. 4. Results of SEM suggested for defining the relationship between JS and burnout for academicians



The results of a SEM suggested for defining the relationship between JS and burnout of the academicians are given in Figure.4. Fit measure of the model found with LISREL 8.54 program were calculated as RMSE=0.09; NFI=0.89; CFI=0.91; RMR=0.08; GFI=0.80. According to examination of fit measure the suggested SEM is understood to remain within the acceptable limits. The factor loads for JS indicate that the attitude items “**43**. I believe that the bond between employees and management is strong” and “**50**. There is a mutual sense of trust between individuals and units” have the highest factor loads (0.81 and 0.80, respectively). R^2 values of these attitude items are 0.66 and 0.64, respectively. Such attitude items, which have effects on development of JS factor, were determined as “**20**. I find the company I work for an ideal workplace”, “**42**. Our managers become integrated with us and strive at solving our problems”, and “**51**. There is a permanent exchange of views among managers and their staff”. When these attitude items are examined, it may be expressed that the words “*bond*”, “*trust*”, “*integration*”, “*exchange of views*”, and “*managers*” should be underlined. According to review of the factor loads of EEE dimension, the loads are found to be 0.64-0.78. The factor load of those items “**32**. I’m worried that this work sears me emotionally”, “**28**. I feel myself disappointed because of my work”, and “**27**. I feel myself exhausted because of my work” is 0.78. The highest factor load for PA is (0.80) with “**38**. I easily create a comfortable working environment together with individuals working for our

organization". Please find below the structural equations gained as a result of the analysis.

$$EEE = -0.27*PE - 0.35JS ; \quad R^2 = 0.31$$

$$(t=-3.33) \quad (t=-4.49)$$

$$PE = 0.61*JS \quad R^2 = 0.37$$

$$(t=8.04)$$

Test statistics calculated for the test of hypothesis H1 was found as -4.49. Absolute value of this being higher than 2 indicates the coefficient is statistically significant. This result means the hypothesis H1 is verified. The regression coefficient between JS and EEE was expected to be -0.35. This coefficient's being negative makes academicians think that EEE will decrease as JS increases. *t* value calculated for the test of hypothesis H3 was found as -3.33. The regression coefficient was expected to be -0.27. This coefficient has also negative meaning and H3 was verified. Test statistics calculated for the test of hypothesis "PA will increase as JS increases" was 8.04. The estimated coefficient was 0.61, which has a positive meaning. In brief, a one-point decrease of JS will result in 0.35-point increase of EEE, one-point increase of PA will result in 0.27-point decrease of EEE, while one-point increase of JS will cause 0.61-point increase of PA.

Conclusion

According to the results of SEM, the need for the managers to make certain arrangements for raising JS of academicians has arisen. The reason is JS's affecting PA in a positive way and the decrease of EEE by reasons of the increase of PA. From these relationships, if it is desired to increase PA and decrease EEE, it is required to implement those decisions on raising JS of the academicians. Therefore, the major factors affecting JS should be determined and it would be vital to take corrective decisions with respect thereto.

The hypothesis suggesting that there is no significant difference between the burnout averages of the academicians in terms of gender was tested with ANOVA to reach the values $F=4.17$ ($df=1;300$), $p=0.04$. This result indicates that the burnout averages in terms of gender are different, with the average higher for men. A study was done in two universities to find out whether their burnout value is same, and the values found were $F=0.14$ ($df=1;300$), $p=0.71$. This result claimed that the burnout averages of these two universities were similar. The difference between the burnout averages in terms of academic position was found significant, with $F=6.02$ ($df=2;300$), $p=0.002$. The burnout level of assistant professors was higher than that of other two positions. The highest value for EEE was 40, while the lowest value 8. The highest averages relating to the expressions contained in EEE are those numbered 31, 28 and 27, respectively.

Beckstead (2002) investigated the burnout level of 151 nurses working in Florida, with CFA and using MBI. The author determined a 0.65-point correlation between emotional exhaustion and depersonalization, -0.16-point correlation between emotional exhaustion and personal achievement, and -0.25-point correlation between

depersonalization and personal achievement. In the study performed by Proctor and Steadman (2003) 63 psychologists constituted the sampling group to find out the effects of burnout and job satisfaction. In the study, a 28-point Likert-type scale was used to collect data. According to the findings achieved at the end of the study, it was found that gender, age or experience has no effect on JS and burnout and that those who have higher JS experience lower level of exhaustion. Sari (2004) investigated the factors affecting JS and burnout of 295 private school teachers. He determined that, particularly, gender and work experience factors are significant. In a study on the employees working for a library in Greece, Tsigilis et.al. (2004) examined the relationship between burnout and job satisfaction. A questionnaire was applied to 135 academic librarians to find out burnout and JS levels. Interrelated two-factor model was assumed and supported. The authors determined a higher negative correlation (-0.75) between two structures, through SEM. Chiang Ku Fan and Chen-Liang Cheng (2007) analyzed with MBI the burnout levels of those employees working in the life-insurance sector in Taiwan, and determined that gender and working hours are important factors.

In later studies, especially the factor structure of JS scale should be reexamined with new items. The model mentioned in this study is initially and of suggestion level, so it is considered that new factors should be added to improve it.

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Flora of Karaköy (Bilecik-Turkey) and Its Environs

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Abstract

In this study, vascular flora of Karaköy (Bilecik-Turkey) and its environs were investigated between 1996 and 2012. Our study area comprises Karaköy (Bilecik-Turkey) and 17 villages (Fig. 1). It is located at the junction point of A2, A3, B2 and B3 squares according to the grid system adopted in the Flora of Turkey and Aegean Islands. The flora of study area consisted of 546 taxa including 544 species, 1 subspecies and 1 variety belonging to 345 genera of 80 families. Among these, 46 taxa (2 taxa VU, 5 taxa NT, 3 taxa CD and 36 taxa LC) are endemic to Turkey and the ratio of endemism is 8.42 %. Distribution of taxa according to their floristic region reveals that the Mediterranean elements are the most abundant with 16.85 % (92 taxa). Ratio of Euro-Siberian elements is 14.28 % (78 taxa) and this is followed by Irano-Turanian elements with 8.06 % (44 taxa). The rest 322 taxa (60.81 %) are elements of one or more floristic regions or their floristic regions are unknown. The largest family in study area is Asteraceae which contains 61 taxa (11.17 %). Second largest is Fabaceae includes 47 taxa (8.06 %) and third is Lamiaceae includes 43 taxa (7.87 %).

Keywords: Bilecik, Biodiversity, Endemism, Flora, Karaköy, Turkey

Introduction

Turkey has considerable topographical, climatical and ecological diversity because of the effects of different events which occurred in geological formation process (Akman, 1990). Also, Turkey is located at intersection of the Euro-Siberian, Mediterranean and Irano-Turanian floristic regions and so act as a bridge between Asia and Europe continents. From all reasons above, Turkey has very high biological diversity (about 12.000 taxa) in comparison with neighboring countries (Davis, 1965; Erik and Tarıkahya, 2004).

The first studies on flora of Turkey were started with botanical excursions of Tournefort in 1702 (Erik and Tarıkahya, 2004). Afterwards, many native and foreign researchers have studied on flora of Turkey until today. First notable study between these studies is Boissier's *Flora Orientalis*. But undoubtedly that the most important and detailed study between these is *Flora of Turkey and Aegean Islands* which performed by P.H. Davis et al. Although *Flora of Turkey and Aegean Islands* and other studies have contributed significantly to the flora of Turkey, detailed floristic structure of provinces and grids haven't been identified yet (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2000; Ocağ and Tokur, 2000; Türe and Tokur, 2000).

The study area comprises Karaköy (Bilecik) and 17 villages (Fig. 1). It is located at the junction point of A2, A3, B2 and B3 squares according to the grid system adopted in the *Flora of Turkey and Aegean Islands*. The area at the latitudes of 39° 54' - 40° 06' N and the longitudes of 29° 56' - 30° 04' E. Altitude of area is ranging from 400 to 1200 m and surface is 500 km².

Major soil groups of the study area are composed of brown forest soil, colluvial soil, red-brown soil, alluvial soil and non calcareous brown soil. The most widespread is the brown forest soil type. Major rock structures are limestone (Bilecik Toprak Su Envanteri, 1983).

Climatic features of study area have been evaluated according to the obtained data from Bilecik, Bozüyük, Pazaryeri and Söğüt meteorological stations. The average temperature of Bilecik is 12.3°C, Bozüyük is 10.4°C, Pazaryeri is 11.2°C and Söğüt is 11.4°C. Annual precipitation of Bilecik is 436.6 mm, Bozüyük is 484.5 mm, Pazaryeri is 436.5 mm and Söğüt is 472.7 mm. When all the climatic data is evaluated according to the Emberger method, climate type of study area is determined as semi arid Mediterranean type. The precipitation regime belongs to the East Mediterranean (Akman, 1990; Türe and Tokur, 2000; Meteoroloji Gn. Md., 1998).

There have been no other specific studies related to the flora of Karaköy (Bilecik) and its environs. The aim of this study was to determine the floristic characteristics of Karaköy (Bilecik) and its environs. We hope that, this study will make contribution to the all related researches and plant diversity of Turkey.

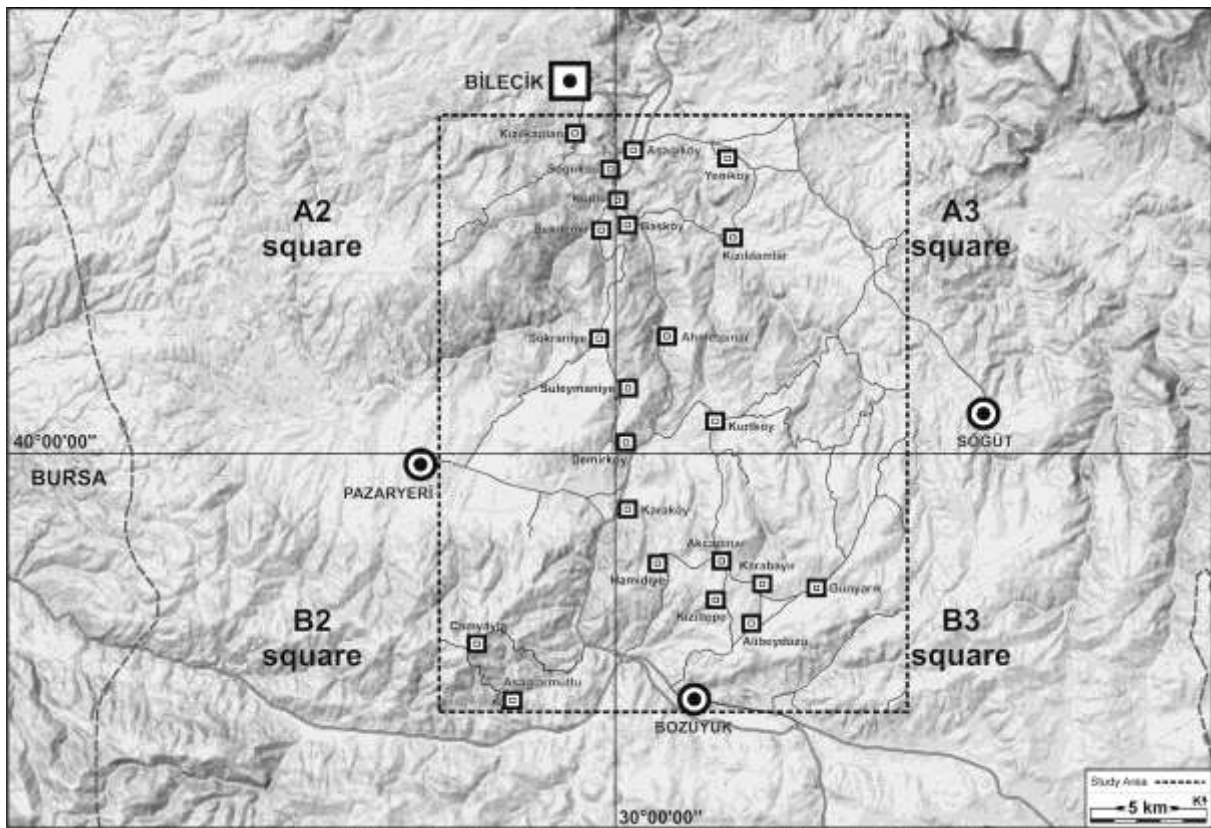


Figure 1. Geographic map of the study area.

Material and Methods

This study based on 1723 plant specimens, which were collected from 20 localities in Karaköy (Bilecik) and its environs between 1996 and 2012. The majority of the specimens were identified with the help of the Flora of Turkey and the East Aegean Islands (Davis, 1965-1988; Güner et al., 2000). Some doubtful identifications were checked in Flora Europaea (Tutin et al., 1964-1980), Flora Iranica (Reichinger, 1965-1977), Flora Palestina (Zohary, 1966-1986), Flora of Iraq (Guest and Townsend, 1966-1985), Flora Orientalis (Boissier, 1867-1888). The herbaria of GAZI, ANK and OUFE were used to check the specimens. The plant specimens prepared for herbarium collections have been stored in the Herbarium at OUFE. The floral data are listed in the appendix. All taxa in the floristic list are given according to the Angiosperm Phylogeny Group (APG III, 2009). In the floristic list, locality, altitude, OUFE number, collection date, phytogeographical region, whether the plant is endemic or not and threatened categories it belongs to are mentioned at the end. Author's abbreviations follow Brummitt and Powell (1992) and The International Plant Names Index (2012). Threatened categories are proposed for endemic and some non-endemic taxa according to IUCN risk categories (IUCN, 2001; Ekim et al., 2000). The abbreviations used in the text and the floristic list are as follows: Ir.-Tur.: Irano-Turanian; Medit.: Mediterranean; E. Medit. (mt.): East Mediterranean (mountain); Omni Medit.; Omni Mediterranean; Eur.-Sib.: Euro-Siberian; Eux.: Euxine; End.: Endemic; CR: Critically endangered; EN: Endangered; VU: Vulnerable; NT: Near threatened; CD: Conservation dependent; LC:

Least concern; ANK: Ankara University Herbaria; GAZI: Gazi University Herbaria; OUFE: Eskişehir Osmangazi Univeristy Herbaria.

Result and Discussion

In this study, 546 taxa belonging to 80 families and 345 genera were identified. Three of these taxa are Pteridophyta, and other 543 taxa are Spermatophyta which includes 5 taxa from the Gymnospermae and 538 taxa from the Angiospermae.

The Angiospermae includes 468 taxa from the Magnoliopsida and 70 taxa from Liliopsida. The dispersion of the plant taxa that were defined in the study area according to the large taxonomical groups is shown in Table 1.

Phytogeographical distributions of 214 taxa are given in Table 1. Apart from these, other 359 taxa are multi-regional elements or their phytogeographic region is unknown. The percentage of phytogeographical origins of 187 taxa was 92 (16.85 %) Mediterranean, 78 (14.28 %) Euro-Siberian, and 44 (8.06 %) Irano-Turanian. The rest of the 332 (60.81 %) taxa are either multi-area elements or single elements which have not yet been accepted as members of the phytogeographical area.

The largest families of study area according to number of taxa are Asteraceae (61 taxa), Fabaceae (47 taxa), Lamiaceae (43 taxa), Brassicaceae (42 taxa) and Poaceae (32 taxa).

The richest genera of study area according to number of taxa are *Salvia* (9 taxa), *Trifolium* (8 taxa), *Centaurea* (8 taxa), *Geranium* (7 taxa), *Alyssum* (6 taxa), *Silene* (6 taxa), *Hypericum* (5 taxa), *Stachys* (5 taxa) and *Galium* (5 taxa).

Endemism ratio of study area is 8.42 % and includes 46 taxa (2 taxa VU, 5 taxa NT, 3 taxa CD and 36 taxa LC). Endemism ratio of study area is very low in comparison with the average endemism ratio (34.5%) of the Flora of Turkey (Güner et al., 2000).

The results of this study generally show accordance with other similar studies (Ocak and Tokur, 2000; Türe and Tokur, 2000; Koyuncu et al., 2012a; Koyuncu et al., 2012b). In the research area, the most important treated factors of the floristic structure are urbanization, livestocking, agricultural activities and erosion. Firstly, this study aims to identify, conserve and examination of the floristic diversity in Turkey

Table 1. Floristic properties of the research area.

| | Taxonomic Groups | | | | Total | Ratio of total taxa in the research area (%) |
|--|------------------|--------------|--------------|-----------|-------|--|
| | Pteridophyta | Gymnospermae | Angiospermae | | | |
| | | | Dicots. | Monocots. | | |
| Families | 3 | 3 | 63 | 11 | 80 | |
| Genera | 3 | 4 | 289 | 49 | 345 | |
| Species and Under Species Taxa | 3 | 5 | 468 | 70 | 546 | |
| Species | 3 | 5 | 466 | 70 | 544 | |
| Subspecies | - | - | 1 | - | 1 | |
| Varieties | - | - | 1 | - | 1 | |
| Distribution of taxa to Phytogeographic Regions | | | | | | |
| Euro-Siberian (Total) | - | 1 | 66 | 11 | 78 | 14.28 |
| Euro-Siberian | - | 1 | 60 | 11 | 72 | 13.18 |
| Euxine | - | - | 6 | - | 6 | 1.10 |
| Mediterranean (Total) | - | - | 72 | 20 | 92 | 16.85 |
| Mediterranean | - | - | 56 | 15 | 71 | 13.00 |
| E. Medit. (mt) | - | - | 15 | 5 | 20 | 3.66 |
| Omni Medit. | - | - | 1 | - | 1 | 0.19 |
| Irano-Turanian | - | - | 39 | 5 | 44 | 8.06 |
| Others | 3 | 4 | 291 | 34 | 332 | 60.81 |
| Endemism and Risk Categories (IUCN 2001). | | | | | | |
| Endemic Taxa | - | - | - | - | 46 | 8.42 |
| VU | - | - | 2 | - | 2 | 0.36 |
| NT | - | 1 | 3 | 1 | 5 | 0.91 |
| CD | - | - | 3 | - | 3 | 0.55 |
| LC | - | - | 36 | - | 36 | 6.60 |

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Appendix

List of Flora

PTERIDOPHYTA

SPHENOPSISIDA

HYPOLEPIDACEAE

Pteridium Scop.

P. aquilinum (L.) Kuhn.

Environs of Bekdemir village, 220m., OUFE 7794, 18 vii 1997.

ASPLENIACEAE

Asplenium L.

A. trichomanes L.

25-30 km of Bozüyük-Bilecik road, 330m., OUFE 7795, 01 iix 1997.

ASPIDIACEAE

Dryopteris Adans.

D. filix-mas (L.) Schott

Environs of Kurtköy village, 600m., OUFE 7796, 12 vi 1997.

SPERMATOPHYTA

GYMNOSPERMAE

PINACEAE

Abies Mill.

A. nordmanniana (Stev.) Spach subsp. *equi-trojani* (Asch.&Sint. ex Boiss.)
Coode&Cullen

Environs of Küplü village, 290m., OUFE 7797, 22 iii 1998, End. (NT), Eur.-Sib.

Pinus L.

P. nigra Arn. subsp. *pallasiana* (Lamb.) Holmb. var. *caramanica*

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 7798, 01 v 1997.

CUPRESSACEAE

Juniperus L.

J. oxycedrus L. subsp. *oxycedrus*

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7800, 01 v 1997.

J. foetidissima Willd.

Environs of Kızıltepe village, 1000m., OUFE 7801, 10 ix 1997.

EPHEDRACEAE

Ephedra L.

E. major Host

Environs of Bekdemir village, 290m., OUFE 7802, 06 iix 1998.

ANGIOSPERMAE

DICOTYLEDONAE

RANUNCULACEAE

Helleborus L.

H. orientalis Lam.

25-30 km of Bozüyük-Bilecik road, 260m., OUFE 7803, 03 x 1998, Eux.

Nigella L.

N. arvensis L. var. *glauca* Boiss.

Environs of Kurtköy village, 740m., OUFE 7804, 06 iix 1998.

N. elata Boiss.

Environs of Şükranıye village, 725m., OUFE 7805, 19 ix 1997.

Delphinium L.

D. venulosum Boiss.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7806, 18 vii 1997, End., (LC),
Ir-Tur.

***D. peregrinum* L.**

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7807, 01 iix 1997.

***Consolida* (DC.) S.F. Gray**

***C. orientalis* (J.Gay) Schrödinger**

Environs of Yeniköy village, 330m., OUFE 7808, 25 vii 1997.

C. regalis* Gray subsp. *paniculata* (Host) Soó var. *paniculata

Environs of Kurtköy village, 740m., OUFE 7809, 06 iix 1998.

***C. raveyi* (Boiss.) Schrödinger**

Environs of Karaköy village, 690m., OUFE 16593, 11 vii 2000, End., (LC).

***Anemone* L.**

***A. coronaria* L.**

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 16594, 18 iii 2001, Medit.

***Clematis* L.**

***C. cirrhosa* L.**

Environs of Kızıldamlar village, 810m., OUFE 16595, 06 ii 1999, Medit.

***C. vitalba* L.**

25-30 km of Bozüyük-Bilecik road, 450m., OUFE 7810, 29 v 1997.

***C. viticella* L.**

1-25 km of Bozüyük-Bilecik road, 710m., OUFE 7811, 19 ix 1997.

***Adonis* L.**

***A. annua* L.**

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7812, 13 vi 1997, Medit.

***A. flammea* Jacq.**

Environs of Şükranıye village, 700m., OUFE 16596, 04 v 2005.

***Ranunculus* L.**

***R. constantinopolitanus* (DC.) d'Urv.**

Environs of Demirköy village, 700m., OUFE 7814, 25 vii 1998.

***R. arvensis* L.**

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 7815, 02 xi 1997.

***Ficaria* Guett.**

***F. verna* subsp. *ficariiformis* (Rouy&Foucaud) B.Walln.**

Environs of Kurtköy village, 730m., OUFE 16597, 13 iv 2007.

***Thalictrum* L.**

***T. lucidum* L.**

Environs of Karaköy village, 600m., OUFE 16598, 24 vi 2010.

PAPAVERACEAE

Chelidonium L.

C. majus L.

1-25 km of Bozüyük-Bilecik road, 550m., OUFE 16599, 12 vi 2011, Eur.-Sib.

Glaucium Adans.

G. corniculatum (L.) Curtis

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16600, 13 vi 2004.

G. leiocarpum Boiss.

Environs of Aşağıköy village, 260m., OUFE 7816, 04 iv 1998.

Papaver L.

P. apokrinomenon Fedde

25-30 km of Bozüyük-Bilecik road, 360m., OUFE 7817, 04 vii 1997, End., (LC).

P. rhoeas L.

Environs of Karaköy village, 690m., OUFE 7819, 11 vii 1997.

P. virchowii Asch.&Sint. ex Boiss.

25-30 km of Bozüyük-Bilecik road, 230m., OUFE 7820, 21 v 1998, End., (CD).

Hypecoum L.

H. imberbe Sm.

Environs of Şükranıye village, 700m., OUFE 16601, 04 v 2011.

Corydalis Medik.

C. solida (L.) Clairv. subsp. *solida*

Environs of Karaköy village, 600m., OUFE 7821, 24 vi 1998.

Fumaria L.

F. officinalis L.

Environs of Süleymaniye village, 650m., OUFE 7822, 12 vi 1997, Medit.

BRASSICACEAE (CRUCIFERAE)

Brassica L.

B. elongata Ehrh.

25-30 km of Bozüyük-Bilecik road, 380m., OUFE 7823, 06 vi 1997.

Sinapis L.

S. arvensis L.

Environs of Şükranıye village, 700m., OUFE 16602, 04 v 2002.

Hirschfeldia Moench

H. incana (L.) Lagr.-Foss.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16603, 13 vi 2012.

Diplotaxis DC.

D. tenuifolia (L.) DC.

25-30 km of Bozüyük-Bilecik road, 350m., OUFE 16604, 14 v 2011.

Eruca Mill.

E. vesicaria (L.) Cav.

Environs of Şükranıye village, 700m., OUFE 7824, 04 v 1998.

Raphanus L.

R. raphanistrum L.

Environs of Küplü village, 240m., OUFE 16605, 04 v 2010.

Crambe L.

C. tataria Sebeok var. *tataria*

Environs of Hamidiye village, 920m., OUFE 16606, 04 v 2008.

Rapistrum Crantz

R. rugosum (L.) All.

Environs of Hamidiye village, 920m., OUFE 7825, 03 x 1998.

Lepidium L.

L. latifolium L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7826, 18 vii 1997.

L. draba L. subsp. *draba*

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7827, 18 vii 1997.

Iberis L.

I. simplex DC.

Environs of Demirköy village, 660m., OUFE 7828, 25 vii 1997.

Aethionema R. BR.

A. arabicum (L.) Andr. ex DC.

Environs of Alibeydüzü village, 940m. OUFE 16607, 12 v 2006.

Thlaspi L.

T. arvense L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 16608, 18 iii 2003.

Capsella Medik.

C. bursa-pastoris (L.) Medik.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7829, 13 vi 1997.

Boreava Jaub. et Spach

B. orientalis Jaub. et Spach

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 16609, 15 v 2001.

Neslia Desv.

N. paniculata subsp. *thracica* (Velen.) Bornm.

Environs of Küplü village, 290m., OUFE 7847, 11 vii 1997.

Fibigia Medik

F. clypeata (L.) Medik.

Environs of Süleymaniye village, 780m., OUFE 7830, 06 iix 1998.

F. eriocarpa (DC.) Boiss.

Environs of Yeniköy village, 300m., OUFE 7831, 22 iix 1998.

Alyssum L.

A. desertorum Stapf var. *desertorum*

Environs of Kızıldamlar village, 810m., OUFE 7832, 06 iix 1998.

A. minutum Patrin ex DC.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7833, 18 vii 1997.

A. simplex Rudolph

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7834, 06 iix 1998.

A. strigosum Banks et Sol. subsp. *strigosum*

Environs of Akçapınar village, 900m., OUFE 7835, 03 x 1998.

A. obtusifolium Steven ex DC.

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 7837, 19 ix 1997.

A. sibiricum Willd.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 16610, 27 vi 2000.

Clypeola L.

C. jonthlaspi L.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16611, 22 v 2010.

Draba L.

D. brunifolia Stev. subsp. *olympica* (DC.) Coode&Cullen

Environs of Kızıltepe village, 910m., OUFE 16612, 04 v 2010.

Erophila DC.

E. verna (L.) DC. subsp. *verna*

Environs of Küplü village, OUFE 16613, 300m., 04 v 2009.

Arabis L.

A. alpina L. subsp. *caucasica* (Willd.) Briq.

Environs of Kızıldamlar village, OUFE 16614, 810m., 06 iix 2007.

A. nova Vill.

Environs of Kurtköy village, 560m., OUFE 7838, 18 vii 1997.

Turritis L.

T. glabra L.

Environs of Hamidiye village, 920m., OUFE 16615, 04 v 2003.

T. laxa (Sm.) Hayek

Environs of Hamidiye village, 920m., OUFE 16616, 04 v 2002.

Rorippa Scop.

R. sylvestris (L.) Besser

Environs of Ahmetpınar village, 400m., OUFE 7839, 18 vii 1997.

Cardamine L.

C. bulbifera (L.) Crantz

Environs of Kurtköy village, 740m., OUFE 7840, 06 iix 1998, Eur.-Sib.

C. hirsuta L.

Environs of Aşağıarmutlu village, 890m., OUFE 16617, 04 iv 2010.

Aubrieta Adans.

A. deltoidea (L.) DC.

Environs of Hamidiye village, 920m., OUFE 16618, 04 v 2009.

Matthiola R. Br.

M. longipetala (Vent.) DC. subsp. *bicornis* (Sm.) P.W. Ball

Environs of Aşağıköy village, 310m., OUFE 16619, 15 vi 2010.

Malcolmia R. Br.

M. africana (L.) R. Br.

Environs of Hamidiye village, 920m., OUFE 16620, 04 v 2011.

Erysimum L.

E. crassipes Fisch. et Mey.

Environs of Süleymaniye village, 730m., OUFE 7843, 04 v 1998.

Sisymbrium L.

S. altissimum L.

Environs of Akçapınar village, 870m., OUFE 16621, 04 v 2008.

Descurainia Webb et Berth.

D. sophia (L.) Webb ex Prantl

Environs of Hamidiye village, 920m., OUFE 16622, 04 v 2005.

Camelina Crantz

C. rumelica Velen.

Environs of Süleymaniye village, 750m., OUFE 7844, 10 ix 1997.

C. microcarpa Andrz. ex DC.

Environs of Kızıldamlar village, 810m., OUFE 7845, 06 iix 1998.

RESEDACEAE

Reseda L.

R. lutea L. var. *lutea*

Environs of Demirköy village, 560m., OUFE 7846, 06 iix 1998.

CISTACEAE

Cistus L.

C. laurifolius L.

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 16623, 01 v 2000, Medit.

C. creticus L.

Environs of Küplü village, 290m., OUFE 7847, 11 vii 1997, Omni Medit.

Helianthemum Adans.

H. nummularium (Cav.) Losa&Rivas Goday subsp. ***nummularium***

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7848, 22 v 1997.

Fumana Spach

F. aciphylla Boiss.

Environs of Çamyayla village, 810m., OUFE 16624, 24 v 2009, Ir. Tur.

VIOLACEAE

Viola L.

V. odorata L.

Environs of Kızıldamlar village, 630m., OUFE 7850, 12 vii 1997.

V. occulta Lehm.

Environs of Alibeydüzü village, 940m., OUFE 16625, 12 v 2010.

POLYGALACEAE

Polygala L.

P. pruinosa Boiss. subsp. ***pruinosa***

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7852, 18 vii 1997.

P. supina Schreb.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7853, 18 vii 1997.

P. monspeliaca L.

Environs of Küplü village, 240m., OUFE 7854, 04 v 1997, Medit.

CARYOPHYLLACEAE

Arenaria L.

A. serpyllifolia L.

Environs of Karaköy village, 580m., OUFE 16626, 12 vi 1999.

Minuartia L.

M. hamata (Hausskn.) Mattf.

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 7855, 04 vii 1997.

M. anatolica (Boiss.) Woronow var. ***polymorpha***

Environs of Karaköy village, 690m., OUFE 7856, 11 vii 1997.

Stellaria L.

S. media (L.) Vill. subsp. *media*

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 16627, 01 iix 2011.

Cerastium L.

C. banaticum (Rochel) Heuff.

Environs of Kurtköy village, 310m., OUFE 7857, 02 xi 1997.

C. perfoliatum L.

Environs of Aşağıarmutlu village, 890m., OUFE 7858, 04 iv 1998.

Holosteum L.

H. umbellatum L. var. *umbellatum* L.

Environs of Hamidiye village, 920m., OUFE 16628, 04 v 2010.

Moenchia Ehrh.

M. mantica (L.) Bartl. subsp. *mantica*

Environs of Küplü village, 300m., OUFE 16629, 04 v 2011.

Telephium L.

T. imperati L. subsp. *orientale* (Boiss.) Nyman

Environs of Ahmetpınar village, 440m., OUFE 7859, 30 v 1998.

Dianthus L.

D. micranthus Boiss. et Heldr.

Environs of Çamyayla village, 810m., OUFE 7860, 19 ix 1997.

D. zonatus Fenzl var. *zonatus*

Environs of Karaköy village, 800m., OUFE 16630, 18 vii 2012.

D. cruentus Griseb.

Environs of Karaköy village, 720m., OUFE 16631, 11 vii 2010.

D. cibrarius Clem.

Environs of Alibeydüzü village, 940m., OUFE 7862, 26 ix 1998, End., (NT).

Velezia L.

V. rigida L.

Environs of Karaköy village, 700m., OUFE 16632, 11 vii 2008.

Saponaria L.

S. glutinosa M.Bieb.

Environs of Akçapınar village, 900m., OUFE 16633, 03 v 2010.

S. kotschy Boiss.

Environs of Alibeydüzü village, 940m., OUFE 16634, 26 vi 2010, End., (LC).

Gypsophila L.

G. pilosa Huds.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 16635, 27 vi 2010, Ir.-Tur.

Bolanthus (Ser.) Eichb.

B. minuartioides (Jaub. et Spach) Hub.-Mor.

Environs of Akçapınar village, 900m., OUFE 16636, 18 vii 2009, End., (LC).

Silene L.

S. italica (L.) Pers.

25-30 km of Bozüyük-Bilecik road, 330m., OUFE 7863, 27 vi 1997.

S. latifolia Poir.

Environs of Karaköy village, 690m., OUFE 16637, 11 vii 2001.

S. behen L.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7864, 01 iix 1997.

S. dichotoma Ehrh. subsp. *sibthorpiana* (Reichb.) Rech.

25-30 km of Bozüyük-Bilecik road, 320m., OUFE 16638, 26 vii 2010.

S. conica L. subsp. *subconica* (Friv.) Gavioli

Environs of Alibeydüzü village, 940m., OUFE 16639, 26 vii 2010.

S. conoidea L.

Environs of Karaköy village, 700m., OUFE 16640, 11 vii 2010.

Agrostemma L.

A. githago L.

Environs of Demirköy village, 690m., OUFE 16641, 25 vii 2010.

Herniaria L.

H. hirsuta L.

1-25 km of Bozüyük-Bilecik road, 870m., OUFE 16642, 12 iv 2007.

Paronychia Mill.

P. carica Chaudhri var. *carica*

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16643, 06 vi 2001.

Scleranthus L.

S. annuus L. subsp. *verticillatus* (Tausch) Arcang.

Environs of Kurtköy village, 715m., OUFE 16644, 24 v 2000.

POLYGONACEAE

Polygonum L.

P. cognatum Meisn.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 7865, 27 vi 1997.

P. aviculare L.

25-30 km of Bozüyük-Bilecik road, 570m., OUFE 7866, 20 vi 1997.

P. bellardii All.

Environs of Aşağıarmutlu village, 890m., OUFE 7867, 04 iv 1998.

Rumex L.

***R. acetosella* L.**

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7868, 18 vii 1997.

***R. crispus* L.**

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7869, 22 v 1997.

AMARANTHACEAE

Chenopodium L.

***C. foliosum* Asch.**

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7870, 18 vii 1997.

TAMARICACEAE

Tamarix L.

***T. smyrnensis* Bunge**

Environs of Aşağıköy village, 320m., OUFE 7871, 26 ix 1998.

HYPERICACEAE (GUTTIFERAE)

Hypericum L.

***H. calycinum* L.**

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16645, 13 vi 2010, Eur.-Sib.

***H. perforatum* L.**

Environs of Süleymaniye village, 700m., OUFE 7872, 24 iix 1997, Medit.

***H. origanifolium* Willd.**

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 7873, 24 iix 1997.

***H. aviculariifolium* Jaub. et Spach subsp. *depilatum* (Frey et Bornm.) Robson
var. *depilatum***

Environs of Karaköy village, 720m., OUFE 16645, 11 vii 2010, End., (LC), Ir.-
Tur.

***H. perforatum* L.**

Environs of Çamyayla village, 810m., OUFE 7874, 19 ix 1997.

MALVACEAE

Hibiscus L.

***H. trionum* L.**

Environs of Kurtköy village, 740m., OUFE 16646, 06 iix 2009.

Malva L.

***M. sylvestris* L.**

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7875, 06 iix 1998.

M. neglecta Wallr.

Environs of Küplü village, 300m., OUFE 16647, 23 iix 2008.

Alcea L.

A. pallida (Willd.) Waldst.&Kit.

25-30 km of Bozüyük-Bilecik road, 350m., OUFE 7877, 14 v 1998.

Althaea L:

A. hirsuta L.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7876, 22 v 1997.

LINACEAE

Linum L.

L. nodiflorum L.

Environs of Çamyayla village, 810m., OUFE 7878, 19 iix 1997, Medit.

L. hirsutum L. subsp. *anatolicum* (Boiss.) Hayek var. *anatolicum*

25-30 km of Bozüyük-Bilecik road, 570m., OUFE 16648, 20 vi 2010, End., (LC),
Ir.-Tur.

L. bienne Mill.

Environs of Ahmetpınar village, 410m., OUFE 7879, 25 vii 1997, Medit.

GERANIACEAE

Geranium L.

G. lucidum L.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7880, 01 iix 1997.

G. purpureum Vill.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7881, 27 vi 1997.

G. robertianum L.

Environs of Kızıldamlar village, 810m., OUFE 7882, 06 iix 1998.

G. rotundifolium L.

Environs of Yeniköy village, 300m., OUFE 7883, 22 iix 1998.

G. dissectum L.

Environs of Bekdemir village, 230m., OUFE 7884, 24 v 1997.

G. asphodeloides Burm.f. subsp. *asphodeloides*

1-25 km of Bozüyük-Bilecik road, 620m., OUFE 7887, 08 v 1997, Eux.

G. pyrenaicum Burm.f.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 16649, 18 vii 2005.

Erodium L' Herit.

E. ciconium (L.) L'Hér.

Environs of Alibeydüzü village, 940m., OUFE 16650, 12 v 2006.

E. absinthoides Willd. subsp. *absinthoides*

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 16651, 28 vi 2008, End., (LC),
Ir.-Tur.

E. cicutarium (L.) L'Hér. subsp. *cicutarium*

Environs of Alibeydüzü village, 940m., OUFE 7890, 26 ix 1998.

RUTACEAE

Ruta L.

R. montana (L.) L.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7892, 18 vii 1997.

R. thesioides Fisch. ex DC.

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 7894, 04 vii 1997.

SIMAROUBACEAE

Ailanthus Desf.

A. altissima (Mill.) Swingle

25-30 km of Bozüyük-Bilecik road, 600m., OUFE 7895, 12 ix 1997.

VITACEAE

Vitis L.

V. vinifera L.

Environs of Karaköy village, 580m., OUFE 7896, 12 vi 1998.

RHAMNACEAE

Paliurus Mill.

P. spina-christi Mill.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7897, 22 v 1997.

Rhamnus L.

R. rhodopea Velen.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7898, 01 iix 1997.

ANACARDIACEAE

Rhus L.

R. coriaria L.

Environs of Bekdemir village, 220m., OUFE 7900, 23 iix 1998.

Pistacia

P. terebinthus L. subsp. *palaestina* (Boiss.) Engler

Environs of Aşağıarmutlu village, 890m., OUFE 16651, 04 iv 2009, Medit.

CELASTRACEAE

Euonymus L.

E. latifolius (L.) Mill. subsp. *latifolius*

1-25 km of Bozüyük-Bilecik road, 870m., OUFE 7901, 12 iv 1997, Eur.-Sib.

FABACEAE (LEGUMINOSAE)

Cytisus L.

C. austriacus L.

Environs of Kızıltepe village, 910m., OUFE 16652, 24 v 2007, Eur.-Sib.

Genista L.

G. tinctoria L.

Environs of Aşağıarmutlu village, 890m., OUFE 7902, 04 iv 1998, Eur.-Sib.

G. lydia Boiss. var. *lydia* Griseb.

Environs of Kızıltepe village, 910m., OUFE 7903, 04 v 1998, Medit.

Lotononis Eckl. et Zeyh.

L. genistoides (Fenzl) Benth.

Environs of Kurtköy village, 740m., OUFE 7904, 06 iix 1998, Ir.-Tur.

Argyrolobium Eckl. et Zeyh.

A. biebersteinii P.W.Ball

25-30 km of Bozüyük-Bilecik road, 220m., OUFE 7905, 13 v 1997.

Robinia L.

R. pseudoacacia L.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7906, 06 vi 1997, Culture.

Galega L.

G. officinalis L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 7907, 12 ix 1997, Eur.-Sib.

Astragalus L.

A. glycyphyllos L. subsp. *glycyphyllos*

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 16653, 18 vii 2005, Eur.-Sib.

A. angustiflorus K. Koch subsp. *anatolicus* (Boiss.) D.F.Chamb.

Environs of Alibeydüzü village, 940m., OUFE 16654, 26 vi 2004, End., (LC), E.
Medit.

A. macrocephalus Willd. subsp. *macrocephalus*

- Tur. Environs of Demirköy village, 690m., OUFE 16655, 25 vii 2001, End., (NT), Ir.-
A. lydius Boiss.
- Tur. Environs of Akçapınar village, 900m., OUFE 16656, 24 vii 2011, End., (LC) Ir.-
Tragacantha Mill.
T. elongata (Willd.) Kuntze
- Environs of Çamyayla village, 810m., OUFE 7910, 19 ix 1997, Ir.-Tur.
Bituminaria C.H.Stirt.
B. bituminosa (L.) C.H.Stirt.
1-25 km of Bozüyük-Bilecik road, 660m., OUFE 7911, 25 vii 1997, Medit.
Vicia L.
V. cassubica L.
- Environs of Demirköy village, 690m., OUFE 7912, 25 vii 1997, Eur.-Sib.
V. tenuifolia subsp. **dalmatica** (A.Kern.) Greuter
- Environs of Hamidiye village, 920m., OUFE 7913, 04 v 1998.
V. grandiflora Scop. var. **grandiflora**
- Environs of Süleymaniye village, 780m., OUFE 7914, 06 iix 1998.
Lathyrus L.
L. aureus (Steven) D.Brandza
- Environs of Karaköy village, 600m., OUFE 7915, 24 vi 1998, Eux.
L. digitatus (M.Bieb.) Fiori
- Environs of Kızıldamlar village, 810m., OUFE 7916, 06 iix 2010, E. Medit.
L. undulatus Boiss.
- Sib. Environs of Kurtköy village, 715m., OUFE 7917, 12 iv 1998, End., (VU), Eur.-
L. nissolia L.
- Environs of Demirköy village, 650m., OUFE 7919, 01 iv 1997.
Pisum L.
P. sativum L. subsp. **elatius** (M.Bieb.) Asch.&Graebn. var. **elatius**
1-25 km of Bozüyük-Bilecik road, 600m., OUFE 7920, 29 iv 1997, Medit.
Trifolium L.
T. repens L. var. **repens**
- Environs of Akçapınar village, 900m., OUFE 7921, 03 x 1998.
T. hybridum L. var. **hybridum**
- Environs of Alibeydüzü village, 940m., OUFE 7922, 26 ix 1998.
T. campestre Schreb.
Environs of Küplü village, 290m., OUFE 16657, 22 iii 2000.

T. nigrescens Viv. subsp. ***petrisavii*** (Clementi) Holmboe

1-25 km of Bozüyük-Bilecik road, 620m., OUFE 7923, 08 v 1997.

T. physodes M.Bieb. var. ***physodes***

Environs of Karaköy village, 580m., OUFE 7924, 28 vii 1998, Medit.

T. pratense L. var. ***pratense*** Boiss. et Bal.

Environs of Kızıltepe village, 910m., OUFE 7925, 04 v 1998.

T. arvense L. var. ***arvense***

Environs of Aşağıköy village, 260m., OUFE 16658, 04 iv 2010.

T. hirtum All.

Environs of Aşağıarmutlu village, 890m., OUFE 7928, 04 iv 1998, Medit.

Melilotus L.

M. officinalis (L.) Pall.

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 7929, 27 iv 1997.

M. alba Desr.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 7930, 27 vi 1997.

Trigonella L.

T. cretica (L.) Boiss.

25-30 km of Bozüyük-Bilecik road, 350m., OUFE 16659, 14 v 2003, End., (NT),
E. Medit.

T. lunata Boiss.

Environs of Süleymaniye village, 720m., OUFE 16660, 25 v 2004, Ir.-Tur.

T. spruneriana Boiss. var. ***spruneriana***

Environs of Bekdemir village, 220m., OUFE 7932, 26 iix 1997, Ir.-Tur.

Medicago L.

M. monantha (C.A.Mey.) Trautv. subsp. ***monantha***

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 16661, 27 vi 2008, Ir.-Tur.

M. radiata L.

Environs of Kurtköy village, 740m., OUFE 7933, 06 iix 1998, Ir.-Tur.

M. minima (L.) L. var. ***minima***

Environs of Küplü village, 300m., OUFE 16662, 22 v 2008.

M. lupulina L.

Environs of Karaköy village, 800m., OUFE 16663, 18 vii 2009.

M. sativa L. subsp. ***sativa***

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7934, 01 iix 1997.

Dorycnium Mill.

D. graecum (L.) Ser.

Environs of Yeniköy village, 320m., OUFE 7936, 25 v 1998, Eux.

D. pentaphyllum Scop. subsp. *herbaceum* (Vill.) Rouy

Environs of Demirköy village, 650m., OUFE 7937, 01 iix 1997.

Lotus L.

L. corniculatus L. var. *corniculatus* (Bieb.) Arc.

Environs of Kızıldamlar village, 810m., OUFE 7938, 06 iix 1998.

Coronilla L.

C. scorpioides (L.) Koch

25-30 km of Bozüyük-Bilecik road, 570m., OUFE 16664, 20 vi 2009.

Hedysarum L.

H. varium Willd.

Environs of Alibeydüzü village, 940m., OUFE 16665, 26 vi 2010, Ir.-Tur.

Onobrychis Adans.

O. caput-galli (L.) Lam.

Environs of Kızıltepe village, 910m., OUFE 7940, 04 v 1998.

O. hypargyrea Boiss.

Environs of Karaköy village, 580m., OUFE 16666, 24 iv 2010.

Securigera DC.

S. varia (L.) Lassen

Environs of Kızılkaplan village, 400m., OUFE 16667, 10 iix 2009.

ROSACEAE

Prunus L.

P. amygdalus Batsch

Environs of Demirköy village, 650m., OUFE 7948, 01 iix 1997, Culture.

P. spinosa L. subsp. *dasyphylla* (Schur) Domin

Environs of Karaköy village, 580m., OUFE 7943, 29 v 1997.

P. x domestica L.

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 7944, 26 ix 1998.

Cerasus Duhamel

C. avium (L.) Moench

Environs of Küplü village, 290m., OUFE 7945, 26 ix 1998, Culture.

Filipendula Mill.

F. vulgaris Moench

Environs of Aşağıköy village, 310m., OUFE 16668, 15 vi 2007, Eur.-Sib.

Rubus L.

R. ulmifolius Schott subsp. *sanctus* (Schreb.) Sudre

Environs of Demirköy village, 660m., OUFE 7949, 25 vii 1997.

R. tomentosus Borkh. var. *canescens* (DC.) Wirtg.

Environs of Karaköy village, 570m., OUFE 7950, 06 iix 1998.

Potentilla L.

P. recta L.

Environs of Küplü village, 300m., OUFE 7951, 04 v 1998.

P. reptans L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 16669, 18 vii 2006.

Fragaria L.

F. vesca L.

Environs of Karaköy village, 560m., OUFE 16670, 23 iv 2008.

Geum L.

G. urbanum L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 16671, 18 vii 2008, Eur.-Sib.

Agrimonia L.

A. eupatoria L.

1-25 km of Bozüyük-Bilecik road, 620m., OUFE 7952, 08 v 1997.

Poterium L.

P. lasiocarpum Boiss.&Hausskn.

Environs of Kızıldamlar village, 810m., OUFE 16672, 06 iix 2009.

Rosa L.

R. foetida Herrm.

Environs of Bekdemir village, 220m., OUFE 7953, 28 vi 1998, Ir.-Tur.

R. turcica Rouy

1-25 km of Bozüyük-Bilecik road, 550m., OUFE 7954, 12 vi 1998.

R. canina L.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7955, 18 vii 1997.

Cotoneaster Medik.

C. nummularius Fisch.&C.A. Mey.

Environs of Süleymaniye village, 720m., OUFE 16673, 25 v 2010.

Crataegus L.

C. orientalis Pall. ex Bieb. var. *orientalis*

Environs of Karaköy village, 800m., OUFE 16674, 18 vii 2009.

C. monogyna Jacq. subsp. *monogyna*

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 7956, 04 v 1998.

Malus Mill.

M. domestica Borkh.

Environs of Karaköy village, 580m., OUFE 7957, 29 v 1997, Culture.

Pyrus L.

P. communis L. subsp. *communis*

Environs of Bekdemir village, 220m., OUFE 7958, 19 ix 1997, E. Medit.

CUCURBITACEAE

Ecballium A. Rich.

E. elaterium (L.) A.Rich.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 16675, 24 ix 2008, Medit.

LYTHRACEAE

Lythrum L.

L. salicaria L.

Environs of Alibeydüzü village, 940m., OUFE 16676, 26 v 2011, Eur.-Sib.

ONAGRACEAE

Epilobium L.

E. angustifolium L.

Environs of Alibeydüzü village, 940m., OUFE 16677, 26 vii 2011.

E. hirsutum L.

Environs of Karaköy village, 290m., OUFE 7959, 11 vii 1997.

E. parviflorum Schreb.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 7960, 27 vi 1997.

CRASSULACEACEAE

Umbilicus DC.

U. luteus (Huds.) Webb&Berthel.

Environs of Kızıldamlar village, 810m., OUFE 16678, 06 iix 2012.

Sedum L.

S. acre L.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 7963, 18 vii 1997.

S. album L.

Environs of Çamyayla village, 810m., OUFE 7964, 19 ix 1997.

UMBELLIFERAE (APIACEAE)

Sanicula L.

S. elata Buch.-Ham. ex D. Don.

Environs of Yeniköy village, 300m., OUFE 7965, 22 iix 1998, Eur.-Sib.

***Eryngium* L.**

***E. campestre* L. var. *virens* (Link) Weins**

Environs of Alibeydüzü village, 940m., OUFE 7966, 26 ix 1998.

***Echinophora* L.**

***E. tenuifolia* L. subsp. *sibthorpiana* (Guss.) Tutin**

Environs of Kızılkaplan village, 310m., OUFE 16679, 10 ix 2010, Ir.-Tur.

***Chaerophyllum* L.**

***C. byzantinum* Boiss.**

Environs of Kızıltepe village, 1000m., OUFE 16680, 19 ix 2009, Eur.-Sib.

***Anthriscus* Pers.**

***A. nemorosa* (M.Bieb.) Spreng.**

Environs of Akçapınar village, 900m., OUFE 16681, 03 v 2000.

***Scandix* L.**

***S. stellata* Banks&Sol.**

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7967, 22 v 1997.

***S. pecten-veneris* L.**

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 7968, 06 vi 1997.

***Smyrnum* L.**

***S. perfoliatum* L.**

Environs of Küplü village, 300m., OUFE 7969, 22 v 1997.

***Pimpinella* L.**

***P. lithophila* Schischk.**

Environs of Akçapınar village, 900m., OUFE 7971, 03 x 1998.

***Oenanthe* L.**

***Oe. silaifolia* Bieb.**

Environs of Karaköy village, 800m., OUFE 7972, 18 vii 1997.

***Conium* L.**

***C. maculatum* L.**

Environs of Demirköy village, 660m., OUFE 16682, 25 vi 2003.

***Bupleurum* L.**

***B. rotundifolium* L.**

Environs of Kızıltepe village, 910m., OUFE 16683, 04 vii 2001.

***B. sulphureum* Boiss.&Balansa**

Environs of Kurtköy village, 740m., OUFE 16684, 06 iix 2002, End., (LC), Ir.-Tur.

***Falcaria* Fabr.**

***F. vulgaris* Bernh.**

Environs of Küplü village, 280m., OUFE 16685, 18 iix 2007.

Ferulago W. Koch

F. macrosciadea Boiss.&Balansa

Environs of Hamidiye village, 920m., OUFE 7973, 04 v 1998, End., (LC), Medit.

Malabaila Hoffm.

M. secacul Banks&Sol.

Environs of Demirköy village, 700m., OUFE 16686, 25 vii 2004.

Heracleum L.

H. platytaenium Boiss.

Environs of Karaköy village, 690m., OUFE 16687, 11 vii 2009, End., (LC), Eur.-
Sib.

Tordylium L.

T. maximum L.

Environs of Akçapınar village, 900m., OUFE 7975, 03 x 1998.

Torilis Adans.

T. arvensis (Huds.) Link subsp. *arvensis*

Environs of Aşağıarmutlu village, 780m., OUFE7976, 06 iix 1998.

T. leptophylla (L.) Rchb. f.

Environs of Kızılkaplan village, 400m., OUFE 7977, 10 iix 1997.

Turgenia Hoffm.

T. latifolia (L.) Hoffm.

Environs of Küplü village, 240m., OUFE 16688, 04 v 2010.

Daucus L.

D. carota L.

Environs of Kurtköy village, 320m., OUFE 7978, 06 iix 1998.

Artemisia L.

A. squamata L.

Environs of Alibeydüzü village, 940m. OUFE 16689, 12 v 2010.

ARALIACEAE

Hedera L.

H. helix L.

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 7979, 02 xi 1997.

CORNACEAE

Cornus L.

C. mas L.

Environs of Kurtköy village, 715m., OUFE 7980, 24 v 1997.

ADOXACEAE

Sambucus L.

S. ebulus L.

Environs of Aşağıarmutlu village, 890m., OUFE 7981, 04 vii 1998, Eur.-Sib.

CAPRIFOLIACEAE

Valeriana L.

V. dioscoridis Sm.

Environs of Aşağıarmutlu village, 890m., OUFE 7982, 04 vii 1998, E. Medit.

Valerianella Mill.

V. coronata DC.

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 16690, 27 vii 2011.

V. turgida Betcke

Environs of Kızıltepe village, 910m., OUFE 16691, 04 v 2012.

Dipsacus L.

D. laciniatus L.

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 7983, 29 v 1997.

Knautia L.

K. orientalis L.

Environs of Çamyayla village, 810m., OUFE 7986, 19 ix 1997, E. Medit.

Scabiosa L.

S. atropurpurea L. subsp. *maritima* (L.) Arc.

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 7984, 15 v 1997.

Pteroccephalus Vaill. ex Adanson

P. plumosus Coult.

Environs of Yeniköy village, 300m., OUFE 16692, 22 iix 2003.

ASTERACEAE (COMPOSITAE)

Ceratocephalus Moench.

C. falcatus (L.) Pers.

Environs of Şükranıye village, 700m., OUFE 16693, 04 v 2000.

Xanthium L.

X. spinosum L.

Environs of Çamyayla village, 810m., OUFE 7988, 24 v 1998.

X. strumarium L. subsp. *strumarium*.

Environs of Çamyayla village, 810m., OUFE 7989, 19 ix 1997.

Inula L.

I. ensifolia L.

Environs of Yeniköy village, 300m., OUFE 7991, 22 iix 1998, Eur.-Sib.

I. heterolepis Boiss.

Environs of Hamidiye village, 920m., OUFE 7992, 04 v 1998, E. Medit.

Pulicaria Gaertner

P. dysenterica (L.) Bernh.

Environs of Yeniköy village, 300m., OUFE 7993, 22 iix 1998.

Filago L.

F. pyramidata L.

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 16694, 15 v 2003.

Bombycilaena (DC.) Smolj.

B. erecta (L.) Smoljan.

Environs of Hamidiye village, 920m., OUFE 16695, 04 v 2004.

Erigeron L.

E. acer L. subsp. *acer*

Environs of Kurtköy village, 740m., OUFE 7996, 06 iix 1998.

Conyza Less.

C. canadensis (L.) Cronquist

Environs of Yeniköy village, 300m., OUFE 7997, 22 iix 1998.

Doronicum L.

D. orientale Hoffm.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 7998, 27 vi 1997.

Senecio L.

S. leucanthemifolius Poir. subsp. *vernalis* (Waldst.&Kit.) Greuter

Environs of Aşağıarmutlu village, 890m., OUFE 7999, 04 iv 1998.

Tussilago L.

T. farfara L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8000, 24 v 1998, Eur.-Sib.

Eupatorium L.

E. cannabinum L.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 8001, 13 vi 1997, Eur.-Sib.

Anthemis L.

A. cretica L. subsp. *anatolica*. (Boiss.) Grierson

Environs of Kurtköy village, 740m., OUFE 8002, 06 iix 1998.

A. tinctoria L. var. *tinctoria*

- 1-25 km of Bozüyük-Bilecik road, 600m., OUFE 16696, 29 v 2006.
A. tinctoria L. var. *pallida* DC.
Environs of Çamyayla village, 810m., OUFE 8004, 19 ix 1997.
A. wiedemanniana Fish. et Mey.
1-25 km of Bozüyük-Bilecik road, 560m., OUFE 8005, 04 vii 1997, End., (LC).
Achillea L.
A. santolinoides Lag. subsp. *wilhelmsii* (K.Koch) Greuter
1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8006, 18 vii 1997, Ir.-Tur.
A. nobilis L. subsp. *neilreichii* (A.Kern.) Velen.
Environs of Kızıldamlar village, 810m., OUFE 16697, 06 iix 2008, Eur.-Sib.
A. biebersteinii Afan.
Environs of Akçapınar village, 900m., OUFE 16698, 18 vii 2001, Ir.-Tur.
Arctium L.
A. minus (Hill) Bernh. subsp. *minus*
Environs of Süleymaniye village, 780m., OUFE 8008, 06 iix 1998, Eur.-Sib.
Onopordum L.
O. tauricum Willd.
Environs of Yeniköy village, 320m., OUFE 16699, 30 vii 2001, Eur.-Sib.
Cirsium Mill.
C. vulgare (Savi) Ten.
Environs of Alibeydüzü village, 940m., OUFE 8011, 26 ix 1998.
C. hypoleucum DC.
1-25 km of Bozüyük-Bilecik road, 620m., OUFE 8012, 08 v 1997.
C. arvense (L.) Scop.
25-30 km of Bozüyük-Bilecik road, 330m., OUFE 16700, 01 iix 2001.
Picnomon Adans.
P. acarna (L.) Cass.
Environs of Şükranıye village, 725m., OUFE 16701, 19 ix 2003, Medit.
Carduus L.
C. nutans L. subsp. *trojanus* P.H. Davis
1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8013, 18 vii 1997, End., (CD).
C. arabicus Jacq.
Environs of Kurtköy village, 730m., OUFE 16702, 24 v 2004.
Tyrimnus Cass.
T. leucographus (L.) Cass.
1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16703, 13 vi 2007, Medit.
Jurinea Cass.

- J. pontica* Hausskn.&Freyn ex Hausskn.
Tur. Environs of Bekdemir village, 290m., OUFE 16704, 06 iix 2009, End., (LC), Ir.-
- Centaurea L.**
C. wiedemanniana Fisch.&C.A.Mey.
1-25 km of Bozüyük-Bilecik road, 580m., OUFE 8017, 13 vi 1997, End., (VU).
C. virgata Lam.
Environs of Kurtköy village, 740m., OUFE 16705, 06 iix 2010, Ir.-Tur.
C. thracica (Janka) Janka ex Gugler
1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8018, 18 vii 1997,
C. solstitialis L. subsp. *solstitialis*
Environs of Süleymaniye village, 780m., OUFE 8019, 06 iix 1998.
C. iberica Trevir. ex Spreng.
1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8020, 27 vi 1997.
C. urvillei DC. subsp. *urvillei*
Environs of Kurtköy village, 740m., OUFE 8021, 06 iix 1998,
C. urvillei DC. subsp. *stepposa*
Medit. Environs of Karaköy village, 800m., OUFE 16706, 18 vii 2008, End., (LC), E.
- C. depressa* M.Bieb.
25-30 km of Bozüyük-Bilecik road, 450m., OUFE 16707, 29 v 2007.
- Crupina** (Pers.) DC.
C. vulgaris Pers. ex Cass.
Environs of Hamidiye village, 920m., OUFE 8022, 04 v 1998.
- Carthamus L.**
C. dentatus Vahl
Environs of Süleymaniye village, 780m., OUFE 16708, 06 iix 2001.
- Carlina L.**
C. vulgaris L.
Environs of Karaköy village, 800m., OUFE 8023, 18 vii 1997.
- Xeranthemum L.**
X. annuum. L.
1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8024, 24 v 1998.
- Echinops L.**
E. ritro L.
Environs of Aşağıarmutlu village, 890m., OUFE 8027, 04 iv 1998.
E. microcephalus Sm.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8025, 12 vi 1998.

Scolymus L.

S. hispanicus L.

Environs of Çamyayla village, 810m., OUFE 16709, 19 iix 2010, Medit.

Cichorium L.

C. intybus L.

Environs of Yeniköy village, 300m., OUFE 8029, 22 iix 1998.

Scorzonera L.

S. laciniata L. subsp. *lacinata*

Environs of Bekdemir village, 230m., OUFE 8031, 06 iix 1998.

S. cana (C.A.Mey.) O.Hoffm. var. *cana*

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 16710, 28 vi 2004.

S. eriophora DC.

Environs of Hamidiye village, 920m., OUFE 16711, 04 v 2004, End., (LC).

Tragopogon L.

T. porrifolius L. subsp. *longirostris* (Sch.Bip.) Greuter

Environs of Karaköy village, 580m., OUFE 8032, 24 v 1998.

Leontodon L.

L. crispus Vill.

Environs of Karaköy village, 290m., OUFE 16712, 11 vii 2009.

Picris L.

P. angustifolia DC.

Environs of Alibeydüzü village, 940m., OUFE 16713, 26 ix 2007, Eur.-Sib.

Sonchus L.

S. asper (L.) Hill subsp. *glaucescens* (Jord.) Ball ex Ball

Environs of Kızıltepe village, 910m., OUFE 8034, 24 v 1998.

Hieracium L.

H. pannosum Boiss. subsp. *bornmuelleri* (Freyn)

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 16714, 18 vii 2000, End., (LC).

Pilosella Hill

P. hoppeana (Schultes) C.H. et F.W. Schultz subsp. *macrantha* (Ten.)
S.Bräut.&Greuter

Environs of Kızıldamlar village, 630m., OUFE 16715, 12 vii 2001.

Mycelis Cass.

M. muralis (L.) Dumort.

Environs of Aşağıköy village, 260m., OUFE 8036, 10 x 1998, Eur.-Sib.

Lapsana L.

L. communis L. subsp. *adenophora* (Boiss.) Rech.f.

Environs of Çamyayla village, 810m., OUFE 16716, 19 ix 2012.

Taraxacum Wiggers

T. serotinum (Waldst.&Kit.) Poir.

1-25 km of Bozüyük-Bilecik road, 810m., OUFE 8037, 10 v 1998.

Chondrilla L.

C. juncea L. var. *juncea*

Environs of Karaköy village, 600m., OUFE 8038, 24 v 1998.

Crepis L.

C. commutata Greuter

Environs of Süleymaniye village, 730m., OUFE 16717, 04 v 2010.

CAMPANULACEAE

Campanula L.

C. lyrata Lam. subsp. *lyrata*

Environs of Hamidiye village, 920m., OUFE 8039, 04 v 1998, End., (LC), Medit.

C. rapunculoides L. subsp. *cordifolia* (K.Koch) Damboldt

Environs of Süleymaniye village, 780m., OUFE 16718, 06 iix 2008.

C. olympica Boiss.

Environs of Kurtköy village, 750m., OUFE 8040, 12 iv 1998.

Asyneuma Griseb. et Schenk

A. limonifolium (L.) Janch. subsp. *limonifolium*

Environs of Karaköy village, 600m., OUFE 16719, 24 v 2000.

Legousia Durande

L. speculum-veneris (L.) Durande ex Vill.

Environs of Akçapınar village, 870m., OUFE 16720, 04 v 2010, Medit.

L. pentagonia (L.) Thell.

Environs of Karaköy village, 720m., OUFE 8041, 11 vii 1997, E. Medit.

ERICACEAE

Erica L.

E. arborea L.

Environs of Karaköy village, 800m., OUFE 16721, 18 vii 2010.

Arbutus L.

A. unedo L.

Environs of Ahmetpınar village, 400m., OUFE 16722, 03 x 2005.

PRIMULACEAE

Primula L.

P. vulgaris Huds. subsp. *vulgaris*

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 16723, 24 v 2007, Eur.-Sib.

Cyclamen L.

C. coum Mill. var. *coum*

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8042, 01 iix 1997.

Lysimachia L.

L. vulgaris L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8043, 24 ix 1997.

Anagallis L.

A. arvensis L. subsp. *foemina* (Mill.) Schinz&Thell.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8044, 18 vii 1997, Medit.

OLEACEAE

Jasminum L.

J. fruticans L.

Environs of Kurtköy village, 740m., OUFE 8045, 06 iix 1998, Medit.

Olea L.

O. europaea L. var. *europaea*

Environs of Kızılkaplan village, 310m., OUFE 8046, 10 ix 1997.

APOCYNACEAE

Vinca L.

V. major L. subsp. *major*

Environs of Karaköy village, 890m., OUFE 16724, 04 vi 2009, Medit.

Periploca L.

P. graeca L. var. *graeca* Boiss. et Heldr.

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 16725, 29 v 2002, E. Medit.

Cynanchum L.

C. acutum L. subsp. *acutum*

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 16726, 18 vii 2003.

Vincetoxicum N.M. Wolf

V. fuscatum intermedium Taliev

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 16727, 04 vii 2010.

Cionura Griseb.

C. erecta (L.) Griseb.

Environs of Bekdemir village, 220m., OUFE 16728, 13 v 2005, E. Medit.

GENTIANACEAE

Gentiana L.

G. asclepiadea L.

Environs of Hamidiye village, 920m., OUFE 16729, 04 v 2009, Eur.-Sib.

CONVOLVULACEAE

Convolvulus L.

C. cantabricus L.

Environs of Aşağıarmutlu village, 890m., OUFE 8047, 04 iv 1998.

C. holosericeus M. Bieb. subsp. *holosericeus*

Environs of Yeniköy village, 330m., OUFE 16730, 25 vii 2008.

C. arvensis L.

Environs of Karaköy village, 700m., OUFE 8048, 11 vii 1997.

C. betonicifolius Mill. subsp. *betonicifolius*

1-25 km of Bozüyük-Bilecik road, 660m., OUFE 8049, 25 vii 1997.

Calystegia R. Br.

C. sepium (L.) R. Br. subsp. *sepium*

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 8050, 29 v 1997.

BORAGINACEAE

Heliotropium L.

H. europaeum L.

Environs of Akçapınar village, 870m., OUFE 8051, 04 v 1998, Medit.

Lappula Fabricius

L. barbata (M. Bieb.) Gürke

Environs of Akçapınar village, 900m., OUFE 16731, 18 vii 2007, Ir.-Tur.

Myosotis L.

M. arvensis (L.) Hill

Environs of Kızılkaplan village, 310m., OUFE 8053, 10 ix 1997, Eur.-Sib.

M. densiflora C. Koch

Environs of Bekdemir village, 220m., OUFE 16732, 18 vii 2010.

M. sicula Guss.

Environs of Kızılkaplan village, 400m., OUFE 8054, 10 iix 1997.

Cynoglossum L.

C. creticum Mill.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8055, 27 vi 1997, Eur.-Sib.

C. montanum L.

Environs of Çamyayla village, 810m., OUFE , 19 ix 1997.

Aegonychon Gray

A. purpurea-coeruleum Holub.

Environs of Alibeydüzü village, 940m., OUFE 8056, 26 ix 1998, Eur.-Sib.

Echium L.

E. italicum L.

Environs of Karaköy village, 720m., OUFE 8057, 11 vii 1997, Eur.-Sib.

E. vulgare L.

Environs of Kızıldamlar village, 810m., OUFE 8058, 06 iix 1998, Medit.

Onosma L.

O. bracteosa Hausskn.&Bornm.

Environs of Hamidiye village, 920m., OUFE 8059, 04 v 1998, End., (LC), Ir.-Tur.

O. brevifolia DC. ex Boiss.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 16733, 01 v 2009, End., (LC).

O. x bornmuelleri Hausskn.&Bornm.

Environs of Demirköy village, 660m., OUFE 8060, 25 vii 1997, End., (LC).

O. aucheriana DC.

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 8061, 02 xi 1997, E. Medit.

Cerinth L.

C. minor L. subsp. **auriculata** (Ten.) Domac

Environs of Süleymaniye village, 780m., OUFE 8062, 12 ix 1998.

Symphytum L.

S. tuberosum subsp. **nodosum** (Schur) Soo

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 8063, 15 v 1997, Eur.-Sib.

Anchusa L.

A. leptophylla Roem.&Schult. subsp. **leptophylla**

Environs of Hamidiye village, 920m., OUFE 8064, 04 v 1998.

A. undulata L. subsp. **hybrida** (Ten.) Cout.

Environs of Çamyayla village, 810m., OUFE 8065, 19 ix 1997, Medit.

A. stylosa M.Bieb.

Environs of Akçapınar village, 870m., OUFE 8066, 04 v 1998.

Alkanna Tausch

A. orientalis (L.) Boiss. var. **leucantha** (Bornm.) Hub.-Mor.

Environs of Kurtköy village, 740m., OUFE 16734, 06 iix 2004, End., (CD), Ir.-

Tur.

A. tinctoria Tausch subsp. *tinctoria*

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 16735, 29 v 2008, Medit.

SOLANACEAE

Solanum L.

S. dulcamara L.

Environs of Kurtköy village, 740m., OUFE 8067, 06 iix 1998, Eur.-Sib.

Datura L.

D. stramonium L.

Environs of Aşağıarmutlu village, 890m., OUFE 8068, 04 iv 1998.

Hyoscyamus L.

H. niger L.

Environs of Karaköy village, 690m., OUFE 8069, 11 vii 1997.

SCROPHULARIACEAE

Verbascum L.

V. orientale (L.) All.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8070, 12 ix 1997, Medit.

V. glomeratum Boiss.

Environs of Süleymaniye village, 780m., OUFE 8071, 12 ix 1998.

V. cheiranthifolium Boiss. var. *asperulum* (Boiss.) Murb.

Environs of Küplü village, 300m., OUFE 8072, 23 iix 1997, End., (LC).

OROBANCHACEAE

Orobanche L.

O. alba Stephan

Environs of Karaköy village, 700m., OUFE 8079, 11 vii 1997.

O. minor Sm.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8080, 27 vi 1997.

Melampyrum L.

M. arvense L. var. *arvense*

Environs of Alibeydüzü village, 940m., OUFE 8078, 26 ix 1998, Eur.-Sib.

ACANTHACEAE

Acanthus L.

A. hirsutus Boiss.

Environs of Süleymaniye village, 700m., OUFE 8081, 24 iix 1998, End., (LC).

LAMIACEAE (LABIATAE)

Ajuga L.

***A. orientalis* L.**

Environs of Akçapınar village, 900m., OUFE 8083, 24 vii 1998.

A. chamaepitys* (L.) Schreb. subsp. *chia* (Schreb.) Arcang. var. *chia

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8084, 12 ix 1997.

Teucrium L.

T. chamaedrys* L. subsp. *chamaedrys

Environs of Kızıldamlar village, 810m., OUFE 8085, 06 iix 1998, Eur.-Sib.

***T. polium* L.**

Environs of Kurtköy village, 740m., OUFE 8086, 06 iix 1998.

Scutellaria L.

S. albida* L. subsp. *albida

Environs of Süleymaniye village, 780m., OUFE 8088, 06 iix 1998.

***S. orientalis* L. subsp. *pinnatifida* Edmondson**

Environs of Kurtköy village, 740m., OUFE 16736, 06 iix 2009, Ir.-Tur.

Phlomis L.

***P. pungens* Willd. var. *hispida* Hub.-Mor.**

Environs of Süleymaniye village, 780m., OUFE 16737, 06 iix 2008.

***P. russeliana* (Sims) Lag. ex Benth.**

Environs of Alibeydüzü village, 940m., OUFE 16738, 26 ix 2010, End., (LC), Eur.-Sib.

Lamium L.

***L. amplexicaule* L.**

1-25 km of Bozüyük-Bilecik road, 620m., OUFE 8093, 08 v 1997, Eur.-Sib.

L. purpureum* L. var. *purpureum

Environs of Aşağıarmutlu village, 890m., OUFE 8094, 04 iv 1998, Eur.-Sib.

***L. orientale* (Fisch.&C.A.Mey.) E.H.L.Krause.**

Environs of Hamidiye village, 920m., OUFE 16739, 04 v 2011, Ir.-Tur.

Ballota L.

***B. nigra* L. subsp. *anatolica* P.H. Davis**

Environs of Karaköy village, OUFE 8096, 12 ix 1998, End., (LC), Ir.-Tur.

Marrubium L.

***M. vulgare* L.**

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 16740, 15 v 2011.

M. parviflorum* Fisch.&C.A.Mey. subsp. *parviflorum

Environs of Karaköy village, 700m., OUFE 16741, 11 vii 2010, Ir.-Tur.

M. peregrinum L.

Environs of Aşağıarmutlu village, 890m., OUFE 8099, 04 iv 1998.

Sideritis L.

S. montana L. subsp. *montana*

Environs of Aşağıarmutlu village, 890m., OUFE 8100, 04 iv 1998, Medit.

S. germanicopolitana Bornm. subsp. *germanicopolitana*

Environs of Süleymaniye village, 700m., OUFE 8102, 24 iix 1997, End., (LC).

Stachys L.

S. tmolea Boiss.

Environs of Demirköy village, 560m., OUFE 8103, 23 iix 1997, End., (LC), E. Medit.

S. cretica L. subsp. *anatolica* Rech. Fil.

Environs of Karaköy village, 600m., OUFE 16742, 24 v 2010, End., (LC), Ir.-Tur.

S. byzantina K.Koch

Environs of Alibeydüzü village, 940m., OUFE 8105, 26 vii 1998, Eur.-Sib.

S. thirkei K.Koch

Environs of Karaköy village, 690m., OUFE 8106, 11 vii 1997.

S. annua (L.) L. subsp. *annua* var. *lycaonica* Bhattacharjee

Environs of Kızıldamlar village, 810m., OUFE 8108, 06 iix 1998, Ir.-Tur.

Nepeta L.

N. italica L.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8110, 20 vi 1997.

Prunella L.

P. vulgaris L.

Environs of Süleymaniye village, 780m., OUFE 8111, 12 ix 1998, Eur.-Sib.

Origanum L.

O. sipyleum L.

Environs of Bekdemir village, 220m., OUFE 16743, 28 vi 2007, End., (LC), E. Medit.

O. vulgare L.

Environs of Karaköy village, 670m., OUFE 8112, 12 iv 1997.

Clinopodium L.

C. vulgare L. subsp. *vulgare*

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8115, 27 iv 1997.

Micromeria Benth

M. myrtifolia Boiss.&Hohen.

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8116, 01 iix 2006, E. Medit.

Thymus L.

T. longicaulis C. Presl subsp. *longicaulis* var. *subisophyllus*

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 16744, 04 vii 2002.

T. sipyleus Boiss. subsp. *sipyleus* var. *sipyleus*

Environs of Ahmetpınar village, 410m., OUFE 16745, 25 vii 2003, End., (LC).

Mentha L.

M. pulegium L.

1-25 km of Bozüyük-Bilecik road, 660m., OUFE 8121, 25 vii 1997.

M. longifolia (L.) Huds. subsp. *typhoides* (Briq.) Harley

Environs of Akçapınar village, 900m., OUFE 16746, 03 x 2010.

Ziziphora L.

Z. capitata L.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8123, 18 vi 1997, Ir.-Tur.

Z. tenuior L.

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 8124, 15 v 1997, Ir.-Tur.

Salvia L.

S. tomentosa Mill.

Environs of Yeniköy village, 300m., OUFE 8125, 22 iix 1998, Medit.

S. bracteata Banks&Sol.

Environs of Kurtköy village, 740m., OUFE 16747, 06 iix 2008, Ir.-Tur.

S. cadmica Boiss.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8126, 18 vii 1997, End., (LC).

S. viridis L.

Environs of Demirköy village, 660m., OUFE 8127, 25 vii 1997.

S. sclarea L.

Environs of Hamidiye village, 920m., OUFE 8128, 04 v 1998.

S. aethiopsis L.

Environs of Karaköy village, 580m., OUFE 16748, 24 vi 2003.

S. argentea L.

Environs of Süleymaniye village, 720m., OUFE 16749, 25 v 2009, Medit.

S. cyanescens Boiss.&Balansa

Environs of Kurtköy village, 740m., OUFE 8129, 06 iix 1998, End., (LC).

S. virgata Jacq.

1-25 km of Bozüyük-Bilecik road, 580m., OUFE 8130, 22 v 1997, Ir.-Tur.

PLUMBAGINACEAE

Plumbago L.

***P. europaea* L.**

Environs of Süleymaniye village, 780m., OUFE 16750, 06 iix 2005, Eur.-Sib.,

Acantholimon Boiss.

A. acerosum* (Willd.) Boiss. var. *acerosum

Environs of Akçapınar village, 900m., OUFE 8132, 18 vii 1998, Ir.-Tur.

PLANTAGINACEAE

Plantago L.

P. major* L. subsp. *major

Environs of Karaköy village, 690m., OUFE 8133, 11 vii 1997.

***P. lanceolata* L.**

Environs of Hamidiye village, 920m., OUFE 8134, 04 v 1998.

***P. scabra* Moench**

Environs of Demirköy village, 690m., OUFE 16751, 25 vii 2007.

Linaria Mill.

***L. corifolia* Desf.**

Environs of Ahmetpınar village, 400m., OUFE 8073, 20 ix 1997, End., (LC).

Digitalis L.

D. ferruginea* L. subsp. *ferruginea

Environs of Aşağıarmutlu village, 890m., OUFE 8074, 04 iv 1998, Eur.-Sib.

***D. lamarckii* Ivanina**

Environs of Alibeydüzü village, 940m., OUFE 16752, 26 ix 2007, End., (LC), Ir.-
Tur.

Veronica L.

***V. bozakmanii* M.A.Fisch.**

Environs of Kızıldağlar village, 630m., OUFE 16753, 12 vii 2001, Ir.-Tur.

***V. persica* Poir.**

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8076, 18 vii 1997.

***V. anagallis-aquatica* L.**

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8077, 27 vi 1997.

Globularia L.

***G. trichosantha* Fisch.&C.A.Mey.**

Environs of Hamidiye village, 920m., OUFE 8082, 04 v 1998.

THYMELAEACEAE

Daphne L.

***D. pontica* L.**

Environs of Kızıldamlar village, 810m., OUFE 8135, 06 iix 1998, Eux.

***D. sericea* Vahl**

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 8136, 29 v 1997, E. Medit.

ELAEAGNACEAE

***Elaeagnus* L.**

***E. angustifolia* L.**

Environs of Aşağıarmutlu village, 890m., OUFE 8137, 04 iv 1998.

SANTALACEAE

***Osyris* L.**

***O. alba* L.**

Environs of Yeniköy village, 300m., OUFE 8138, 22 iix 1998, Medit.

***Viscum* L.**

V. album* L. subsp. *album

Environs of Karaköy village, 690m., OUFE 8139, 11 vii 1997.

ARISTOLOCHIACEAE

***Aristolochia* L.**

***A. pallida* Willd.**

Environs of Hamidiye village, 920m., OUFE 8140, 04 v 1998.

***A. hirta* L.**

Environs of Akçapınar village, 870m., OUFE 8141, 04 v 1998.

EUPHORBIACEAE

***Andrachne* L.**

***A. telephioides* L.**

Environs of Kurtköy village, 740m., OUFE 16754, 06 iix 2002.

***Chrozophora* A. Juss.**

***C. tinctoria* (L.) A.Juss.**

Environs of Çamyayla village, 810m., OUFE 16755, 19 ix 2008.

***Mercurialis* L.**

***M. annua* L.**

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 16756, 20 vi 2008.

***Euphorbia* L.**

***E. apios* L.**

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 8136, 29 v 1997, E. Medit.

E. helioscopia L.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8143, 18 vi 1997.

E. taurinensis All.

Environs of Alibeydüzü village, 940m., OUFE 16757, 26 vi 2006.

E. herniariifolia Willd. var. *herniariifolia*

Environs of Karaköy village, 800m., OUFE 8144, 18 vii 1997.

URTICACEAE

Urtica L.

U. dioica L.

Environs of Karaköy village, 690m., OUFE 8145, 11 vii 1997, Eur.-Sib.

MORACEAE

Morus L.

M. alba L.

Environs of Küplü village, 260m., OUFE 8146, 10 ix 1997.

Ficus L.

F. carica L. subsp. *carica* (All.) Schinz et Thell.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8147, 18 vii 1997.

ULMACEAE

Ulmus L.

U. glabra Huds.

Environs of Kızıldamlar village, 810m., OUFE 8148, 06 iix 1998, Eur.-Sib.

CANNABACEAE

Celtis L.

C. australis L.

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8149, 18 vii 1997, Medit.

JUNGLANDACEAE

Junglans L.

J. regia L.

Environs of Karaköy village, 690m., OUFE 8150, 11 vii 1997.

PLATANACEAE

Platanus L.

***P. orientalis* L.**

Environs of Karaköy village, 580m., OUFE 8151, 28 vii 1998, Eur.-Sib.

FAGACEAE

Fagus L.

***F. orientalis* Lipsky**

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 8152, 18 vii 1997, Eur.-Sib.

Castanea Mill.

***C. sativa* Mill.**

Environs of Kızıltepe village, 920m., OUFE 8153, 24 ix 1998, Eur.-Sib.

Quercus L.

Q. petraea* (Mattuschka) Liebl. subsp. *petraea

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8154, 01 iix 1997.

***Q. pubescens* Willd.**

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8155, 20 vi 1997.

***Q. coccifera* L.**

Environs of Kızıltepe village, 1000m., 19 ix 1997, OUFE 8156, Medit.

BETULACEAE

Carpinus L.

***C. betulus* L.**

1-25 km of Bozüyük-Bilecik road, 600m., OUFE 8157, 15 v 1997, Eur.-Sib.

Corylus L.

C. avellana* L. var. *avellana

Environs of Akçapınar village, 900m., OUFE 8158, 24 ix 1998, Eur.-Sib.

SALICACEAE

Salix L.

S. alba

Environs of Karaköy village, 700m., OUFE 8159, 11 vii 1997, Eur.-Sib.

***S. cinerea* L.**

Environs of Alibeydüzü village, 940m., OUFE 8160, 26 ix 1998, Eur.-Sib.

Populus L.

***P. alba* L.**

25-30 km of Bozüyük-Bilecik road, 310m., OUFE 8161, 02 xi 1997, Eur.-Sib.

***P. tremula* L.**

Environs of Aşağıarmutlu village, 890m., OUFE 8162, 04 iv 1998.

RUBIACEAE

Asperula L.

A. lilaciflora Boiss. subsp. *phrygia* (Bornm.) Schönb.-Tem.

25-30 km of Bozüyük-Bilecik road, 360m., OUFE 8164, 04 vii 1997, End., (LC).

A. involucrata Wahlenb.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8165, 20 vi 1997, Eux.

A. arvensis L.

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8166, 18 vii 1997, Medit.

Galium L.

G. rotundifolium L.

Environs of Kızıldamlar village, 810m., OUFE 8169, 06 iix 1998.

G. odoratum (L.) Scop.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8167, 18 vi 1997, Eur.-Sib.

G. rivale (Sibth.&Sm.) Griseb.

Environs of Yeniköy village, 300m., OUFE 16758, 22 iix 1998, Eur.-Sib.

G. verum L. subsp. *verum*

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8168, 01 iix 1997, Eur.-Sib.

G. paschale Forssk.

Environs of Demirköy village, 660m., OUFE 8170, 25 vii 1997, E. Medit.

Rubia L.

R. tinctorium L.

25-30 km of Bozüyük-Bilecik road, 320m., OUFE 8172, 26 vii 1998, Ir.-Tur.

MONOCOTYLEDONE

ARACEAE

Arum L.

A. elongatum Steven subsp. *elongatum*

1-25 km of Bozüyük-Bilecik road, 690m., OUFE 16759, 18 vii 2001.

LILIACEAE

Fritillaria L.

F. fleischeriana Steud.&Hochst. ex Schult.&Schult.f.

Environs of Kurtköy village, 715m., OUFE 16760, 24 v 2010, End., (NT), Ir.-

Tur.

Tulipa L.

T. armena Boiss. var. *armena*

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 16761, 20 vi 2002, Ir.-Tur.

Gagea Salisb.

G. bohemica (Zauschn.) Schult.&Schult.f.

Environs of Aşağıarmutlu village, 890m., OUFE 16762, 04 iv 2004.

G. granatellii (Parl.) Parl.

Environs of Aşağıarmutlu village, 890m., OUFE 8186, 04 iv 1998, Ir.-Tur.

G. villosa (M.Bieb.) Sweet var. *villosa*

Environs of Süleymaniye village, 780m., OUFE 16763, 06 v 2010, Medit.

ASPARAGACEAE

Ruscus L.

R. aceulatus L. var. *aceulatus*

Environs of Akçapınar village, 900m., OUFE 8173, 03 v 1998.

Asparagus L.

A. tenuifolius Lam.

Environs of Karaköy village, 690m., OUFE 8174, 11 vii 1997, Eur.-Sib.

Prospero Salisb.

P. autumnale (L.) Speta

Environs of Kızıldamlar village, 810m., OUFE 16764, 06 iix 2001, Medit.

Ornithogalum L.

O. pyrenaicum L.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8179, 27 vi 1997.

O. oligophyllum E.D.Clarke

Environs of Kızıldamlar village, 810m., OUFE 16765, 06 iix 2008.

O. comosum L.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8180, 01 vi 1997.

Leopoldia Herb.

L. comosa (L.) Parl.

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8181, 18 vi 1997, Medit.

L. tenuiflora (Tausch) Heldr.

Environs of Kızıldamlar village, 610m., OUFE 8182, 26 vii 1997.

Muscari Mill.

M. neglectum Guss. ex Ten.

Environs of Kızıldamlar village, 810m., OUFE 8184, 06 v 1998.

AMARYLLIDACEAE

Allium L.

A. paniculatum* L. subsp. *paniculatum

Environs of Alibeydüzü village, 940m., OUFE 8176, 26 v 1998, Medit.

***A. ampeloprasum* L.**

Environs of Süleymaniye village, 780m., OUFE 8178, 06 v 1998, Medit.

***A. guttatum* Steven subsp. *sardoum* (Moris) Stearn**

Environs of Çamyayla village, 810m., OUFE 16766, 24 v 2010, Medit.

***A. rotundum* L.**

1-25 km of Bozüyük-Bilecik road, 550m., OUFE 16767, 12 vi 2002, Eur.-Sib.

COLCHICACEAE

Colchicum L.

***C. atticum* Spruner ex Tommas.**

Environs of Demirköy village, 690m., OUFE 16768, 25 xii 2007, E. Medit.

IRIDACEAE

Iris L.

***I. orientalis* Mill.**

25-30 km of Bozüyük-Bilecik road, 220m., OUFE 8187, 13 v 1997, E. Medit.

***I. pumila* L. subsp. *attica* (Boiss.&Heldr.) K.Richt.**

1-25 km of Bozüyük-Bilecik road, 810m., OUFE 8188, 13 v 1998, E. Medit.

Crocus L.

***C. chrysanthus* (Herb.) Herb.**

Environs of Kızıldamlar village, 810m., OUFE 8189, 06 ii 1998.

C. olivieri* J.Gay subsp. *olivieri

1-25 km of Bozüyük-Bilecik road, 670m., OUFE 8191, 18 iii 1997.

C. pallasii* Goldb. subsp. *pallasii

Environs of Akçapınar village, 900m., OUFE 8190, 03 x 1998.

ORCHIDACEAE

***Cephalanthera* L.C.M. Richard**

***C. epipactoides* Fisch.&C.A.Mey.**

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8192, 20 ii 1997, E. Medit.

***C. rubra* (L.) Rich.**

Environs of Süleymaniye village, 780m., OUFE 16769, 06 iix 2009.

***C. damasonium* (Mill.) Druce**

Environs of Akçapınar village, 900m., OUFE 16770, 03 v 2007, Eur.-Sib.

Epipactis Zinn

E. helleborine (L.) Crantz

Environs of Demirköy village, 660m., OUFE 8193, 25 vii 1997.

Limodorum Boehmer

L. abortivum (L.) Sw. var. *abortivum*

Environs of Karaköy village, 800m., OUFE 16771, 18 vii 2002.

Platanthera L. C. M. Richard

P. chlorantha (Custer) Rchb.

Environs of Hamidiye village, 920m., OUFE 16772, 04 v 2010.

Anacamptis L. M. C. Richard

A. pyramidalis (L.) Rich.

Environs of Alibeydüzü village, 940m., OUFE 16773, 26 vii 2001.

Orchis L.

O. purpurea Huds.

Environs of Kızıltepe village, 910m., OUFE 16774, 04 v 2007, Eur.-Sib.

O. mascula L. subsp. *mascula*

Environs of Bekdemir village, 220m., OUFE 8194, 13 v 1998, E. Medit.

Dactylorhiza Necker et Nevski

D. romana (Sebast.) Soó subsp. *romana*

Environs of Alibeydüzü village, 940m., OUFE 8195, 26 vi 1998, Medit.

TYPHACEAE

Typha L.

T. domingensis Pers.

Environs of Karaköy village, 560m., OUFE 16775, 23 iv 2009.

JUNCACEAE

Juncus L.

J. bufonius L.

Environs of Demirköy village, 690m., OUFE 8196, 25 vii 1997.

CYPERACEAE

Carex L.

C. pendula Huds.

Environs of Hamidiye village, 920m., OUFE 8198, 04 v 1998, Eur.-Sib.

POACEAE (GRAMINAE)

Brachypodium L.

B. sylvaticum (Huds.) P.Beauv.

Environs of Alibeydüzü village, 940m., OUFE 8199, 26 iix 1998.

B. pinnatum (L.) P.Beauv.

25-30 km of Bozüyük-Bilecik road, 330m., OUFE 8200, 26 iix 1998, Eur.-Sib.

Elymus L.

E. hispidus (Opiz) Melderis subsp. *hispidus*

Environs of Çamyayla village, 810m., OUFE 8202, 19 iix 1997.

Aegilops L.

Ae. umbellulata Zhuk. subsp. *umbellulata*

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 16776, 04 vii 2007, Ir.-Tur.

Ae. geniculata Roth

Environs of Aşağıarmutlu village, 890m., OUFE 8205, 04 vii 1998, Medit.

Hordeum L.

H. bulbosum L.

Environs of Kızılkaplan village, 400m., OUFE 8206, 10 iix 1997.

Bromus L.

B. japonicus Thunb. subsp. *japonicus*

1-25 km of Bozüyük-Bilecik road, 530m., OUFE 8208, 27 vi 1997.

B. sterilis L.

Environs of Alibeydüzü village, 940m., OUFE 8209, 26 vii 1998.

Avena L.

A. barbata Pott ex Link subsp. *barbata*

Environs of Küplü village, 290m., OUFE 8211, 11 vii 1997, Medit.

Arrhenatherum P. Beauv.

A. elatius (L.) P.Beauv. ex J.Presl&C.Presl. subsp. *elatius*

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 8213, 12 iix 1997, Eur.-Sib.

Rostraria Trin.

R. cristata (L.) Tzvelev var. *cristata*

Environs of Kurtköy village, 740m., OUFE 8214, 06 iix 1998.

Koeleria Pers.

K. nitidula Velen.

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8215, 01 iix 1997.

K. cristata (L.) Tzvelev

Environs of Kızıltepe village, 910m., OUFE 8216, 04 vii 2010.

Alopecurus L.

A. myosuroides Huds. var. *myosuroides*

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8221, 01 iix 1997, Eur.-Sib.

Phleum L.

P. montanum K.Koch subsp. *montanum*

Environs of Karaköy village, 800m., OUFE 16777, 18 vii 2004.

Festuca L.

F. callieri (Hack.) Markgr. subsp. *callieri*

Environs of Kurtköy village, 740m., OUFE 8224, 06 iix 1998.

F. beckeri (Hack.) Trautv.

25-30 km of Bozüyük-Bilecik road, 450m., OUFE 8225, 29 v 1997.

F. valesiaca Schleich. ex Gaudin

1-25 km of Bozüyük-Bilecik road, 680m., OUFE , 01 v 1997.

Lolium L.

L. perenne L.

Environs of Kurtköy village, 300m., OUFE 8226, 22 iix 1998, Eur.-Sib.

Poa L.

P. trivialis L.

Environs of Kurtköy village, 750m., OUFE 8228, 12 iv 1998.

P. pratensis L.

Environs of Kızıldamlar village, 810m., OUFE 8229, 06 iix 1996.

P. bulbosa L.

Environs of Karaköy village, 690m., OUFE 16778, 11 vii 2007.

Dactylis L.

D. glomerata L. subsp. *hispanica* (Roth) Nyman

1-25 km of Bozüyük-Bilecik road, 500m., OUFE 8230, 01 iix 1997, Eur.-Sib.

Cynosurus L.

C. cristatus L.

1-25 km of Bozüyük-Bilecik road, 560m., OUFE 16779, 04 vii 2012, Eur.-Sib.

Briza L.

B. media L.

Environs of Kurtköy village, 930m., OUFE 8233, 16 vi 2009.

Echinaria Desf.

E. capitata (L.) Desf.

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 8234, 12 iix 1997.

Melica L.

M. ciliata L. subsp. *ciliata*

Environs of Kızılkaplan village, 310m., OUFE 8235, 10 ix 1997, Ir.-Tur.

Glyceria R.Br.

G. notata Chevall.

Environs of Demirköy village, 580m., OUFE 8236, 13 x 1997.

Stipa L.

S. bromoides (L.) Dörfl.

Environs of Hamidiye village, 920m., OUFE 8237, 04 v 1998, Medit.

Oryzopsis Michx.

O. coerulescens (Desf.) Hack.

1-25 km of Bozüyük-Bilecik road, 570m., OUFE 8238, 20 vi 1997.

Chrysopogon Trin.

C. gryllus (L.) Trin. subsp. *gryllus*

Environs of Küplü village, 280m., OUFE 8241, 18 iix 1998.

Bothriochloa O. Kuntze

B. ischaemum (L.) Keng

1-25 km of Bozüyük-Bilecik road, 680m., OUFE 8242, 12 iix 1997.

Women, Poverty and Child-labor: The Contending Evils with Child Development in Akure Region, Nigeria.

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Abstract

The share of the great proportion of the problems of poverty by women, no doubt, has significant correlation with child-labor in Nigerian cities today. This paper, therefore, investigates specifically child-labor in trading activities –being the major job of women in Akure, Nigeria. It equally looks at the influence of these women (mothers) on the child-laborers in the face of poverty. The study adopts simple descriptive statistics and a pair-wise association between child-laborers and employers, using the Pearson's Correlation test. Results show that women associate highly statistically (0.96) with child-labor. To reduce the menace, some policy measures are recommended including poverty-targeted/social assistance programs, gender gap reduction in tertiary education, initiation of projects on vocational skills, introduction of peer educators to campaign against child labor and intensification of family planning awareness to combat the menace.

Keywords: Women, Poverty, Trading, Child-labor, Akure, Ondo State, Nigeria

1. Introduction

Childhood is a critical period of development in life. This is a period when children are particularly vulnerable to exploitation and abuse because they are still growing physically and are dependent on adults for their wellbeing and security (Marshall, 2003). In many societies, children within the family have particular developmental needs and rights which are met by parents. Women are naturally equipped and disposed to nurture succeeding generations of the human species (Ogbuigwe, 1996), hence, tend to attend to children's needs than men (fathers). Within the context of this study, women are referred to as 'mothers' and the child as a youth in the family under the working age of 18.

The focus of this research is the use of child labor by women, which is the engagement of a child in harmful work considered illegal, hazardous or extremely exploitative. In 1998, the International Labor Organization (ILO) reported that 250 million children worldwide are victims of child-labor; 80 million of which is in Africa, and are under the minimum age of employment 18. The 1998 ILO report further reveals that these children were engaged in commercial agriculture, manufacturing or industrial labor, domestic service, salary and bonded labor as well as prostitution – all which, either keep them out of school or put them at health and development risk.

Poor families rely upon child-labor to attain basic necessities. About one-fifth of the world's 6 billion people live in absolute poverty – the main cause of child-labor in parts of Africa, Asia and Latin America (Cause of Child Labor, 2009). The African continent is generally poor, but sub-Saharan Africa (to which Nigeria belongs) stands out as the world's most poverty-stricken region, when measured by the conventional yardstick (Christian Michelsen Institute, 1998) of living below US \$1 per day. In Nigeria, for instance, the size of the poor rose from 36 million in 1985 (Osinubi, 2003) to 40 million in 1995, of which 43 percent lived in urban areas (FOS Survey, 1996/97). In 1999, at least 87 percent of Nigerian 120million lived in poverty (Nnamani, 2003). Poverty is about a lack of economic, social, physical, environmental, cultural and political resources that prevent people of all ages from fulfilling their potential (Marshall, 2003).

Women in particular, represent a disproportionate share of the poor. Typically, they occupy lower paid and lower status jobs than men; women's unemployment rates are higher than men's and far more women than men work in the "informal sector" occupations like street vending and market work (Ashford, 2001). His reports indicate that, worldwide, more men (80 percent) than women (64 percent) are literate; in many societies the laws pertaining to family, disallow them from inheriting land and other properties – a disadvantaged position that perpetuates their early entry into motherhood, and a continued circle of poverty. The social, political and economic inequalities that women face are the results of historically rooted culture, outdated traditions, retrograde taboos and inadequate policies (Kanshahu, 2000:45)

Women do most agricultural work (the major occupation in Nigeria) and carry out local trading (Mallum, 1990). Majority of them bear "dual burden" of working outside the home while at the same time doing a larger share of work in the home than men – such as child bearing, cooking, and cleaning (Ashford, 2001). It is often argued that women are most frequent with the children; they spend more time at home with them than men and often dictate the kind of activities they carry out. Greater percentages of

the unemployed in Nigeria are women (Afonja, *et al*, 2002:2). The great proportion of the family responsibilities women bear, therefore, suggests why most children in the cities today turn to laborers to compliment their mother's effort.

The highest incidence of child labor is found in Africa, where one in three children works (Bass, 2004). The work typically done by African children in the home are apprentices and in commercial labor markets (Kielland and Tovo, 2006). Assumptions are often made that policies targeted at the adults and households will be of tremendous impacts on the survival, protection and development of the children. This study, therefore, aims at investigating the role of women in the use of child labor at market places in Akure region, Nigeria. The objectives are to: (1) the category of children engaged in the act; (2) investigate the type job done; (3) assess the locations of operation; and (4) examine the factors responsible. Understanding the fundamental causes will assist in setting policy measures aimed at raising women's efficiency and productivity while reducing child labor in Nigerian cities.

2.0 Theoretical Framework of Study

The theories and concepts that provide the basis for understanding child labor in human societies include the concept of discrimination, social exclusion, marginalization and vulnerability and childhood poverty.

Discrimination embraces separateness from the life experience common to the majority within a society (Anderson, 2000). The concept focuses on the multi-dimensionality of deprivation. That is, the different treatment of others based on their membership in a socially distinct group or category such as race, ethnicity, sex, religion, age or disability. Discrimination can be favorable or unfavorable, depending on whether a person receives favors or opportunities, or is denied them (Dorsen and Liberman, 2007). There are no societies in which children enjoy the same opportunities as adults. Examples of such discrimination include the prohibition to allocate land to them, the right to choose a career, and lack of accessibility to real properties, and job positions (Kanshahu, 2000:45). This indirectly implies exclusion (deprivation) in the economic, social as well as political realms.

Social exclusion is similar to various types of social disadvantage that is related to special problems such as unemployment, ghettoisation, fundamental changes in family life etc (Cannan, 1997). Excluded categories include a wide variety of people, not only the women, but also the poor, 'handicapped, suicidal people and abused children (De Hann, 1999:1). These are individuals or groups who are wholly or partially excluded from full participation in the society within which they live. The UNDP (1997:73) reveals that the discourse, procedures, structures and functions of governance, for instance, remain heavily skewed in favors of adults (men) in many countries of the world, thus, resulting in unequal sharing of power and resources – time, incomes and property between children and adults. Many concede that this concept is useful because, it helps to focus not just on the existence of poverty and inequality, but also on the dynamic processes whereby they are created and perpetuated (De Hann, 1999:2-3).

The concept of marginalization can be applied to people and environments to illuminate restrictions in people's options in the management of their environment (Blaikie, 1985). In highlighting marginalization, the concern is for fair treatment, such that no one or group of people is excluded in the community. In practice, children are subordinated historically, always striving for equality through right to basic necessities

and securing voice in public matters, not only to provide access to an important resource for children in the same term as adults enjoy, but as positive steps to redress the injustice of marginalization. A marginalized child lacks access to resources needed to overcome the restrictions of living beyond the limits of subsistence or poverty. Marginalization, therefore, correlates with “vulnerability as a dynamic concept of susceptibility to risks of falling into poverty” (Moser, 1998) and by extension, abuse. In practical term, the more assets people have, the less vulnerable they are and the greater their security against poverty.

Childhood poverty means children and young people growing up without access to different types of resources that are vital for their wellbeing and for them to fulfill their potentials (Marshall, 2003). Poverty at this level, share causes and manifestations in inadequate livelihood, lack of family and community structures that nurture and protect children and opportunities for their collective voice. Much of children and young people’s experience of poverty is clearly similar to and share with that of their families, communities and countries (Marshall, 2003). Nigerian population in 2006 was 140,431,790 (Gazette, 2009), of which 70.2% were poor. Poverty in the family, therefore, underpins childhood poverty with important consequences of hunger, getting into enormous stress, having to drop out of school, missing out on critical health care, and wearing old or torn clothing by children.

3.0 Justification for the Study

Akure was selected for this study in view of its major geographical and economic distinction. As a state capital since 1976, it has witnessed growth in terms of built-up areas, population density, volume of traffic and commercial activities. The rapid growth of the city, particularly within the last three decades, has made it one of the fastest growing metropolitan areas in South-western Nigeria. The population of Akure grew significantly from 198,228 in 1986 to 304,883 in 2002 and “387,400 in 2004” (World Gazetteer, 2004) with a growth in retail and industrial ventures which traders and children exploit to escape poverty.

Poverty indicators that characterize urban poor (especially in the developing countries) include: visible evidence of growing numbers of working children and homeless people, as well as increased numbers of young people who are unable to find formal or semi-formal sector employment (Abugre and Holland, 1998). Underage children, therefore, do all sorts of jobs in Akure, usually because they and their families are extremely poor.

Ebigbo (1977) observes that several parents in northern Nigeria, for example, have entrusted their wards to Mallams (Koranic teachers) who, as custodians live on the children by sending them out to the streets to beg for arms and collect food from dumps. His report also reveals that as many as 298,000 children were engaged in agricultural labor in Anambra State in 1979. Out of the 112 laboring children investigated in Enugu, most of them came from neighboring villages, while 67 were girls, 45 were boys; 64 of them were housekeepers whose work ranged from children minding, cooking, house cleaning, laundry, shopping, gardening to hawking and attending to several other chores in the house (Ebigbo, 1977).

Child abuse is at its highest degree in Lagos, Nigeria, where young children are seen hawking wares, meat pie, chin-chin, ice cream and more often pure water from day break to sunset (Boga, 2000). Investigations show that the vice is thriving so much in

Ibadan, Oshogbo, Benin, Akure, Port-Harcourt, Calabar, Enugu, Abuja, Jos and a host of other urban centres (usually state capitals) and tertiary institutions in Nigeria. This denies children the opportunities to quality education, life skills and health services that will affect the rest of their life.

South Asia and sub-Saharan Africa are homes to the large number of the 1.2 billion poor people in the world (Dasgupa, 2003). Approximately 40 percent of sub-Saharan African children do not attend school (Causes of Child-labor, 2009) with high vulnerability to abuse. Poverty experienced by parents, increase pressure on them to become child laborers. In view of the prevalence of the use of child-labor by women in diverse ramifications in Akure and the negative consequences on the children, it becomes imperative to adopt feasible strategies for combating the menace.

4.0 Materials and Methods

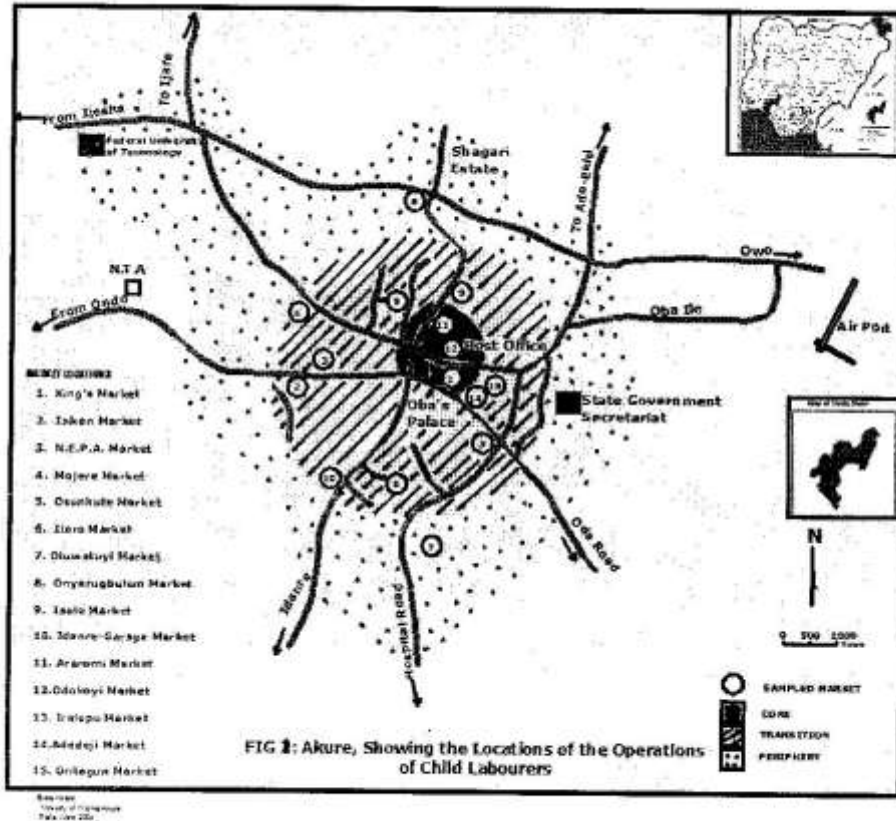
4.1 Research Locale: The research was carried out in Akure the political and administrative capital of Ondo State, which locates in the western region of Nigeria. It is a largely traditional and agrarian settlement that situates at about 311 kilometers North East of Lagos and about 415 kilometers South West of Abuja (the new Federal capital city). Geographically, the city is compact; of about 7-kilometre radius from the city centre and contains roughly 600 residential family and public layouts as well as administrative quarters that are served with about fifteen markets. The city is dominated by three major roads – Oba-Adesida/Oyemekun, Ondo/Arakale/Igbatoro and Oke-Aro / Araromi roads along which 80 percent of the city markets locate. Major private and public land uses along these routes were examined to elicit the complimentary roles played in attracting population to boost trading in the markets.

Table 1: Major landuses along the main routes in Akure

| S/N | Route Area | Market | Major landuse |
|-----|-----------------------|---------------|--|
| 1 | Oba-Adesida/Oyemekun | King's main | (1) King's palace (2) Town hall (3) Post office (4) Museum |
| | | Odokoyi | (5) Banks (6) Central mosque (7) Shopping complexes |
| | | Isolo | (8) Maternity centers (9) Police stations (10)Warehouses |
| | | Oritagun | (11) Cultural centre, (12) Sacred-heart cathedral, (13) Schools, |
| | | | (14) Ilesa garage |
| 2 | Ondo/Arakale/Igbatoro | Isikan | (1) Prison, (2) Television, (3) Ondo motor park, (4) Cocacola depot, |
| | | NEPA | (5) Army barracks, (6) Aluminum industry (7) Hotel (8) Churches |
| | | Oluwatuyi | (9) Power Holding Company, (10) Governor's House, |
| | | Adedeji | (11) State House of Assembly (12) State secretariats (13) Federal Secretariat (14) School of Nursing |
| 3 | Oke-Aro/Araromi | Iralepo | (1) Idanre garage (2) Churches (3) Hospitals (4) Stadium |
| | | Onyarugbulem | (5) Schools (6) Sawmills |
| | | Idanre garage | |
| | | Ararom | |

Source: Author's Findings, 2011

At the city core is the main market otherwise called the 'King's market', and two other markets, both which locate at about 200 meters from the main market. As a result of high concentration of population, commercial or business activities around the markets, there is attraction of heavier volume of traffic and child labor at their respective locations. The city is popular for its bustling commercial environment, and the parts are adequately linked with road network, thereby creating possible avenue for trading and hawking by its residents.



4.2 Database Description: Two types of interview were conducted with the child laborers and their employers. Children hawking and selling in the market places were purposefully targeted as subjects. Findings reported herein are based on responses from the child-laborers, sought in pre-coded alternatives provided for closed-ended questions meant to ascertain their levels of involvement in hawking and trading, and who is responsible for this. Follow-up oral interviews with a few employers were used to elaborate on the child laborers' responses and solicit additional comments not covered by the research questions.

Ten final (fifth) year Urban and Regional students of the Federal University of Technology, Akure, who acted in the capacity of research assistants and had earlier been tutored by the author, administered the questionnaires. Only one questionnaire was administered on each child laborer. Although the questions were in English, they were

translated into Yoruba (the major language in the Western region of Nigeria) in cases where the respondents did not understand English.

In the survey, 840 questionnaire were administered out of which 761 (i.e. 90 percent and above) were retrieved in usable form and analyzed. The interview which lasted two weeks were carried out in 10 out of the 15 market places, which indeed are the busiest commercial areas; a few with intra-city parks. Majority of the child laborers are fairly literates who operate freely. They provided answers promptly and adequately with little stress of interpreting questions in the local dialect. Survey utilized simple stratified systematic sampling techniques to select cases, while analysis adopted the Pearson's Correlation Co-efficient (r) statistical measure of association for pair-wise variables.

5.0 Research Findings and Discussion

The analysis is disaggregated spatially into the core (the Central Business District) the transition zone between the core and suburban, and the periphery (suburban area). The markets in the designated zones represent the study sites. These markets vary in size (land area covered and population) and intensity of patronage. Table 1 presents ranking of the markets, the basis upon which the sample size (of child laborers) was taken.

Table 2: Level of Child Involvement in Trading /Hawking by Women at Ten Market Locations in Akure

| S/N | Market | Zone | Ranking | No of children sampled (X) | Employment by Women (Y) |
|-----|--------------|------------|---------|----------------------------|-------------------------|
| 1. | King's /Main | Core | 1 | 120 | 41 |
| 2. | Araromi | Core | 11 | 80 | 22 |
| 3. | Odokoyi | Core | 12 | 60 | 18 |
| 4. | Isikan | Transition | 2 | 100 | 30 |
| 5. | NEPA | Transition | 3 | 100 | 26 |
| 6. | Iloro | Transition | 6 | 80 | 23 |
| 7. | Mojere | Transition | 4 | 80 | 21 |
| 8. | Isolo | Transition | 9 | 60 | 15 |
| 9. | Iralepo | Transition | 13 | 21 | 7 |
| 10. | Oluwatuyi | Periphery | 7 | 60 | 16 |
| | TOTAL | | | 761 | 219 |

Source: Author's Fieldwork, 2011

All the three markets at the city core (King's/Main, Araromi and Odokoyi markets) were, selected due to their central location. Six (Isikan, NEPA, Iloro, Mojere, Isolo and Iralepo markets) out of the ten markets that locate within the transition zone, as well as, one (Oluwatuyi market) out of the two sited at the periphery were picked for sampling. The spatial disaggregating approach, therefore, allows survey to cut across the whole city, covering all its major segments (residential quarters) and at least 50 percent of the markets in the designated zones. Five basic socio-demographic factors were identified as stimulants of child-labor, which the research actually investigated in connection with women. These include: household size, education, job preference, rate of income and

employer, which in an overall sense may really explain child involvement in trading by women at the market locations in Akure.

Analysis of survey indicates that 74.3 percent and 75.2 percent of the laboring children have their fathers and mothers alive respectively. This attests to the facts that, majority of the children have living parents who are aware of their activities. Nearly half of the child-laborers interviewed claimed to belong to a fairly large household, an indication of high responsibility and large burden for their parents. About 35.5 percent of the children attributed their involvement in trading to the need to assist mainly their mothers. In Nigeria, it is easy to notice discrepancies between fathers and mothers by children. More affection is accorded to mother as a major care-taker from childhood with whom children commonly share their feelings and financial obligations. Earning a living and preparing for academic pursuit were the reasons given by 32.2 percent and 14.0 percent respectively. As expected, most Nigerians are poor, hence, are “characterized by low income, unstable employment, low status of job, large families, absence of savings and constant struggle for survival” (Onibokun and Kumuyi, 1996, Olanrewaju, 2004). Generally, the children lack adequate educational background that could earn them well-paid jobs. The highest attainment was secondary education (44.7 percent), followed by primary education (39.6 percent). Only 15.7 percent had no formal education.

As a result of the little interest in monthly-paid jobs which attracts low wages, women in Nigerian societies often like to expose their children to trading at an early age so that they can be enterprising or acquire basic trading knowledge. Seeing this as a regular source of income in an economy with poor capital base, explains why a significant proportion of the respondents (49.3 percent) preferred hawking to any other kind of business. This dominates the commerce of light manufactured goods like cosmetics, food stuffs and fruits with small capital resources. Since the activity does not take place in a fixed location, no rent or rate payment is demanded. Greater percentage (45.6 percent) was seen hawking at the motor parks in the markets and 37.2 percent inside the markets. Only a few rendered hired labor such as carrying loads, using wheel barrow in most cases and keeping shops.

The big threat to the contemporary Nigerian traditional family that is so obvious is the changing roles of women as providers in their poor status. Apparently, in recent time, men have seen themselves less and less as breadwinners, and have ceased to measure their masculinity through their success as husbands and providers (Jaja and Emelike, 2002). This suggests that, an increasingly large proportion of women of urban families, bear sole responsibility for their children’s well-being. Considering this implication, and the degree at which living in the city is expensive with the escalated economic hardship, it is expected that an average woman (mother), therefore, would desire to be creative, energetic and courageous, to be able to make ends meet. The highest employment (28.8 percent) of child laborers in Akure by women, however, is not unconnected with the failure on the side of men (fathers) to meet their responsibilities in the family. However, the unusual influence of fathers on child-labor (3.7percent) is not unlikely predicated on their desires to rely on the total support of mothers, who turn round to exploit the children.

Incessant illness, accidents and cases of theft remain the prominent problems of these child laborers in Akure. About 28.8 percent of them claim to work all-day-round, thus, often fall sick on account of regular stress. These children face the risk of being

knocked down by vehicles in the process of chasing buyers on motion in order to sell their articles. On several occasion, some (females in particular) are sexually harassed, while a few others (usually the young ones) are threatened by police for child abuse.

A hypothesis was established to determine if any significant correlation exists between the number of children engaged in trading (hawking) at the market areas and employment by women in the city. In the analysis, two variables were involved viz: level of child labor (X) and level of employment by women (Y). The Pearson's Correlation test was employed to determine the degree of correlation. The 'r' value in the correlation analysis is highly positive (i.e. 0.96) - a strong indication that a significant correlation exists between the level of child involvement in trading (hawking) and employment by women at the market areas in Akure.

6.0 Conclusion and Policy Implication

In this study, the role of women in child labor under the influence of poverty have been identified and analyzed. Research results indicate that concentration of markets and other business activities are the major locational factors that motivate childlabour in the core, transition and the peripheral areas of Akure. On the other hand, enlarged household size, poor education and interest of mothers in trading as a regular source of income are the socio-demographic factors that have implications for the continuous involvement of their children or wards in labor in the city.

Poverty is undoubtedly a potential cause of child labor in Akure as the situation is anchored on the desires of both the child and mother to alleviate family economic problems. The government therefore, needs to encourage more investment in those preventive measures such as poverty targeted social assistance programs that will provide cash grants to poor families with school age children. To compliment this effort, government should increase the scholarship awards / grants to the state indigenes in the tertiary institutions, and subsidize school fees at this level to make education affordable for all, especially the poor.

The World Bank regards women's education as the "single most influential investment that can be made in the developing world" (Ashford, 2001). The government therefore, should intensify effort to support women education more at the tertiary level by granting them "maintenance allowance" to serve as incentive for reducing the gender gap – differences in boys' and girls' enrollment in tertiary education. Also, government should try as much as possible to increase opportunities for women's employment and tackle the problems of retrenchment and low income to reduce family hardships that prompt child labor.

The existing law that proscribes children's (less than 18 years) employment should be enforced by government in the State. The free education programs (at the primary and post-primary level) of the State government, as well as the Universal Basic Education program of the Federal Government are laudable strategies that will enhance formal education of these children. In collaboration with these efforts, the State government, through the Ministry of Women Affairs and Youth Development should organize training of 'peer educators' to reach out to these young people and preach against child labor. The peer educators will carry out such duty like peer counseling, where more young people are trained to talk to their peers in the school, the workplace, playground or other public places frequented by children. Such message can also be delivered via the mass media and entertainment like songs, videos, television spots and

theatre performances. This will prove appealing while reaching the children in many settings.

Finally, the education and awareness of the women on the danger of uncontrolled birth should be intensified by the State Ministry of Health through the Family Planning Department, Hospitals and the Local Government Maternity and Health Centers in the town. Reduction in the current national population growth rate of 2.9 percent to 2.0 percent or lower by 2015, encouragement of child spacing, increase in the use of modern contraceptives by at least 2.0 percent points per year through family planning among others, are specific targets of the National policy on population which the health institutions must emphasize for sustainable development.

Finally, there should be regular campaign on child abuse by government and non-governmental agencies through publications, workshops, seminars, public lectures and so on. In this vein, it is necessary for government to initiate projects meant to teach vocational skills like; carpentry, sewing, painting, hair dressing and other small scale manufacturing to provide employment for those children who are interested in creative work. As practiced in Bangladesh, Mobile Training Schools can be introduced in Akure, such that classes are run in specific vocational skill at the market locations where child labor is common for career training. If these policies are adopted, the issue of child labor will certainly be minimized in Nigerian cities.

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Personalized offline signature verification using multiple HMM-classifiers and SOM-fuzzy decision fusion

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Abstract.

This paper presents a user-optimized multiple classifiers approach for an offline signature verification system. Local features are extracted from a sliding window that slides across the signature images. Multiple HMM-based classifiers are used for the soft decisions, where each classifier is trained on a particular feature. In this work, we select the two best features to represent each user via ANOVA statistical analysis. A fuzzy decision fusion system that is tuned using SOM based clustering technique is used to combine the soft decisions from the selected HMM classifiers in producing the final verification output. The system has been tested on SIGMA signature database which is a collection of over 6000 genuine and 2000 forged signatures. Results show that our personalized multiple classifiers approach out performs common single classifier systems.

Keywords: Fuzzy Decision Fusion, Hidden Markov Model, Multiple Classifiers, Offline Signature Verification System, Self Organizing Maps

INSPEC Code: (C10) Systems and control theory, (C61) Software techniques and systems, (C78) Other computer applications.

1. Introduction

Handwriting signature is a widely used form of human identification for paper based applications such as in legal document bindings and financial transactions. It is popular due to the ongoing tradition and also being the least pervasive form (Popel and Popel, 2005). Handwritten signature verification can either be in online (Alonso-Fernandez et al., 2005, Baltzakis and Papamarkos, 2001, Fierrez and Ortega-Garcia, 2008, Pascual-Gaspar and Cardenoso-Payo, 2007, Pascual-Gaspar et al., 2011, Sánchez-Diaz et al., 2010, Yanikoglu and Kholmatov, 2009) or offline domain (Das and Dulger, 2009, Freire et al., 2007, Frias-Martinez et al., 2006, José Vélez et al., 2009, Justino et al., 2005, Kertész and K"ovári, 2008, Ma et al., 2007, Piyush Shanker and Rajagopalan, 2007, Ruiz-del-Solar et al., 2008, Woo et al., 2006). In online domain, temporal and spatial signals captured by tablets and pens during the signing (Alonso-Fernandez et al., 2005, Baltzakis and Papamarkos, 2001, Fierrez and Ortega-Garcia, 2008, Pascual-Gaspar and Cardenoso-Payo, 2007, Pascual-Gaspar et al., 2011, Sánchez-Diaz et al., 2010, Yanikoglu and Kholmatov, 2009) are used, while in the offline domain, signature images captured on paper are scanned into digital images to be processed (Das and Dulger, 2009, Freire et al., 2007, Frias-Martinez et al., 2006, José Vélez et al., 2009, Justino et al., 2005, Kertész and K"ovári, 2008, Ma et al., 2007, Piyush Shanker and Rajagopalan, 2007, Ruiz-del-Solar et al., 2008, Woo et al., 2006). A lot of research has been done in both domains, with the aim of improving the accuracy in verifying human signatures.

Signature verification is challenging since there are two conflicting needs that must be fulfilled (Baltzakis and Papamarkos, 2001, Das and Dulger, 2009, Fierrez and Ortega-Garcia, 2008, Frias-Martinez et al., 2006, José Vélez et al., 2009, Justino et al., 2005, Pascual-Gaspar et al., 2011, Sánchez-Diaz et al., 2010, Yanikoglu and Kholmatov, 2009). One is that it must be flexible in accommodating variations inherent in human signatures. Unlike in other biometrics such as fingerprint and iris patterns which are highly stable and consistent, signature of a person differ in each instance of signing. Another need is that it must be accurate to reject skilled forgeries which is crucial, particularly in the offline domain which rely solely on the spatial images. It is easier to forge the shape of the signatures without being noticed. In the online domain, verification is performed using the dynamic signals (Alonso-Fernandez et al., 2005, Baltzakis and Papamarkos, 2001, Fierrez and Ortega-Garcia, 2008, Pascual-Gaspar and Cardenoso-Payo, 2007, Pascual-Gaspar et al., 2011, Sánchez-Diaz et al., 2010, Yanikoglu and Kholmatov, 2009), which are more resilient to spoofing as it is harder to obtain and to imitate dynamic signals (Sánchez-Diaz et al., 2010). In this work, we focus on increasing the accuracy of signature verification in the offline domain only. This is challenging as the two conflicting requirements mentioned earlier need to be satisfied simultaneously.

To perform offline signature verification, a set of features from the signature image needs to be extracted (Freire et al., 2007, José Vélez et al., 2009, Justino et al., 2005, Kertész and K"ovári, 2008, Ma et al., 2007). As the signature signal of each person is not unique across different users and less stable between samples of the same user, it is not effective to use the same set of features for all users. Many researchers tend to personalize the signature verification process at the classification level in both the online domain (Pascual-Gaspar and Cardenoso-Payo, 2007) and offline domain (José Vélez et al., 2009). Pascual and Cardenoso (Pascual-Gaspar and Cardenoso-Payo, 2007) for example performed user customization by modifying the HMM architecture to adjust the number of states and their Gaussian distributions to individual needs. José (José Vélez et

al., 2009) use snake adjustment technique to tune a fuzzy classifier system that is optimized to individual signer.

We hypothesize that different features provide different discriminating capabilities on different users; hence user customization needs to be done at both feature and classification levels. To prove that, we performed analysis on a single HMM based classifier built on a per feature basis across the signature population (Balbed et al., 2009). This leads to the building of an offline signature verification system optimized and customized to each user's needs by choosing the best set of features that can be used to characterize that user's signature.

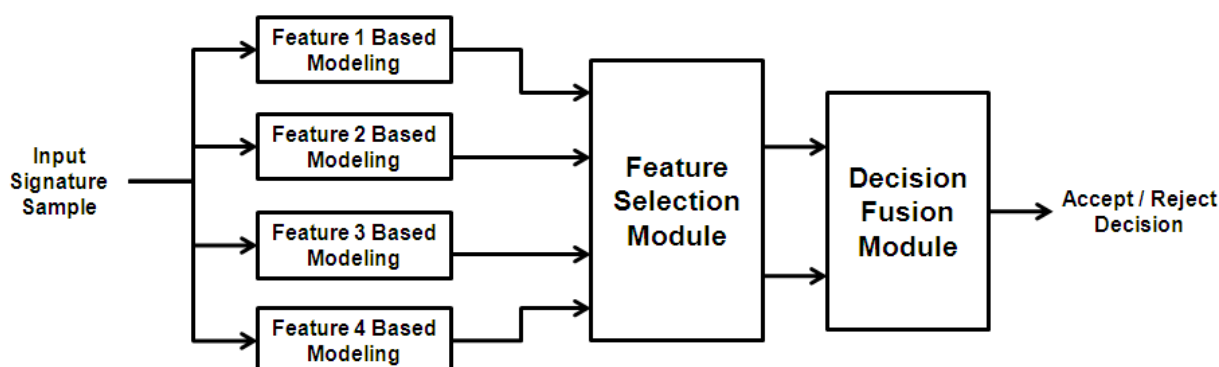


Figure1. A Generic multiple classifier approach

We then present a multiple classifier approach in Figure 1 that determines the best features to be used and how to combine them to increase the system verification accuracy taking into account the intra and inter user variability. This work is motivated by our earlier study on feature based analysis (Balbed et al., 2009) which indicated that feature selection per individual is necessary. The experiments reported in this paper were conducted on the SIGMA database (Ahmad et al., 2008) which consists of over 6000 genuine and 2000 skilled forged signatures. The database was collected, following closely the recommendations made by the UK Biometrics Group (Mansfield and Wayman, 2002) and the best practices made by International Organization of Standardization (ISO) (19795-2:2007, 2007) that emphasize on scenario evaluation. The data collection strategy used by SIGMA database ensures that it reflects a subset of signature samples of the Malaysian population, capturing the intra user variability of the target user population. Additionally, only forged signature samples of close resemblance are accepted into the database.

In this work, we improved the offline signature verification by using four localized static features; pixel density, centre of gravity, angle and distance, all computed within a sliding window of 5×5 pixels across the image. The signatures are modeled by Hidden Markov Models (HMM) to cater for intra user variability in them as done by other researchers (Alonso-Fernandez et al., 2005, Fierrez and Ortega-Garcia, 2008, Justino et al., 2005, Pascual-Gaspar and Cardenoso-Payo, 2007). The p-values obtained by ANOVA statistical analysis (Balbed et al., 2009, Guest, 2004) was used to identify the best two features for each user. The features are then used by a Fuzzy Logic module to fuse the soft HMM probability decisions into a final hard decision of accepts or reject. The Fuzzy Logic is tuned via Self Organizing Maps (SOM) (Rabiner, 1989) which is customized to individual user.

The rest of this paper is organized as follows: Section 2 presents the SIGMA database used in this work. In Section 3, experimental setups, categorization of signature samples, testing methodology and performance measurements are described. Sections 4 and 5 explain the overall framework of both the single classifier (pre-processing, feature extraction, HMM modeling, verification, z-score comparator) and multiple classifiers approach (ANOVA feature selection, fuzzy decision system and SOM). The experimental results and discussions are presented in section 6 followed by a conclusion.

2. SIGMA database

The experiments conducted in this work were done using the SIGMA database, compiled by the authors. The data collection strategies for SIGMA were presented in (Ahmad et al., 2008). The database contains over 6000 genuine and 2000 forged signature samples. It was compiled from a population of Malaysians. Genuine signature samples were taken in three different occasions to capture the necessary intra user variability. All forgeries in the database are ‘skilled’ as forgers were given sufficient genuine signature samples and ample time to practice. Only forged signature samples with high level of imitation were accepted into the database. Both offline and online signals were captured for each signature but in this work we only use the offline images.

The samples were signed within guided boxes on A4 papers. The papers were then scanned to obtain grey-scale images of 600 dpi resolution. Signature images were cropped to achieve invariability in orientation, position and size. The total number of genuine and skilled forged signature samples for each user is 30 and 10 respectively. The image resolution, number of samples, number of users, and type of forgeries are comparable to other offline signature databases such as GPDS (Vargas et al., 2007) and MCYT (Freire et al., 2007), as illustrated in Table 1. SIGMA database has slightly less skilled forged signature samples but this is compensated by the inclusion of random forgeries in the testing of false claim of identity (see Section 3).

Table 1. Comparisons between several offline signature databases

| Criterion | GPDS | MCYT | SIGMA |
|--------------------------------------|---------|------------------|-----------|
| Total number of writers | 160 | 75 | 265 |
| Types of forgery | Skilled | Skilled & Random | Skilled |
| Total number of genuine samples / 24 | | 15 | 30 |
| Total number of forged samples / 30 | | 15 | 10 |
| Demographic types of writer | Spanish | Spanish | Malaysian |

3. Experimental Set-ups

Our experiments were carried out according to the best practices of biometrics testing and reporting (19795-2:2007, Mansfield and Wayman, 2002). Two tests were done; genuine claim of identity and false claim of identity. In the first, genuine samples are compared against the claimed reference model. Invalid verification leads to False Rejection Rate (FRR) or Type I error. In the second one, the false claim of identity test, two different samples can be used to compare against the claimed reference model;

random forgeries (different user signature samples) or skilled forgeries (skilled forged signature samples). In both cases, any valid verification for false claim of identity gives rise to False Acceptance Rate (FAR) or also known as Type II error.

For our experiments, the SIGMA database is divided into 3 different sets for different purposes as shown in Figure 2. Each set is chosen so as to avoid any biasness in results. Set I (which consists of 10 genuine samples) is used to build the reference model for each user, Set II (which consists of 10 genuine, 5 random forged and 5 skilled forged samples) is used to investigate the performance of the individual classifier and to tune the multiple classifier system and Set III (consisting of 10 genuine, 5 random forged and 5 skilled forged samples) is used to investigate the performance of the multiple classifier system.

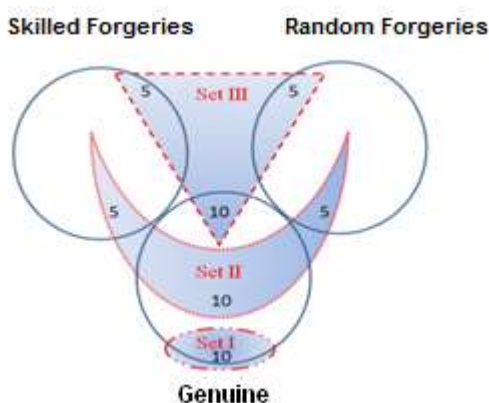


Figure 2. The categorization of signature samples

System performance is measured in terms of the Equal Error Rate (EER) which is the most commonly used metric in the signature verification research domain (Alonso-Fernandez et al., 2005, Fierrez and Ortega-Garcia, 2008, José Vélez et al., 2009, Pascual-Gaspar and Cardenoso-Payo, 2007, Sánchez-Diaz et al., 2010, Woo et al., 2006, Yanikoglu and Kholmatov, 2009). EER is the crossing point between False Acceptance Rate (FAR) and False Rejection Rate (FRR). We are not able to compare the EER results of our experiments with other researchers as we used our own dataset, namely the SIGMA database as mentioned earlier. It is worthy to mention that due to the data collection strategies of the SIGMA database which are different from other databases as highlighted in Section 2, objective comparisons between our results and those of others cannot be made (Woo et al., 2006, Yanikoglu and Kholmatov, 2009). Instead, in our work, we measure the performance improvement (PM) as in Equation 1, between single and multiple classifier approaches. The next two sections present in detail the methodologies of these two approaches.

$$PM \% = \frac{EER_{singleclassifier} - EER_{multipleclassifier}}{EER_{singleclassifier}} \quad (1)$$

4. The Single classifier approach

As shown in Figure 3, this approach involves 5 stages which are pre-processing, feature extraction, modeling, verification and z-score comparator. The first two are common for training and testing. Four features are extracted and used in a single classifier, giving four single classifiers. The modeling and verification stages make use of Hidden Markov Model (HMM). Each of the five stages is described in the following sub-sections.

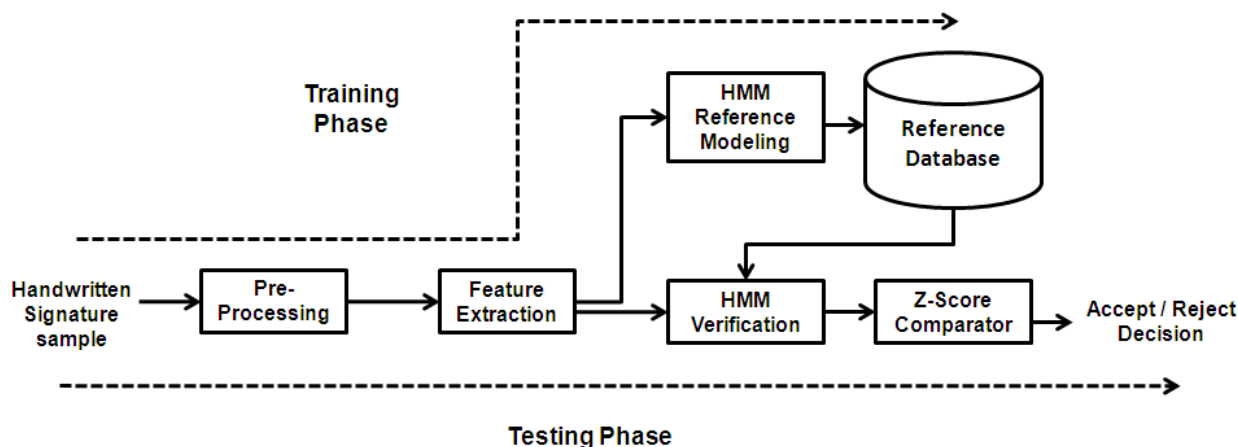
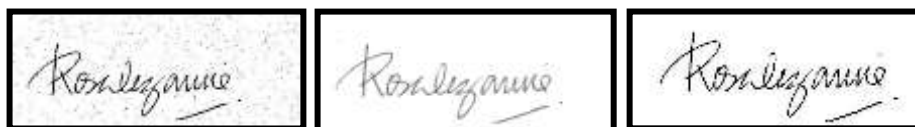


Figure 3. The Single classifier system

4.1 Pre-processing

Offline signature images often contain noise introduced on the paper and during the scanning process. Pre-processing step is needed to remove the noise (Kertész and Kóvári, 2008, Ma et al., 2007, Piyush Shanker and Rajagopalan, 2007, Woo et al., 2006) to ensure that only the desired signals are fed to the feature extractor (José Vélez et al., 2009, Justino et al., 2005, Kertész and Kóvári, 2008, Ma et al., 2007, Piyush Shanker and Rajagopalan, 2007, Ruiz-del-Solar et al., 2008, Woo et al., 2006). Pre-processing involves binarization and noise removal. Binarization converts the scanned gray image into black and white. It was performed using Otsu's (Ostu, 1979) global image threshold to reduce inter class variance of black and white pixels. Noise removal was done using median filter with a 3×3 mask (Ma et al., 2007). Figure 4 shows examples of the resulting images after each pre-processing step. Normalization of the image size, orientation and position was not carried out they are already so.



(a) Scanned Image (b) Binarized Image (c) Noise Removed Image

Figure 4. The results of pre-processing on signature image

4.2 Feature extraction.

In this work, features are extracted on sliding windows of 5×5 pixels along horizontal lines across all pixels of the image.

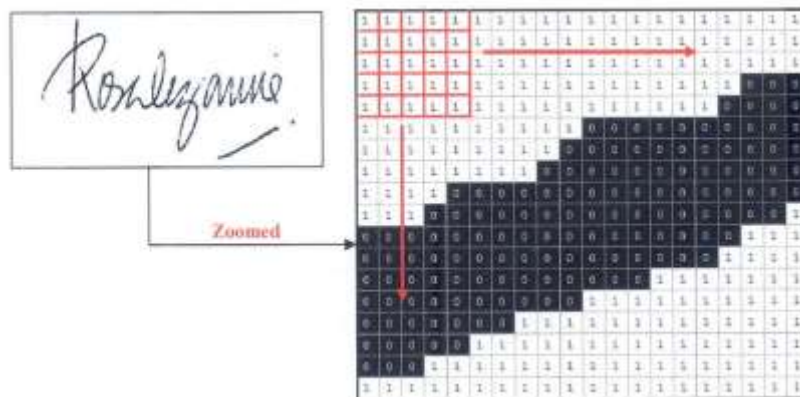


Figure 5. The 5×5 sliding window for feature extraction

There are four features extracted in each window; pixel density, centre of gravity, angle and distance. Computation of pixel density and centre of gravity is straight forward (Justino et al., 2005). In Equation 2, Pixel density (PD) measures the total number of black pixels in the window, whereas in Equation 3, centre of gravity (CG) calculated as the average position of all black pixels from the bottom left most corner of the window (x_0, y_0) .

$$PD = \sum \text{blackpixel} \quad (2)$$

$$CG = \sum \sqrt{(x_{\text{blackpixel}} - x_0)^2 + (y_{\text{blackpixel}} - y_0)^2} \quad (3)$$

Extraction of angle and distance require skeletonization of the image to reduce the thickness of black lines to 1 pixel thick. Angle (AgI) as in Equation 4, is then computed by taking the average angle of each black pixels in the skeletonized image window with respect to the bottom left pixel (x_0, y_0) . In Equation 5, Distance ($Dist$) is taken as the average distance from each black pixel to the bottom left pixel (x_0, y_0) .

$$AgI = \frac{\tan^{-1} \left(\frac{y_{\text{blackpixel}} - y_0}{x_{\text{blackpixel}} - x_0} \right)}{PD} \quad (4)$$

$$DIST = \frac{\left(\frac{y_{\text{blackpixel}} - y_0}{x_{\text{blackpixel}} - x_0} \right)}{PD} \quad (5)$$

4.2 HMM-based reference modeling

Discrete Hidden Markov Model (HMM) is used to model individual local features extracted from the sliding windows of the genuine signature samples for each user. HMM

(Rabiner, 1989) is a doubly embedded stochastic process; one hidden process observable through another stochastic process that produce a sequence of observations (Rabiner, 1989). An HMM is described by Equation 6.

$$\lambda = (A, B, \pi) \tag{6}$$

where,

A = matrix of the probabilities of transition from one state to another

B = matrix of the probabilities of observation in a particular state

π = the initial probability distribution for the states

In our work, an ergodic (fully connected) 5-state discrete HMM as in Figure 6 is used.

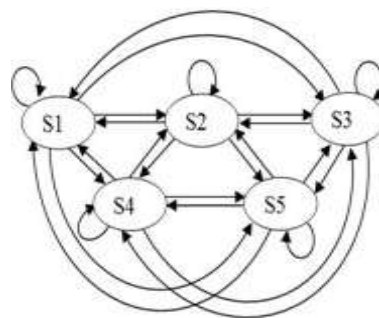


Figure 6. The discrete HMM topology

The topology was chosen to reduce the occurrence of infinity results in the discrete HMM (due to non-occurrence of a symbol) and to cater for intra user variability. The choice was made after empirically tuning the HMM by varying the number of states in an ergodic HMM network. It was discovered a 5-state topology gives the most optimum and stable results. The Baum-Welch algorithm (Rabiner, 1989) was solved. A series of similar features (feature i) from the sliding windows was used to build the reference model $\lambda_{x,i}$ for a particular user x . This was done for all four features, producing four reference models for user x (i.e. $\lambda_{x,PD}$, $\lambda_{x,CG}$, $\lambda_{x,Agl}$ and $\lambda_{x,Dist}$ for models based on pixel density, centre of gravity, angle and distance respectively). To account for intra-user variability the model was built from a set of 10 genuine signature samples belonging to user x from Dataset I. The HMM models are then stored in the reference database indexed on user IDs.

4.4 HMM-based verification

For verification, an unknown test sample t is tested for authenticity. The verification solves HMM Problem 1 of Rabiner (Rabiner, 1989): evaluates the probability that the sample t matches the reference model $\lambda_{x,i}$ ($P(t_i | \lambda_{x,i})$).

4.5 Z - score comparator.

The output of the verification module $P(t_i | \lambda_{x,i})$ is transformed into its equivalent z-score value $zP(t_i | \lambda_{x,i})$. In order to ease the threshold setting using the formula in Equation 7.

$$zP(t_i/\lambda_{x,i}) = \frac{\{P(t_i/\lambda_{x,i}) - \mu_{x,i}\}}{\alpha_{x,i}} \quad (7)$$

where

$\mu_{x,i}$ = mean value for $P(t_i | \lambda_{x,i})$ for the training data set I

$\alpha_{x,i}$ = standard deviation value for $P(t_i | \lambda_{x,i})$ for the training data set I

In the z-score comparator it is assumed that $zP(t_i | \lambda_{x,i})$ follows a normal distribution, lying closely to the centre of z-score distribution (i.e. when z-score is near zero). The value of $zP(t_i | \lambda_{x,i})$ is compared against a threshold_i to arrive at the decision of accepting the test sample as ‘genuine’ or rejecting it as ‘forgeries’ using Equation 8.

$$\text{If Absolute } \{zP(t_i/\lambda_{x,i})\} \leq \text{threshold, then Accept: else Reject} \quad (8)$$

As mentioned in section 3, Dataset II (10 genuine and 10 forged signature samples per user) is used during testing where performance is measured in Equal Error Rate (EER). As EER is the crossing point between False Acceptance Rate (FAR) and False Rejection Rate (FRR), threshold_i is adjusted globally for all users until the equivalent EER_i is achieved.

5. The multiple classifier approach

In the multiple classifier approach, HMM classifiers were used on each feature as in the single classifier approach. Next, the best two features for each individual user were selected based on ANOVA statistical analysis (Figure 7). However, for combining the results of individual feature modeling $P(t_i | \lambda_{x,i})$, the z-score comparator was not used. In the multiple classifiers system, a more practical approach for combining the soft HMM based decisions is devised.

A study of the existing classifier systems being used in offline signature verification systems (José Vález et al., 2009, Woo et al., 2006) revealed that the use of a soft decision module such as a Fuzzy classifier would yield the most optimum results in our case. Therefore in this work we use a Fuzzy decision fusion module tuned by SOM to combine the soft decisions from multiple classifiers to arrive at a final accept/reject decision as shown in Figure 7.

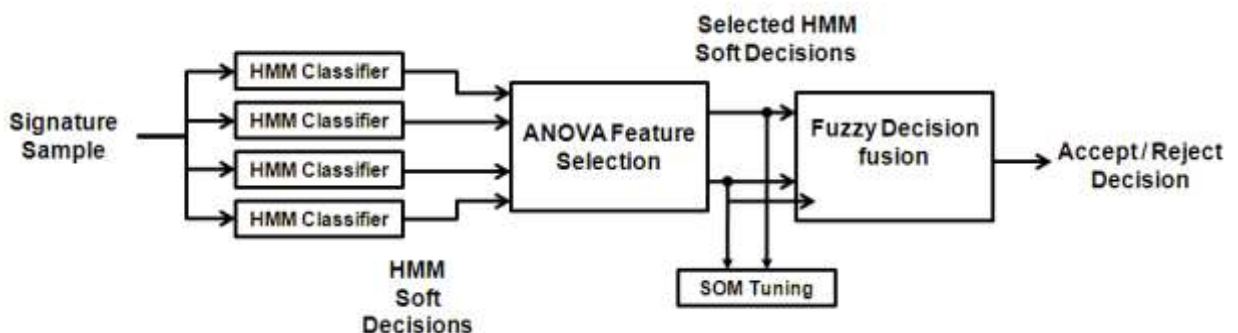


Figure 7. The multiple classifiers system

5.1 ANOVA statistical analysis

Analysis of Variance (ANOVA) is a statistical technique that can be used to determine the existence of differences among several population means. Guest (Guest, 2004) used ANOVA to study the stability of a set of global features in human signatures. It is not possible to analyze local features directly using ANOVA, therefore in this work, we apply ANOVA on $P(t_i | \lambda_x, i)$ of the HMM verification results to identify the stability of each local feature (Balbed et al., 2009). We used ANOVA on Dataset II to evaluate the p-values for the features. A low p-value (less than 0.05) indicates that the feature is stable (consistent across genuine samples, different between genuine and forged samples). An ideal p-value is 0, however, for feature selection purposes, it is sufficient to rank the features according to their p-values. We select only two features with the lowest p-values.

5.2 SOM-guided fuzzy decisions fusion

The Fuzzy Decision Fusion has been successfully applied in the offline signature verification domain (José Véléz et al., 2009, Woo et al., 2006). It consists of fuzzy membership functions and fuzzy rules encapsulated in the fuzzy association matrix. It is used to combine the results of the best features selected earlier. Its output is a final verified output from the HMM probabilistic decisions of the different classifiers. It can also combine soft decisions from imprecise data. Tuning of the system is done on every user. A SOM-based clustering technique is used to aid in the task of modeling the most optimum fuzzy classifier for each user. SOM is an unsupervised neural network (Chen and Mynett, 2004) which provides a representation in 2-dimensions that describes the clustering of signatures belonging to different groups. This was again done on Dataset II described earlier. A similar approach has been applied successfully in other domain (Chen and Mynett, 2004) where fuzzy induction rules are only constructed whenever there is no statistically significant overlap between SOM clusters of 97.5% confidence interval bands. Figure 8 illustrates an example of U Matrix and SOM diagrams for two best features for a user (centre of gravity (CG) and angle (Agl)). The U-Matrix (Unified Distance Matrix) is a representation of a SOM where the Euclidean distance between the codebook vectors of the neighboring neurons is depicted in a gray scale image to visualize the data in a high dimensional space.

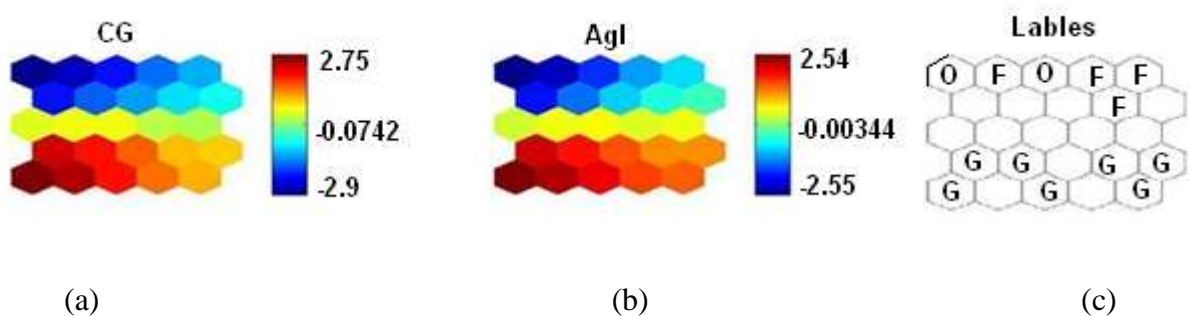


Figure 8. (a) The SOM diagram for centre of gravity feature, (b) The SOM for diagram for Angle Feature, (c) The overall U-matrix

The SOM information is used to tune the fuzzy membership and to construct the fuzzy association matrix. The fuzzy membership function consists of triangular shapes for three fuzzy sets, namely Low, Medium and High. The triangular shapes were chosen due to their simplicity of configuration (Woo et al., 2006). The boundaries are customized to individual user using the SOM data. In this work, we used only two input features in order to reduce the complexity of the fuzzy association matrix that contains the inference rules. Figure 9 shows an example of a personalized fuzzy membership function and Figure 10 illustrates a fuzzy association matrix.

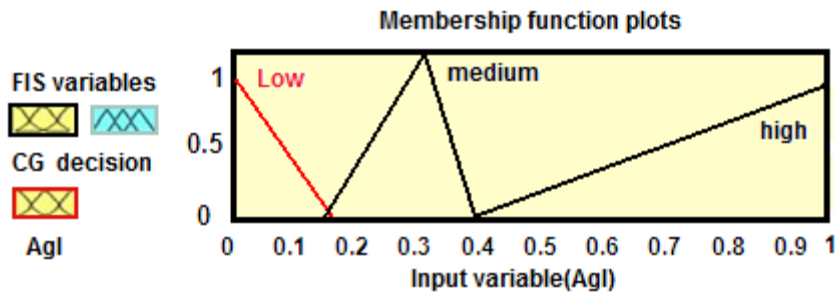


Figure 9. A Personalized fuzzy membership function for angle feature

- 1.if (CG is high) and (Agl is high) then (Decision is accept)
- 2.if (CG is high) and (Agl is medium) then (Decision is accept)
- 3.if (CG is high) and (Agl is low) then (Decision is accept)
- 4.if (CG is medium) and (Agl is high) then (Decision is reject)
- 5.if (CG is medium) and (Agl is medium) then (Decision is reject)
- 6.if (CG is medium) and (Agl is low) then (Decision is reject)
- 7.if (CG is low) and (Agl is high) then (Decision is reject)
- 8.if (CG is low) and (Agl is medium) then (Decision is reject)
- 9.if (CG is low) and (Agl is low) then (Decision is reject)

Figure 10. A Personalized fuzzy association matrix

6. Results and discussions

The error rate of a single classifier using one feature is as shown in Figure 11. The x and y axis represents the threshold and the system the error rate respectively. The False Rejection Rate (FRR) is the error rate that a genuine signature is wrongly rejected, while the False Acceptance Rate (FAR) is the error rate that a forged signature is mistakenly accepted. Figure 11 also shows two types of FAR; skilled and random. It consistently shows that the skilled forgeries gives higher FAR than the random ones for all features. This is expected since the skillfully forged signatures are of closer resemblance to genuine signature images.

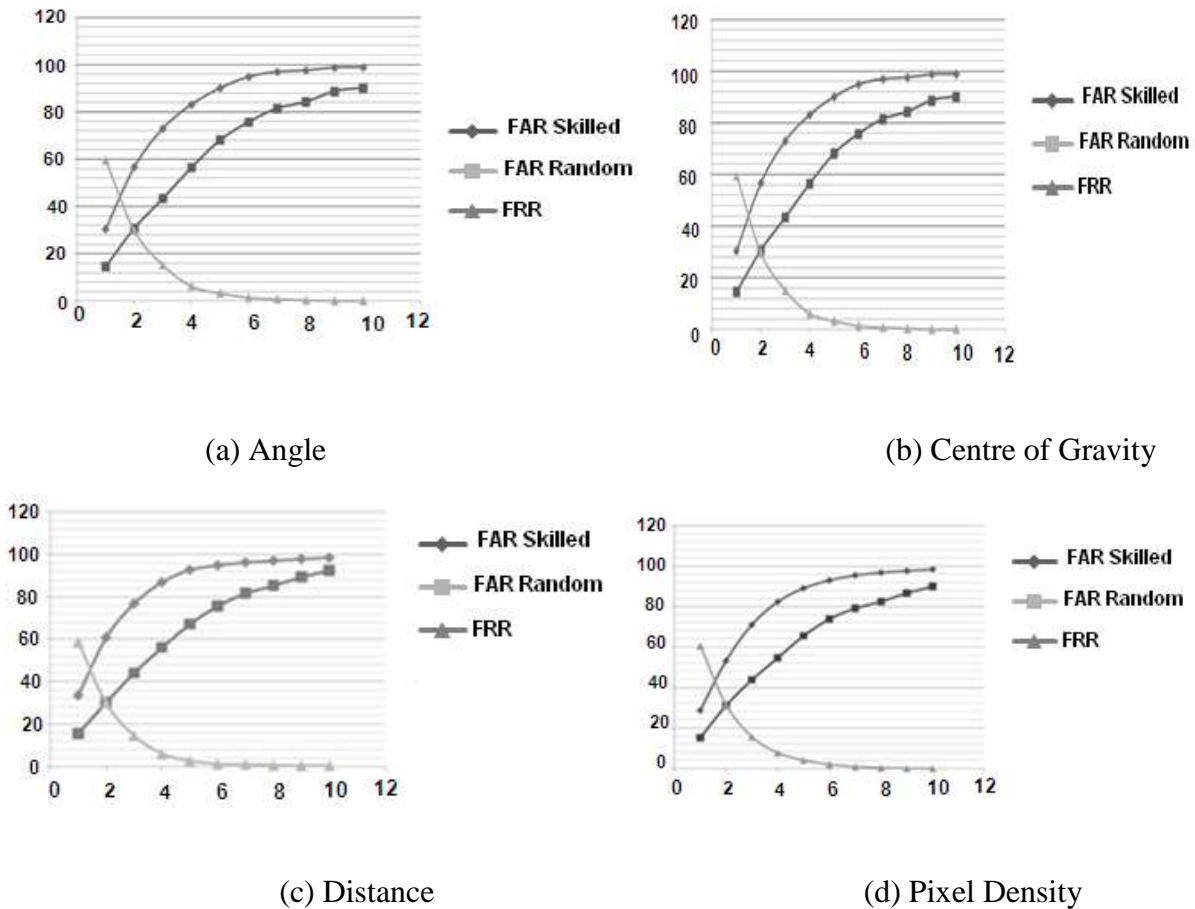


Figure 11. Performance of a single classifier for each feature where x and y axis represents threshold and error rate respectively.

Table 2 gives the Equal Error Rates (EERs); the common point for the combination of both FARs (skilled and random forgeries) with the FRR for all single classifiers. The values for each feature ranges from 36% to 37% which is considerably high.

Table 2.Equal error rates (EER) for feature based HMM classifiers

| Feature based HMM classifier | EER |
|------------------------------|--------|
| Centre of Gravity (CG) | 37.0% |
| Pixel Density (PD) | 37.5% |
| Distance (Dist.) | 36.0% |
| Angle (Agl.) | 36.75% |

Table 3 shows the results of ANOVA analyses. As can be seen from the table, the percentage of user population with p -value less than 0.5 varies among the classifiers and is in the 50% range. It indicates that the individual classifiers are stable for only half the

user population thus making it difficult to construct an accurate signature verifier that relies on a single feature.

Table 3. Statistics of users with P-value less than 0.05

| Feature based HMM classifier | Percentage (%) of user population |
|------------------------------|-----------------------------------|
| Centre of Gravity (CG) | 57.7% |
| Pixel Density (PD) | 55.4% |
| Distance (Dist.) | 58.5% |
| Angle (Agl.) | 59.2% |

There are also large variations in the frequency of each feature being selected as one of the two best features. In Table 4, the percentage column shows how many percent of the time the particular feature is being selected. Distance feature is the least frequently selected although it gives the second highest percentage of users with p -values less than 0.05 and the lowest EER indicating that a good feature across the user population may not be amongst the two best features to describe an individual user signature.

Table 4. Statistics of feature being selected as the two best features

| Feature | Percentage (%) of user population |
|------------------------|-----------------------------------|
| Centre of Gravity (CG) | 54.6% |
| Pixel Density (PD) | 50.8% |
| Distance (Dist.) | 40.8% |
| Angle (Agl.) | 53.8% |

With four features, there are six possible combinations of the best two features. Table 5 shows the percentage appearance of each two-feature combinations. Each combination gives different identifying or discriminating effects, indicating that it is not practical to identify a common set of features effective for all users. This justifies the need to individually select feature(s) for each individual user.

Table 5. Statistics of the best two selected features

| Feature | Percentage (%) of user population |
|----------------|-----------------------------------|
| CG and PD | 26.15% |
| CG and Dist. | 6.15% |
| CG and Agl. | 22.3% |
| PD and Dist. | 13.8% |
| PD and Agl. | 10.8% |
| Dist. And Agl. | 20.8% |

The performance of our personalized Automatic Signature Verification (ASV) system using multiple classifiers approach is shown in Figure 12. FAR in the Figure 12 represents both the skilled and random forgeries. It indicates significant reduction on the overall EER to 13% resulting in system performance improvement of approximately 64%.

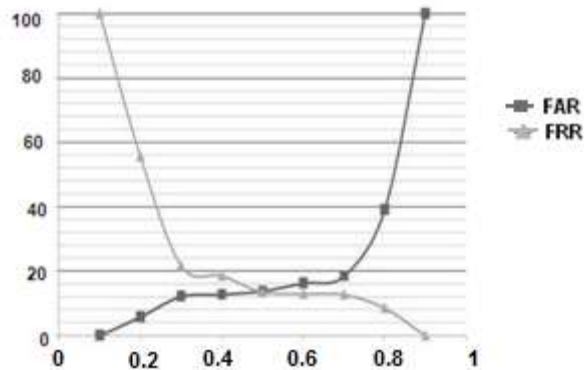


Figure12. Performance of multiple classifiers system

7. Conclusion

We have developed automatic signature verification (ASV) system that uses signature data samples with inconsistencies in the genuine samples and low degree of uniqueness between samples of different users. The results obtained in the analyses done shows that for signature biometrics, it is difficult to use a single feature which is effective for all users, thus the need to use a selection of features. However, to obtain an optimum set of features common for all users is also not practical since different set of features give different identifying or discriminating effects on different users. In this work, we proposed the use of personalized feature set for each individual user. We have presented the design of an offline ASV system using multiple classifiers that selects and combines features systematically. The proposed technique has been proven effective in comparison to the single classifier approach where the overall EER has been reduced significantly

from 37% to 13%, resulting in a 64% performance improvement. The proposed technique can be applied to other biometrics which suffer from similar intra and inter user variability issues, such as speaker and gait recognition systems.

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The needs of families of persons with mental health difficulties

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Abstract

Background: Families of persons with mental health difficulties play a significant role in mental health care, and studies have shown the efficacy of support programmes for families. It is important to understand families' needs in order to design an effective programme, yet review studies on the needs have been limited. **Aims:** To clarify families' needs and correlations between families' or their relatives' characteristics and the number or kind of needs, with a review of lately published articles. **Methods:** PubMed and Web of Knowledge were searched with the terms of 'mental illness' OR 'mental disorder' AND 'family' AND 'needs'. **Results:** Sixteen articles were identified by the search. Families generally showed great needs for information about their relatives' illness. Families wanted emotional care as well. Some studies found associations between families' characteristics such as age and gender and the number or kind of needs, while associations between relatives' characteristics such as duration of illness and the number or kind of needs among families were detected in some other studies. **Conclusions:** Families needed to understand their relatives' illness and to cope with it, whereas families also wanted to be emotionally cared for. It is important to care not only for persons with mental health difficulties, but also their families in order to help them deal with their situations better.

Keywords: carer, caregiver, family, needs, schizophrenia, persons with mental health difficulties

Introduction

Families of persons with mental health difficulties have received attention in various studies. Families play a significant role in efforts towards recovery of their relatives (Addington et al., 2005; Jones, 2009), hence they being important key workers in mental health care.

Whilst families can have positive gains such as becoming more sensitive to persons with disabilities, engendering a greater sense of inner strength and intensification of a relationship with members having mental health difficulties by caring for them (Bauer et al., 2012; Chen and Greenberg, 2004), it is also common that families experience a burden, stress (Caqueo-Urizar and Gutiérrez-Maldonado, 2006; Chan, 2011; Loukissa, 1995; Maji et al., 2011; Saunders, 2003; Teschinsky, 2000) and low quality of life (Boyer et al., 2012; Wong et al., 2012). Furthermore, a study with a follow-up period of 15 years (Brown & Birtwistle, 1998) found that families' distress unchanged between baseline and follow-up, which suggests that families can continue to feel distressed for a long time.

In response to families' difficult experiences, services have been offered to them in order to help them cope with their situations better. A systematic review of 12 studies (Bademli & Çetinkaya Duman, 2011) revealed that family-to-family support programmes for families of patients with schizophrenia had a favourable impact on families, such as bringing about a decrease in the burden and depressive symptoms and an increase in family functioning. In addition, such programmes affected patients positively as well, including an increase in functioning and decrease in readmissions.

To design an effective programme for families, which can have a positive influence both on families and persons with mental health difficulties, it is important to understand what families want. Literature reviews would be useful for this purpose. However, there have been few reviews on needs of families. Noble and Douglas (2004) reviewed 12 articles on families' needs, showing that they wanted information, involvement in decision making, supportive and communicative staff and good coordination among services. Over half of the family participants in the articles reviewed were caring for patients with schizophrenia spectrum disorder. These articles were published between 2001 and 2003. Considering that families' needs might have changed over the past ten years, it would need to review recent studies in order to gain new findings. Furthermore, it would also be helpful to understand what factors are correlated with greater, fewer or specific needs, as such understanding can lead to more appropriate service provision with families.

The aims of the present study were, therefore, twofold: to clarify (1) needs of families of persons with mental health difficulties and (2) correlations between families' or their relatives' characteristics and the number or kind of needs, with a review of studies published since 2004.

Methods

Inclusion/exclusion criteria

Included are empirical studies (1) in which 90% and over of the whole sample consists of families of persons with mental health difficulties or (2) in which 90% and over of one of the sample groups consists of such families and (3) investigating the families' needs or (4) investigating the families' needs and correlations between needs

and characteristics of the family respondents. In the present study, families were defined as relatives such as parents, partners, children and siblings, and persons with mental health difficulties were defined as those who have a psychiatric diagnosis. Studies focusing only on families' opinions on their relatives' needs were excluded because these were not the needs of families but the needs of the persons with mental health difficulties.

Search strategy

Two electronic databases were searched between 2004 and November 2012: PubMed and Web of Knowledge. English language studies were searched, with the search terms being 'mental illness' OR 'mental disorder' AND 'family' AND 'needs'. In the search on Web of Knowledge, the terms were used for Topic search, and Document types were restricted to Article.

Study selection

Articles were retrieved for further assessment if the title or abstract suggested that they dealt with the needs of families of persons with mental health difficulties. If an abstract did not provide sufficient information, the full text was screened for eligibility.

Results

Search results

A total of 4,086 titles were identified by the database search. Of these, 4,051 were excluded upon reading the title and abstract. In the next stage, full texts of fifteen articles of which an abstract provides insufficient information were read, leaving ten articles excluded because of the non-eligibility. Thus, potentially appropriate articles were 25. After the inclusion criteria were applied to these articles, a further nine were excluded: four assessed families' opinions on relatives' needs; the relationship between persons with mental health difficulties and those who care for them was unknown in three articles; and the proportion of non-family participants such as friends exceeded 10% in the remaining two articles. As a result, 16 articles were included for the review in the present study. Of the 16 articles, two (Graap et al., 2008a; Graap et al., 2008b) were counted as one study, with these describing the same study. Thus, the present study reviewed 15 studies.

Studies and participants

Of the 15 studies, only one employed a prospective design with the follow-up period of nine months (Pickett-Schenk et al., 2006). The participants were randomly allocated into two groups: a family-led education programme (an intervention group, N=231) and a control group who were on a waiting list for the programme (N=231). These groups did not significantly differ in demographic or other background features, nor did demographic and psychiatric characteristics of their relatives with mental health difficulties differ. The education programme included participants receiving information on the mental health service system and learning how to access services. Communication and problem-solving skills training were also provided. The participants in the intervention group were interviewed one month before the start of the programme, at course termination and six months after the programme, and the participants in the control group were interviewed at baseline, three months after baseline and eight months post-baseline. The study employed the Family Information Needs scale to assess their

needs. Follow-up rates for both groups were 93% at the second interview and 89% at the third interview. The total number of persons with mental health difficulties was 369, of which 45% were living with the participants and 16% were living with other family members or friends.

The other 14 studies used a cross-sectional design, of which 11 were quantitative studies and 3 were qualitative studies. Table 1 shows characteristics of the 11 quantitative studies. Wancata et al. (2006) used two different sample groups of families: 56 family carers and another 50 carers. However, only findings of the latter sample were included in the present study, as the interview with the former was conducted in order to test whether carers agreed with the content of the research instrument developed by the authors rather than assessing their needs. Mulligan et al. (2012) followed eleven participants after the initial assessment, yet findings of the follow-up were not taken into consideration in the present study because it was for assessing test-retest reliability. Characteristics of the three qualitative studies are shown in Table 2. Of these three studies, one employed the focus group discussion method, where several participants discuss the same topic, whilst the remainder used one-to-one semi-structured interviews. Table 3 reports gender distribution, age and family participants' relationship to persons with mental health difficulties in the 15 studies included. Gender, age and diagnosis of persons with mental health difficulties are presented in Table 4.

Families' needs

Quantitative studies

Of the 12 studies, half investigated families' needs comprehensively, whilst three focussed on educational needs, as did one on information needs, another one on information and educational needs, and the remainder on service needs.

With respect to comprehensive needs, Wancata et al. (2006) found that Counselling and support of the carer by a professional (74%) was most frequently needed by the participants, followed by Self-help group for family members and Relatives group guided by a member of the professional team (66% respectively). The most frequent unmet needs were observed in Printed information material (28%) and Multi-family groups (24%). In a study by Graap et al. (2008a), carers of persons with anorexia nervosa needed Individual psychoeducation, Psychoeducational group and Printed information material most often (93.8% respectively), while carers of persons with bulimia nervosa needed Support/counselling of the carer by a professional most frequently (93.8%), followed by Individual psychoeducation and Family counselling by a professional (87.6% respectively). The most common needs among carers of persons with schizophrenia were noted in Support/counselling of the carer by a professional (90%), Individual psychoeducation (80%) and Printed information material and Family counselling by a professional (73.4% respectively). On the total scores of needs, carers of persons with anorexia nervosa and schizophrenia had significantly higher values than carers of persons with bulimia nervosa. Furthermore, higher ratings were detected in female carers compared to male counterparts. There was no significant correlation between the severity of the relatives' symptoms and duration of illness and the total score. Wancata et al. (2008) found that the intervention needed most frequently was Counselling and support of the carer (mother: 75%, father: 60.6%), followed by Individual psychoeducation (57.8% and 27.8% respectively) and Relatives group guided by a professional (50.9% and

30.8% respectively). Mothers voiced higher frequencies of needs than fathers in all items, with the total score of needs being significantly higher in mothers. Among mothers there was a positive correlation between the Positive and Negative Syndrome Scale (PANSS) general sub-scores of their relatives and the number of needs. A shorter duration of illness was associated with a higher number of needs.

In a study by Yeh et al. (2008), the prevalence of needs in sub-scales was highest in Assisting the aggravating patients (87.2%), Occupational therapy (83.3%) and Transport of the aggravating patient to service setting (79.4%). The mean prevalence of the four need clusters was as follows: Assistance with patient care (77.6%), Access to relevant information (68.2%), Societal support (66.1%) and Burden release (27.2%). Respondents whose patients had duration of illness of more than two years reported needs for Understanding mental health laws and Advice on intimate relationships for a patient more often. Furthermore, younger carers were more likely to need General psychological or practical support and Coping with medical teams. Absalom-Hornby, Gooding and Tarrier (2011) observed that relatives showed the greatest needs for Information about schizophrenia and Relapse prevention (both 100%), followed by the need for Antisocial behaviour classified into the category of Coping with symptoms (83%). In a study by Mulligan et al. (2012), Monitoring of early warning signs was the most needed item (total score = 28), followed by Information (total score = 27) and Emotional experience difficulties (total score = 25), whereas the most urgent needs were noted in Emotional experience difficulties (total score = 25), Affective difficulties (total score = 20) and Constructive difficulties (total score = 19). The overall mean number of needs was 7.58, of which 6.03, on average, was classified as urgent needs.

Regarding educational needs, Sung, Hixson and Yorker (2004) revealed that relatives were most interested in Ways of managing stress more effectively (mean score = 4.08; range = 1-5), Coping with depression and suicidal thoughts and Managing 'burnout' (mean = 4.06 respectively). In a study by Gümüş (2008), relatives needed education on Legal rights of patients with schizophrenia, with an average score of 2.8 (range = 1-3). Education needs for Symptoms that occur when schizophrenia is recurring and for Coping with problems that occur from being a patient with schizophrenia in society received average scores of 2.73. Relatives who had not received education about schizophrenia generally had greater needs compared to those who had received it. The mean scores for needs among families were not statistically different according to their age and gender. In a study by Wei and colleagues (2010), the highest mean scores were observed in needs for Ways of managing stress more effectively (4.19; range = 1-5), Psychiatric medications (4.18) and Loss of pleasure (4.17). Carers of persons with schizophrenia showed more significant unmet needs in items focussing on managing the symptoms of schizophrenia compared to carers of persons with mood disorder.

Pickett-Schenk et al. (2006) investigated information needs on problem management and enhancing patients' social functioning. The study revealed that respondents who had relatives with a primary diagnosis of schizophrenia showed significantly higher needs for social functioning information across all time points. Older participants needed both problem management and social functioning information significantly more than younger counterparts. As for changes in needs, participants in the intervention group showed a significant decrease in both needs for problem management and social functioning information immediately after the programme, and the improvements were sustained over the follow-up period. Drapalski and colleagues (2008)

found that 65% of respondents wanted information about Future planning for care, with 57% of them indicating a need for Advocating for services for their relatives and 52% needing information about Assertive community treatment. Although 96% of participants had received information, the majority of them showed a continued need for that same information. Furthermore, some specific characteristics were associated with fewer or more unmet needs; those whose relative had a more recently occurring or disabling form of illness and whose relative had a shorter length of illness reported significantly greater unmet needs, whilst respondents having a relative with duration of illness of ten years or more voiced fewer unmet needs. Older respondents showed significantly fewer unmet needs. There was no correlation between gender and the number of needs.

Yeh, Liu and Hwu (2011) investigated carers' needs and demands for community psychiatric rehabilitation programmes. In the study a need was defined as a necessity of carers for a specific programme, and a demand was noted when they wanted to use such a programme. The most needed programmes were Structured day service (43.4%), Drop-in service (37.4%) and Caregiver support (25.3%), while carers' most frequent demands were found in Structured day service (39.6%), Drop-in service (36.3%) and Club house (31.9%). Carers who were younger were significantly more likely to need and demand Structured day service than older carers, but older respondents showed a significantly higher demand for Home care than younger counterparts.

Qualitative studies

In the study by Jagannathan et al. (2011), participants were asked to list their needs, group the list of needs into main themes, define the themes and rank them according to the importance. The score on each theme ranged from 0 to 6, with a higher score meaning greater needs. The total score of each item was obtained by adding up the score in each group. Results showed that the theme of Managing illness behaviour of patients received the highest score with 23 (27.7%), followed by the themes of Managing social-vocational problems of patients (17; 20.5%) and of Health of caregivers (15; 18.1%). Social-vocational problems included, for instance, patients' lack of interest in socialisation and difficulty in finding and maintaining a job, whereas the theme of Health of caregivers included managing their emotions such as anger, handling stress and reduced personal life, and so forth. Sin et al. (2012) revealed that the majority of the interviewees wished for information on illness, treatment and available services the most. Although their current needs were similar to those indicated at the onset of patients' illness, they also needed specific information on prognosis and the future at the time of interviews (on average, participants were interviewed approximately 18 months since the onset of symptoms). Doucet, Letourneau and Blackmore (2012) found that respondents needed instrumental support around the house, with their greatest need being having someone look after their infants. All of them wanted information on their partners' health status, treatment plans and long-term prognoses. Their particular interest was in information on managing their partners' illness when home from hospital. In addition, many of them wished for practical support to get out of the house for refreshment. They also needed emotional and affirmational support, wishing to be reassured that everything was going to be fine.

Discussion

The participants in the studies reviewed were predominantly parents of persons with mental health difficulties, with the proportion of mothers exceeding that of fathers in

all studies where the proportion was shown. Females occupied more than half in the majority of the studies. With respect to persons with mental health difficulties, most of the studies included those suffering from schizophrenia or related disorders. This finding is in line with that in the study by Noble and Douglas (2004). Thus, needs of families of individuals with schizophrenia or related disorders have been well studied compared to needs of families of individuals who suffer from other mental illness. Although the present study reviewed only three qualitative studies, these focussed on areas which have been less investigated by quantitative studies, such as needs of families in India, those of siblings and those of males whose partners suffered from postpartum psychosis. The findings of qualitative studies were in line with those of quantitative studies. This suggests that families of persons with mental health difficulties have some common needs regardless of country, their relationship to patients or their relatives' diagnosis.

The present study revealed that families generally showed great needs for information. The contents of information needed included problem management, patients' social functioning, mental illness, relapse prevention, treatment and prognoses. Needs for information were detected in the earlier review study (Noble and Douglas, 2004) as well. The continuous need suggests that families still find difficulties in obtaining information.

Another finding of the present study is that families often wanted emotional support, including counselling of a carer, managing stress and so on. Although emotional support was not a major topic in the previous review, this finding in the present study suggests that more families need such support. As emotional distress is common among families (Winefield and Harvey, 1993; Yusuf and Nuhu, 2011), it may be helpful for them to receive services focussing on reducing it. Foster (2011) showed that an emotional support service piloted in a family education programme benefited family carers. The service was individual-based and ranged from one-off sessions to regular support, with the provision type being face-to-face contact, telephone and/or e-mail. It was offered by a qualified allied health professional who herself was also a family carer. Carers who received the service felt being understood and accepted, and learnt different ways to communicate with their relatives, became more aware of self-care and had greater self-confidence. Although family services which focus on emotional support have been relatively limited to date, it would be important to investigate the effects of such a service further.

In the present study, four Taiwanese studies found that families were often interested in needs in which persons with mental health difficulties seemingly require more than their families, such as needs for coping with depression and suicidal thoughts and for structured day service. This might be due to Taiwanese culture, in which families are heavily involved in the treatment of patients (Sung, Hixson and Yorker, 2004).

Overall, the review of the 15 studies observed that families needed to understand and manage patients' illness, including monitoring a sign for a relapse, whilst they wanted to be cared for as well. The importance of families' obtaining a better understanding about their relatives' illness has been well recognised, resulting in offering a variety of education programmes to families. These programmes were found useful to increase families' knowledge (Pickett-Schenk et al., 2008; Stengård, 2003) and to decrease their burden (Sharif, Shaygan and Mani, 2012; Tanrıverdi and Ekinci, 2012). However, care for families, particularly emotional care, has been a relatively unexploited area. Since caring for someone with mental health difficulties can be a difficult

experience and families need emotional support, it is hoped that services in which families are listened to and can feel being understood and supported will be offered more in future.

Regarding the correlation between needs and families' characteristics, two studies (Graap et al., 2008a; Wancata et al., 2008) found that female respondents had greater needs than male counterparts. However, gender was not associated with the number of needs or mean score of needs among the participants in the other two studies (Drapalski et al., 2008; Gümüş, 2008). The inconsistency between these studies might be explained by the research instruments employed; the studies in which females' higher needs were detected used similar assessment measurements, whereas the other two studies employed different instruments. There might be a possibility that the assessment tools used in the former include more items which women need more.

The finding that families of persons with schizophrenia needed information about social functioning significantly more often than those of persons with other mental illnesses probably reflects the fact that impairment in social functioning is common among people suffering from schizophrenia (Bartles, Mueser and Miles, 1997; Bottlender, Strauss and Möller, 2010; Fleck et al., 2007; Mueser et al., 2010; Patterson et al., 2001). In addition, greater unmet needs were noted in items focussing on management of symptoms of schizophrenia among families of persons with schizophrenia in the study by Wei et al. (2010). These suggest that whilst families share some common needs, there are also specific needs depending upon relatives' symptoms. Therefore, future research will need to focus on particular needs of families as well.

In the study by Wancata et al. (2006), the number of mothers' needs was positively related to the PANSS general sub-scale of their relatives. Drapalski et al. (2008) showed that families of persons with a disabling condition reported a greater number of unmet needs. Thus, families of persons with a more severe form of illness experience wanted more help and had more unmet needs. However, Graap et al. (2008) revealed that the severity of the relatives' illness was not associated with the number of needs. This is puzzling when considering that Wancata et al. (2006) and Graap et al. (2008) employed similar instruments to assess families' needs, and both studies assessed relatives' symptoms over the past four weeks using the PANSS. As Graap et al. (2008) point out, factors such as personality of persons with mental health difficulties and situations of families might have led to the lack of a correlation. Although it seems natural that families of people with a more severe form of illness experience had more needs and unmet needs, the correlation between the severity of patients' symptoms and families' needs and unmet needs might require further exploration.

Duration of patients' illness was often related to greater needs or unmet needs among families. In the study by Drapalski et al. (2008), relatives of individuals having a shorter length of illness reported greater unmet needs, while those of individuals with a longer period of illness showed fewer unmet needs. Wancata et al. (2006) found that a shorter duration of patients' illness correlated with a higher number of needs among mothers. Meanwhile, relatives of persons suffering from schizophrenia for a longer period had higher needs in some specific areas in the study by Yeh et al (2008). Although the finding in the study by Wancata et al. (2006) partially disagrees with the finding in the study by Yeh et al. (2008), it should be noted that families who had persons with longer duration of illness in the latter showed greater needs, not in all areas but in some particular areas. Therefore, it would be reasonable to say that whereas needs and unmet

needs of families generally decrease as they get used to patients' care, they can also be more aware of specific needs as time passes. However, one study (Graap et al., 2008) observed no correlation between the severity of patients' symptoms and the number of families' needs. Again, this might be due to factors which were not shown in the data, such as patients' personality and families' situations.

The respondents' age predicted greater needs in several studies. In the studies by Yeh et al. (2008) and Yeh, Liu and Hwu (2011), younger participants had greater needs or demands in some particular areas, while the latter study revealed that older participants also showed a greater demand in one area. Pickett-Schenk et al. (2006) observed that older respondents reported overall greater needs compared to younger respondents. Meanwhile, in the study by Drapalski et al. (2008), older participants showed fewer unmet needs. These findings suggest that, first of all, each age group has particular needs. Secondly, older family members' needs are generally met probably because they are more used to caring for their relatives, and families have a better understanding of what resources are available for their needs. Thirdly, however, older family members can also have more needs probably because they want more specific support after their general needs were fulfilled.

Understandably, families who had not received education about schizophrenia generally showed more needs compared to those who had received it. In contrast, families who had received information reported a continued need for the same information. Thus, although it is important to offer education and information to families who had not received them before, it is also important to provide families with them on a continuous basis, regardless of prior receipt of education and information.

Conclusions

The present study reviewed 16 articles on needs of families of persons with mental health difficulties, with major findings being that families generally had great needs for information and emotional support. It also revealed that whilst families shared some common needs, they also had specific needs depending upon their age, their relatives' symptoms or their duration of illness. Overall, families needed to gain a better understanding about their relatives' illness and to cope with it, including monitoring a sign suggesting a relapse, whereas families also wanted to be emotionally cared for. The findings in the present study suggest that it is important to not only care for persons with mental health difficulties, but also to care for their families as well.

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Appendix

Table 1. Characteristics of Quantitative Studies

| Study | Setting | Family sample | % of family members living with a person with mental health difficulty | Measurement |
|--|---------|---|--|--|
| Sung, Hixson and Yorker (2004) | Taiwan | One hundred relatives of psychiatric inpatients who were prepared to be discharged from a hospital. | Not available | An original questionnaire based on Muser et al. (1992) |
| Wancata et al. (2006) | Austria | Fifty relatives of persons suffering from schizophrenia or schizoaffective disorders. | 52 | CNA-S [†] |
| Drapalski et al. (2008) | USA | Three hundred and sixteen members of the Maryland chapter of the National Alliance on Mental Illness. | 33 | A questionnaire adapted from the FANS [‡] |
| Graap et al. (2008a); Graap et al. (2008b) | Germany | Sixteen carers of persons with anorexia nervosa (AN), 16 carers of persons with bulimia nervosa (BN) and 22 carers of persons with schizophrenia. | Carers of persons with AN: 68.8 Carers of persons with BN: 56.3 Carers of persons with schizophrenia: 63.3 | CNA [§] |
| Gümüş (2008) | Turkey | Eighty relatives of psychiatric patients. | 100 | The Evaluation of Health Educational Needs Form |
| Wancata et al. (2008) | Austria | Mothers (N=101) and fathers (N=101) of the same patients suffering from schizophrenia. | Mothers:40.6 Fathers:38.6 | CNA-S |
| Yeh et al. (2008) | Taiwan | One hundred and seventy-seven caregivers of inpatients with schizophrenia. | 100 | FBNS [¶] |

Table 1. (Continued)

| Study | Setting | Family sample | % of family members living with a person with mental health difficulty | Measurement |
|--|---------|---|--|------------------------|
| Wei et al. (2010) | Taiwan | Two hundred and sixty-one family caregivers of an adolescent diagnosed with schizophrenia or a mood disorder. | 100 | CM-ENQ ^{††} |
| Absalom-Hornby, Gooding and Tarrier (2011) | England | Eighteen relatives who had a family member at a forensic unit with a diagnosis of schizophrenia. | 0 | RCNS ^{‡‡} |
| Yeh et al. (2011) | Taiwan | One hundred and eighty-two caregivers of an outpatient with either schizophrenia or affective disorder. | Not available | INDCPR ^{§§} |
| Mulligan et al. (2012) | England | Thirty primary carers of users involved with Early Intervention in Psychosis services (EIP). | 70 | RUNS-EI ^{†††} |

[†] CNA-S: The Carers' Needs Assessment for Schizophrenia

[‡] FANS: The Yale-Northeast Program Evaluation Center Family Assessment of Needs for Services

[§] CNA: The carers' Needs Assessment

[¶] FBNS: The Family Caregiver Burden and Need Schedule

^{††} CM-ENQ: The Chinese version of the Modified Educational Needs Questionnaire

^{‡‡} RCNS: The Relatives' Cardinal Needs Schedule

^{§§} INDCPR: The Inventory of Needs and Demands for Community Psychiatric Rehabilitation

^{†††} RUNS-EI: The Relatives' Urgent Needs Schedule Early Intervention version

Table 2. Characteristics of Qualitative Studies

| Study | Setting | Family sample | % of family members living with a person with mental health difficulty |
|---|----------------|---|--|
| Jagannathan et al. (2011) | India | Thirty caregivers of inpatients with schizophrenia. | Not available |
| Sin et al. (2012) | England | Thirty-one siblings of service users treated by local Early Intervention in Psychosis Services. | Not available |
| Doucet, Letourneau and Blackmore (2012) | Canada and USA | Eight male partners of women who suffered from postpartum psychosis within the last 10 years. | 100 |

Table 3. Sample Features in the Studies (Families)

| Study | Gender | Mean age (years) | Relationship to persons with mental health difficulties |
|---|---|--|---|
| Sung, Hixson and Yorker (2004) | Not available | Not available | Parent=39%, spouse=36% |
| Wancata et al. (2006) | Female=68% | 55.3 | Parent=82%, partner=12% |
| Pickett-Schenk et al. (2006) | Total sample: male=90 (20%), female=372 (80%) | Total sample: 51.25 | Total sample: parent=255 (55%), adult child=59 (13%), sibling=57 (12%), spouse/significant other=54 (12%), other=37 (8%) |
| Drapalski et al. (2008)* | Female=223 (73%) | 63.17 | Mother=174 (58%), father=60 (20%), sibling=28 (9%), spouse=18 (6%), child=9 (3%), other=10 (3%) |
| Graap et al. (2008a); Graap et al. (2008b) | Carers of persons with AN: female=9 (56.3%) Carers of persons with BN: female=7 (43.8%) Carers of persons with schizophrenia: female=22 (73%) | Carers of persons with AN: 43.8 Carers of persons with BN: 39.1 Carers of persons with schizophrenia: 51.7 | Carers of persons with AN: mother=8 (50%), partner=5 (31.3%), father=2 (12.5%), friend=1 (6.3%) Carers of persons with BN: mother=6 (37.5%), partner=6 (37.5%), father=3 (18.8%), friend=1 (6.3%) Carers of persons with schizophrenia: mother=14 (46.7%), partner=10 (33.3%), father=5 (16.7%), sibling=1 (3.3%) |
| Gümüş (2008) | Female=51.3% | 46.16 | Parent=71.3% |
| Wancata et al. (2008) | Male=101 (50%), female=101 (50%) | Mothers=54.76, fathers=59.10 | Mother=101 (50%), father=101 (50%) |
| Yeh et al. (2008) | Male=92 (54%), female=85 (46%) | Not available (< 30 years=5.6%, > 60 years=29.8%, 31-60 years=64.6%) | Parent=70.1%, child/sibling=18.6%, spouse=11.3% |

Table 3. (Continued)

| Study | Gender | Mean age (years) | Relationship to persons with mental health difficulties |
|---|--|---------------------|---|
| Wei et al. (2010) | Total sample: Male=60 (23%), female=201 (77%) | Total sample: 48.88 | Total sample: Mother=186 (71.2%), father=53 (20.3%), sibling=10 (3.8%), grandparent=4 (1.6%), other relative=4 (1.6%), adoptive parent=4 (1.5%) |
| Absalom-Hornby, Gooding and Tarrier. (2011) | Male=6 (33%), female=12 (67%) | 54.5 | Mother=8 (44%), father=4 (22%), sister=3 (17%), brother=2 (11%), aunt=1 (6%) |
| Jagannathan et al. (2011) | Male=13 (43.3%), female=17 (56.7%) | 50.6 | Parent=21 (70%), sibling=4 (13.3%), other=3 (10%), spouse=2 (6.7%) |
| Sin et al. (2011) | Male=9 (29%), female=22 (71%) | 22.7 | Elder sister=young sister=14 (45%), 8 (26%), elder brother=5 (16%), young brother=4 (13%) |
| Yeh, Liu and Hwu (2011) | Male=78 (42.9%), female=104 (57.1%) | 55.2 | Parent=122 (67.1%), Sibling=25 (13.7%), Spouse=22 (12.1%), Other=9 (4.9%), Child=4 (2.2%) |
| Doucet, Letourneau and Blackmore (2012) | Male=8 (100%) | 36.25 | Partner=8 (100%) |
| Mulligan et al. (2012) | Male=8 (26.7%), female=22 (73.3%) | 48.97 | Mother=20 (66.7%), father=6 (20%), partner=4 (13.3%) |

* Because of missing data, Ns are different.

Table 4. Sample Features in the Studies (Persons with Mental Health Difficulties)

| Study | Gender | Age (mean) | Diagnosis |
|--|--|--|--|
| Sung et al. (2004) | Not available | Not available | Major depression=44%, schizophrenia=40%, bipolar disorder=14%, other=2% |
| Wancata et al. (2006) | Male=68% | 31.4 | Schizophrenia=90%, schizoaffective psychosis=10% |
| Pickett-Schenk et al. (2006) | Total sample: male=197 (53%), female=172 (47%) | Total sample: 36.23 | Total sample: bipolar disorder=168 (45%), depression=69 (19%), schizophrenia=66 (18%), schizoaffective disorder=20 (5%), obsessive-compulsive disorder=12 (3%), other=34 (2%) |
| Drapalski et al. (2008)* | Male=201 (67%) | 40.22 | Schizophrenia or schizoaffective disorder=169 (56%), bipolar disorder=90 (30%), major depression=38 (13%), anxiety disorder=27 (9%), borderline personality disorder=17 (6%), substance abuse disorder=17 (6%), obsessive-compulsive disorder=15 (5%), other=18 (6%) |
| Graap et al. (2008a); Graap et al. (2008b) | Persons with AN: female=15 (93.8%) Persons with BN: female=16 (100%) Persons with schizophrenia: female=12 (40%) | Persons with AN: 24.3 Persons with BN: 22.1 Persons with schizophrenia: 35 | Anorexia nervosa=16 (26%), Bulimia nervosa=16 (26%), schizophrenia=30 (48%) |
| Gümüő (2008) | Male=70%, female=30% | 31.38 | Schizophrenia=80 (100%) |
| Wancata et al. (2008) | Exact data not available (about two thirds were male) | 28.3 | Schizophrenia=101 (100%) |
| Yeh et al. (2008) | Male=86 (49%), female=91 (51%) | Not available (> 30 years=52.5%, 21-30 years=39.2%, < 20 years=8.3%) | Schizophrenia=177 (100%) |

Table 4. (Continued)

| Study | Gender | Age (mean) | Diagnosis |
|-------------------------------------|---|---------------|--|
| Wei et al. (2010) | Male=137 (52%), female=124 (48%) | 18.54 | Schizophrenia=170 (65%), depression=54 (21%), bipolar disorder=35 (13%), bipolar 1 'mania'=2 (0.8%) |
| Absalom- Hornby et al. (2011) | Not available | Not available | Schizophrenia=18 (100%) |
| Jagannathan et al. (2011) | Male=17 (58.6%), female= 12 (41.4%) | 31 | Schizophrenia =29 (100%) |
| Sin et al. (2011) | Male=20 (80%), female=5 (20%) | 23.5 | Not available |
| Yeh et al. (2011) | Male=93 (51.1%), female=89 (48.9%) | 36.2 | Schizophrenia=151 (83%), affective disorder=31 (17%) |
| Doucet et al. (2012) | Female=9 (100%) | 34 | Postpartum psychosis=9 (100%) |
| Mulligan et al. (2012) | Male=17 (56.7%), female=13 (43.3%) | 24.73 | Not available (they suffered from psychosis such as hallucinations or delusions or both). |

Risk Propensity, Gender and Entrepreneurial Ability

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Abstract

The study surveyed 668 (Male = 356, Female = 312) University undergraduates of two Nigerian Universities in Western Nigeria. Using the correlation and factorial statistical designs, the study which examined the influence of Risk propensity and gender on entrepreneurial abilities, found that gender has no significant influence on entrepreneurial abilities. Risk propensity has significant but inverse correlation with entrepreneurial ability ($r = - 0.23$). High and low risk propensity differs significantly on entrepreneurial abilities with low risk takers ($\bar{x} = 126.55$) showing greater entrepreneurial abilities than high risk ($F(1/651) = 31.044, p < .05$; critical $F = 3.84$). Gender difference does not influence entrepreneurial abilities as indicated by findings in this study ($F(1/651) = 0.522, p < 0.05$). Though literatures appear to suggest that entrepreneurs are people with high risk propensity, this was not confirmed in this study, rather low risk takers shows greater entrepreneurial abilities. There was no significant difference in entrepreneurial abilities of male and female participants. This result is an indication that hypothesized relationship between certain personality variables and entrepreneurship should be viewed with caution. Equally the belief that entrepreneurship is a 'male turf' is not necessarily true. Further local study of these variables is suggested to further confirm these findings.

Key words: Entrepreneurial abilities, Risk propensity, Gender.

Introduction

Risk taking has long been associated with entrepreneurship (McClelland, 1961, 1965), but the relationship between entrepreneurship and risk taking has long puzzled researchers (Naldi, Nordqvist, Sjoberg and Wiklund, 2007). Research has found little empirical evidence to support the idea that entrepreneurs take considerable risks. On the average, entrepreneurs do not take greater risks than managers (Brockhaus, 1980). Entrepreneurs have been referred to as risk avoiders (Miner, 1990) or risk optimizers (McClelland, 1961). According to Petrakis (2005) risk propensity is determined within the entrepreneurial behaviour framework. Indeed the issue of risk is central to the study of entrepreneurial behaviour and performance and different points of view are employed in entrepreneurial risk research agenda (Norton and Moore, 2002). Although not many studies have focused specifically on gender difference among entrepreneurs, it is common to observe many women in Nigeria engaged in entrepreneurial activities especially in the informal sector. Are these in any way different from their male counterparts especially on personality characteristics commonly associated with entrepreneurship? Some studies have however tried to distinguish between male and female managers along these dimensions (Baron, 1999; Wallach, M.A. & Kogan, N. (1959). It is useful to find out how risk propensity and gender influence entrepreneurship in view of dearth of local research on these variables.

Aim and objectives

The first and major aim of this study is to provide local data on the personality of the entrepreneur, by considering the influence of risk propensity and gender on entrepreneurial abilities. Specifically, the study confirms the relationship between risk propensity and entrepreneurship and examines the extent of influence of risk propensity on entrepreneurial abilities. Also the study will investigate gender differences in locus of control and entrepreneurial ability.

Hypotheses

1. There will be significant correlation between risk propensity and entrepreneurial abilities.
2. Participants with high risk propensity will possess greater entrepreneurial abilities than those with low risk propensity.
3. Males and females will differ in risk propensity and entrepreneurial abilities.

Significance of study.

The study is significant in two aspects. Knowledge of the variables influencing entrepreneurship is desirable using Nigerian samples and the implication of risk taking as an explanatory variable though often taken for granted is obvious if confirmed to the contrary.

Operational definition of key terms.

Entrepreneurial Abilities. For the purpose of this study, entrepreneurship as a term popularly used in literature is more of a constitutive definition and capable of having surplus meaning (Kerlinger, 1973). In this wise, Entrepreneurial Ability is used in this study and conceived as possession of abilities necessary for the starting and nurturing to growth of a new enterprise, especially in a competitive environment. That is, the ability to start, nurture and grow businesses to both profitability and survival. This definition

conceives entrepreneurship as a form of ability/potential that can be measured using appropriate psychometric procedure. The Entrepreneurial Ability Scale developed as part of a PhD thesis is used to measure entrepreneurial abilities.

Risk Propensity. Risk taking propensity refers to the probability of an individual to exhibit risk taking or risk avoidance when confronted with risky situations. It goes with the probability of receiving the rewards associated with success of a proposed situation, which is required by an individual before he is subjected to the consequences associated with failure, the alternative situation providing less reward as well as less severe consequences than the proposed situation. Risk propensity can be classified from low, moderate to high risk propensity and has been measured as such (Brockhaus, 1980)

Gender. The term gender, though a categorical variable has social significance in the sense that it is about assignment of roles rather than a biological phenomena. The term therefore is conceived as those roles that distinguish males from females and here in focus, their roles as owners and operators of businesses.

Theoretical backdrop

Personality or trait theory. It is a popular notion that individual factors, focusing on personality characteristics of entrepreneurs affect entrepreneurial behaviour. This theory according to Thomas and Mueller (2000) rests on the assumption entrepreneurs have certain unique characteristics, attitudes and values that provide impetus for them and distinguish them from others. The key questions among trait theorists are, whom the entrepreneurs are, why they become entrepreneurs and the characteristics of successful and unsuccessful entrepreneurs (Littunen, 2000). The trait theory has according to Gurol and Atsan (2006) been a significant element of research on entrepreneurship. Some of the traits commonly associated with entrepreneurship are; achievement motivation (McClelland, 1961, 1965), locus of control (Rotter 1966; Littunen, 2000), tolerance for ambiguity (Entrialgo, Fernandez, and Vazquez, 2000)

Risk-taking propensity.

In the overall, entrepreneurs have been shown to be moderate risk-takers and do not significantly differ from managers on this trait (Sexton and Bowman, 1985; Brockhaus, 1980). This is contrary to common belief that entrepreneurs are high risk managers and their ability to achieve goals viewed as impossible by others pitch them as high risk takers in common perception. In reality, entrepreneurship includes the risks related to the financial well being of self, family, career opportunities, emotional states and psychic well being. Common sense will suggest therefore that entrepreneurs are not averse to risks. In literature, entrepreneurs are characterized as having greater propensity to take risks than other groups (Crommie, 2000; Thomas and Mueller; Teoh and Foo. 1997).

Literature Review

Risk propensity and entrepreneurship.

According to Gurol and Atsan (2006) entrepreneurship is historically related with risk taking. One of the earliest studies by Chantilon (1755) reported that the main factor in differentiating entrepreneurs from employed workers was the uncertainty and risk taken by the former (Entrialgo et al, 2000; Thomas and Mueller, 2000) Expectancy theorists, especially Atkinson (1957) have stimulated much study of risk preferences;

Atkinson's risk taking model is derived from the relationship that McClelland found between need for achievement and preference for moderate probabilities for success. The model proposes that risk taking involve six variables; the subjective probability of success, the subjective probability of failure, the incentive value of success, the incentive value of avoiding failure, the achievement motive and the motive to avoid failure. According to him, performance level should be greatest when there is greatest uncertainty about the outcome (when subjective probability of success is .50) and this he observed to be true regardless of whether the motive to achieve or the motive to avoid failure is stronger in an individual. Persons in whom the achievement motive is stronger however should avoid intermediate risk, preferring instead either very easy and safe undertakings or extremely difficult and speculative ones.

Also, though no empirical data was made available by him, Mancuso (1975) said that there are three levels of risk preferences - low, intermediate or moderate risk preference. Although previous research have not specifically compared risk taking propensity of individuals who decided to start business ventures of their own, with that of individual not so inclined (Brockhaus, 1980), research conducted by Meyer, Walker and Litwin (1961) found that managers selected to represent the entrepreneurial role show greater preferences for intermediate risks on a risk preferences questionnaire than did specialist of comparable age, education and job level. It is notable however that Mill (1848) had included *risk bearing* as major distinguishing characteristics between the functions of a manager and those of an entrepreneur.

Wallach and Kogan (1959, 1961) in studies of risk preferences in everyday life developed choice dilemmas questionnaire (CDQ) based on 12 hypothetical choice situations. Items require the respondent to choose between a safe alternative and a more attractive but risky one. Also, the respondent is asked to indicate the probability of success sufficient for him to select the risky alternative.

This measure was adopted by Brockhaus (1980) in a study using three group of participants composing of (1) individual who had ceased to work for their employees and now own and manage their own business. (2) One group of managers had recently changed organisations while (3) the other had only changed positions within an organization. A total of 158 questionnaires were administered to entrepreneurs previously invited to a meeting and those who could not attend had their questionnaires mailed. Of these, 131 were usable. The managers in group (1) had 106 questionnaires of which 35 were usable while those in group (2) who had joined a new organization had 36 usable questionnaires turned in. The last group returned 28 usable questionnaires.

The null hypothesis for the study is; that individuals who have ceased working for their employers and now own as well as manage business ventures, will have the same risk-taking propensity as will; (a) individuals who have ceased working for their employers and now are managers for different employers (b) individuals who have assumed new managerial positions with the same firms with which they have been associated for a year or more. Mean CDQ score for entrepreneurs was 71, while the transferred managers' mean was 72.52 and promoted managers' mean score was 66.97. This mean difference on subjection to analysis of variance test was found to be statistically significant. Meaning that risk taking propensity of entrepreneurs does not differ significantly from the other group of managers. The study does not support theoretical position that entrepreneurs are more moderate risk takers. It could however be

argued that both managers and entrepreneurs are more moderate risk takers since in Wallach and Kogan's data, scores of respondent were clustered around the means. Earlier study of Mancuso (1975) had however indicated moderate risk taking behaviour for entrepreneurs. The reviewed study also showed that 64% of the entrepreneurs have a propensity for moderate level of risk.

Another, more recent, study by Stewart and Roth (2001) did a meta-analytical review of risk taking propensities of entrepreneurs and managers and found conflicting report. In the first instance, there was a definitional dilemma. For instance, given that entrepreneurs are individuals who independently owns and actively manage a business (Carland, Hoy, Boulton and Carland, 1984), are entrepreneurs who focus on profit and those focusing on growth different, especially in terms of risk propensity? Apart from small samples (Greenberger and Sexton, 1988), there is also noted discord concerning entrepreneurial risk propensity (Kogan and Wallach, 1961, Jackson, 1976).

A view of Stewart and Roth's findings produced mixed results. While Brockhaus (1980), Ray (1982), Master and Meier (1988), Richard (1989) and Patich and Bagby (1995) found no significant difference in risk propensity of entrepreneurs and managers, Sexton and Bousman (1983), Begley and Boyd (1987), Carland and Carland (1991), Carland III, Carland and Pearce (1995), Seth and Sen (1995) and Stewart, Walton and Carland and Carland (1999) found significant difference. Stewart and Roth considered that there is a difference between managers and entrepreneurs in risk propensities and that the significance of the difference depends on ones definition of entrepreneurs. Assuming that the term entrepreneurs include owners with variation in goals for the business, the meta-analysis indicates that entrepreneurs have somewhat higher risk propensity than managers. If focus is on entrepreneurs with growth aspirations versus managers, the difference in risk propensity becomes very large indeed. Small samples measurement and conceptualization were noted limitations of research in this field. Also much concern had been shown to difference in gender which often is little considered except for Carland et al (1991).

Risk Propensity.

Liles (1974) discussed what he observed from a new venture. He argued that in becoming an entrepreneur an individual risks financial well-being, career opportunity, family relations and psychological well-being. Propensity for risk taking according to Brockhaus (1980) is explained as the probability of receiving the rewards associated with success of a proposed situation, which is required by an individual before he is subjected to the consequences associated with failure, the alternative situation providing less reward as well as less severe consequences than the proposed situation. The entrepreneur is faced with this type of situation before he establishes a new business venture for which he is totally responsible for either its failure or its success. His skill and level of control of event surrounding the business environment is of primary importance. McClelland (1961) has however stated that the different situations in which an individual's *degree of control* or skill is most important are moderately risky situations rather than very risky or very certain ones.

Methodology

Research setting and sample characteristics Setting.

Participants were drawn from two universities located in Lagos and Agowoye, Ogun State, that is, Lagos State University (LASU) and Olabisi Onabanjo University (OOU). The two institutions were visited while in session. Students at 300 and 400 levels of academic career were considered as appropriate sample. This is because attributes and abilities are to be measured and educational level cannot possibly contaminate the outcome of study

Sampling and Sample Characteristics.

Participants in the main study were 668 students (M = 312, F = 356) drawn from two Nigerian Universities in the Western part of the country. 334 students were sampled from each of the Universities. By selecting university students, the moderating role of intelligence as well as age, was controlled for. Age of participants range between 18 and 27 years and the average age is 21 years.

Data collection instruments

Risk Propensity Scale (SRP). Risk Propensity was assessed using the Risk Propensity Scale (SRP) by Brockhaus (1980). It is a 31 item scale constructed in the Likert format ranging from Strongly Disagree A=1 to Strongly Agree E=5. The scale has reported reliabilities of .07. In the pilot study, the scale was found to have reliabilities as follows; Alpha= .79 and standardized item alpha= .80. Further exploration shows Guttman split half .71. (Alpha part1= .57, part 2=.76. Equal-length Spearman Brown .72 and unequal-length .72

The entrepreneurial Ability Scale (EAS) is self-constructed by loading items on those indicant entrepreneurial attributes earlier identified. It is a multidimensional scale set in the Likert format and designed to yield quantitative scores useful for statistical analysis. A 42-item scale was derived as explained in table 4.1 below in such a way that the domains of entrepreneurship attributes are adequately sampled.

Scoring of Scales.

Two scales were used in all. These were scored as follows:

i. EAS. The options range from A-F; A=5, B=4, C=3, D=2, E=1 and F=0 i.e. from 'statement applies in every instance' to 'statement does not apply at all'. All the 42 items were scored in the same direction.

ii. SRP. The options range from A-E i.e. from 'strongly disagree' to 'strongly agree'; A=1, B=2, C=3, D=4 and E=5. Items 4,11,17,18 and 19 were reverse scored.

Research Design.

The study employs non-experimental survey design, using Ex-post-Facto and correlational techniques. Statistical designs used includes: correlations and factorial designs.

Study procedures.

In deciding on choice of University, the list of State Universities in the Western states of Nigeria were made and two - Lagos State University (LASU), Ojo and Olabisi Onabanjo University (OOU), Agowoye - were randomly selected. Since course of study

could have moderating role on the variables under study, it was decided that participants will be those pursuing similar course of study in either the social or management sciences. Using random selection, two courses; Industrial Relations and Personnel Management and Psychology were selected. At the time of collecting the data only a handful of students were on enrolment in the Psychology programme at The Lagos State University. It was decided that students studying Industrial Relations and Personnel Management which exist in good numbers in both Universities be sampled. Finally participants were drawn using the simple random sampling technique. The sampled population was stratified into male and female. Though unintended, it turned out that equal number of males and females, that is, 344, took part in completing the scales from both Universities.

Data Analyses.

Responses to the instruments were entered into the Statistical Package for the Social Sciences (SPSS) software, version 13, after they were appropriately coded and the various analyses; correlation and factorial analyses were carried out.

Presentation of results of study.

The Pearson Product Moment correlation index between entrepreneurial abilities and risk propensity was - 0.23, significant at $p < 0.01$, critical $r =$

The results obtained are presented in tables 1 and 2 as descriptive and inferential statistics.

Table1: Mean and standard deviation of scores on entrepreneurial abilities scale of male/female low and high risk takers

| Respondent at 2 levels of sex and risk propensity | | Mean | Std. deviation | N |
|---|-------|--------|----------------|-----|
| Male | Low | 127.12 | 19.27 | 156 |
| | High | 121.77 | 18.72 | 154 |
| | Total | 124.46 | 19.15 | 310 |
| Female | Low | 126.15 | 16.83 | 222 |
| | High | 116.95 | 17.57 | 136 |
| | Total | 122.65 | 17.67 | 358 |
| Total | Low | 126.55 | 17.86 | 378 |
| | High | 119.51 | 18.32 | 290 |
| | Total | 123.49 | 18.38 | 668 |

There are, from table 1, noticeable mean differences in entrepreneurial abilities of the studied low and high risk groups of students. How statistically significant, with respect to stated hypotheses, are the observed differences? Table 2 shows the factorial analysis of observed mean differences in risk propensity of male and female undergraduates.

Table 2: A 2x2 Analysis of variance of mean differences between 2 levels of gender and risk propensity

| Source | Sum of squares | df | Mean square | F | Comment |
|---------------------|----------------|-----|-------------|----------|-----------------|
| Corrected model | 9896.70 | 3 | 3298.90 | 10.17 | Significant |
| Intercept | 9775093.79 | 1 | 9775093.79 | 30126.60 | Significant |
| Sex | 1351.30 | 1 | 1351.30 | 4.16* | Significant |
| Risk Propensity | 8548.91 | 1 | 8548.91 | 26.35** | Significant |
| Sex*Risk Propensity | 598.92 | 1 | 598.92 | 1.84 | Not Significant |
| Error | 215446.24 | 664 | 324.47 | | |
| Total | 10412364.00 | 668 | | | |
| Corrected total | 225342.95 | 667 | | | |

*Significant at $P < 0.05$ $df = 1/664$, Critical $F = 3.84$

**Significant at $P < 0.01$

Discussion

It is noteworthy that the direction of relationship is negative for risk propensity. This appears to suggest that low rather than high risk propensity is important in entrepreneurship. According to Mancuso (1975), there are three risk preferences - low, intermediate or moderate risk takers and high risk takers. The current finding is in line with the view that entrepreneurs according to Sexton and Brown (1985) are moderate risk takers. This view is also supported by Petrakis (2005). Common belief tends to portray entrepreneur as high risk takers. Also Bewley (1989) had proposed that uncertainty construct, rather than risk, appears more related to entrepreneurship. This is because innovation lies at the core of entrepreneurial activity. Entrepreneurs faced technical, demand and competitive uncertainties. In the real sense, risk taking propensity refers to probability that an individual will exhibit risk taking or risk avoidance behaviour when confronted with risky situation. One can infer from the outcome of this study and in line with (Cromie, 2000; Teoh and Foo, 1997) that risk and uncertainty are elements of the entrepreneurial behaviours. The degree of risk propensity however needs further investigation. The work of Forlani and Mullins (2000) showed that the risk reflects the degree of uncertainty and potential loss associated with outcomes which may follow a given behaviour or set of behaviours. The basic element of risk according to Yates and Stone (1992) are the potential loss and the significance of those losses. When extrapolated to the concern of would be entrepreneur, significance loss of income may result in starting business of one's own when compared to seek employment option. The potential loss is however mitigated by unemployment. This means that in reality, there is income loss in the long period of search for the non-existing jobs. Viewed in that way, risk perception is moderated by lack of viable alternative to entrepreneurship. The predictive ability of high risk propensity is however questionable (Cherry and Fraedrich, 2002). Equally, if risk taking will be predictive of entrepreneurship several factors should be put into consideration such as, (1) General environmental changes e.g. in regulation and technology (Cooper and Schendel, 1976); (2) Industry characteristics e.g. number of competitors (Bain, 1968), (3) Number of supplier and customers (Porter, 1980), (4) Mobility barriers (Fox, 1973), (5) Project characteristics e.g. inter cycle and pay back

minimal project size (Bearer, Kettler and Scholes, 1970), (6) Risk return profitability (Markowitz, 1952) (7) Characteristic of decision makers such as age, experience and knowledge, (8) Characteristics of the problem under consideration-complexity ambiguity, controllability (Vlek and Stallen, 1980), (9) Probability of loss (Slovic, 1967) and (10) Problem framing (Tversky and Kahneman, 1981).

Risk propensity affects, as it is, the way entrepreneurs decide to finance their ventures, how they evaluate the origin of their sources of funds, how long the required the decision about required payback period might be and finally decision about project size. Entrepreneurs' nominal risk propensity is also influenced by two other important traits; their tendencies towards independence and their need for achievement (Petraakis, 2005). Will high risk takers differ in entrepreneurial ability? The second hypothesis in this study addressed this question. Factorial analysis showed that observed mean differences between high and low risk takers produce statistically significant difference. Contrary to expectation, low risk takers are higher on entrepreneurial ability as indicated by the mean scores. On the surface, this result is puzzling. When juxtaposed with the negative correlation between risk propensity and entrepreneurship light is thrown on this outcome. As the study of Mancuso (1975) earlier showed, only moderate risk is involved in entrepreneurship. The current result may however need further investigation. Why will the group lower in risk propensity display higher entrepreneurial ability? Since earlier studies have concentrated on difference between managers and entrepreneurs (Brokhaus, 1980; Ray, 1982; Sexton and Brown, 1983; Carland and Carland, 1991, and Stewart, Walton, Carland and Carland, 1999), more studies will be needed to explore differences among individuals of differing degrees of risk propensity.

Conclusion. The study shows that hypothesized relationship between risk propensity and entrepreneurial ability need further study, exploration and explanation. That low risk takers indicated higher entrepreneurial abilities presents out of tune with popular belief to the contrary. Also that male and female did not differ in entrepreneurial abilities may confirm the preponderance of females in self-employment activities especially in the growing informal sector of the Nigerian economy. It will appear that capital mediation, sociological factors, especially role aspiration of females, historical and other factors rather than ability may be the likely explanation for more men as entrepreneurs in Nigeria as well as most economies.

Suggestion for future studies

Much research work is required to understand issues that are militating against entrepreneurship in Nigeria. Other personality variables like motivation, creativity/problem-solving, tolerance of ambiguity, Locus of control and achievement motivation need to be examined on their influence on entrepreneurial ability, behaviour and success and failures of enterprises. Studies of sociodemographic variables like age, education, work history and the role of technology and support systems in fostering entrepreneurial culture are equally required (Allen, 2006; Hisrich, and Peters, 2002).

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The Economic Cost of Fiscal Centralization on the Growth of the Nigerian Economy

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Abstract

Fiscal centralization in Nigeria has generated regional, vertical and horizontal contestations over resource control issues. These contestations have led to militancy and open rebellion that have resulted in oil production shut-in, rising costs of operations in the oil industry, risks and uncertainties for investments and a rise in the cost of maintaining security in Nigeria. This study measures the economic cost of fiscal centralization in the light of the consequences of the militancy and rebellion that have been associated with it. Impacts such as production shut-in, rise in operational costs and uncertainties as well as growth in cost of maintaining security have led to some economic effects that need to be measured and analyzed. The study develops a framework and measures the costs of fiscal centralization in Nigeria. Findings from the study revealed that the oil related cost, expenditure allocation cost and social/human cost of fiscal centralization in the country are very high and rising. Based on these results, we recommend (i) a negotiated decentralization and (ii) economic and political actions that will completely eliminate militancy and its associated economic costs.

Keywords: Fiscal centralization, fiscal decentralization, militancy, costs, Niger Delta, Nigeria

Introduction

The present fiscal structure in Nigeria consists of 36 states, the Federal capital Territory (FCT) and 774 local government areas and the fiscal matters are centralized. The fiscal centralization of the Nigerian state is established from the institutional framework for fiscal federalism in Nigeria. The constitutional provisions on the assignment of responsibilities among the three tiers of government clearly show a deliberate concentration of powers at the central government. The intergovernmental fiscal relations in Nigeria also exhibit fiscal centralization in tax assignment and revenue sharing arrangements. Regarding tax assignment, the major revenue heads in the country, including custom duties, mining rents and royalties, petroleum profit tax and company income tax, all of which account for over 80 per cent of total national recurrent revenues, fall under the legislative and administrative jurisdiction of the federal government, while the less productive and less buoyant sources are devolved to the fiscal jurisdiction of states and local governments.

The rates and principles used for vertical and horizontal revenue sharing are usually from the recommendations of ad hoc committees or commissions formed at particular periods. The rates and principles were often amended by the use of Decrees and annual budget pronouncements by the governments in power. All the revenue sharing rates used, from Philipson Commission in 1946 through to the present, favour the federal government more than lower levels of governments. The principles for horizontal revenue sharing among the states too tend to favour some states more than others.

The present fiscal centralized system has therefore generated severe contestations in Nigeria. The key players in the agitations and conflicts, who also have varied interests, are;

- i) The Federal Government, the 36 States of the Federation and the Federal Capital Territory (FCT) and the 774 Local Government Areas.
- ii) The Federal Government, the oil producing states (Niger Delta region) and the non-oil producing states.
- iii) The Federal Government, oil producing states, communities in Niger Delta region and the multinational oil companies.

The central issue of concern that generates the contestations is the quest for 'resource control'. Among the levels of governments, the disagreement is over the rates of revenue allocation, and among the states, the contentions are over the principles used in sharing the states allocations. For the third category, the agitation revolves around issues of oil rents, compensation and provision of infrastructure, claims to ownership of oil fields, environmental degradation and profit maximization. With oil being strategic as the anchor for Nigeria's fiscal system and as the main source of foreign exchange inflow, contestations that might impact negatively on oil revenue due to fiscal centralization would definitely have severe cost on the Nigerian economy.

Particularly from 1999, the contestations linked to fiscal centralization degenerated to militancy and rebellion. The militancy and rebellion have involved; (i) damages to oil facilities leading to production shut-in; (ii) kidnapping and loss of lives that have increased uncertainties and risks for investment in Oil and Gas Sub-sector (iii) rising cost of operations; and (iv) growing costs of maintaining security in the Niger

Delta Region which may crowd-out spending on agriculture, education, health and economic infrastructure. These developments suggest that net economic cost of fiscal centralization in Nigeria is positive and increasing.

The sustained struggles among the key players, especially the communities in the Niger Delta Region resulted to rebellion and open conflicts. Initially, these communities formed themselves into non-violent groups, agitating for the development of the region but the formations gradually transformed into militant groups. Some of the groups include the Movement for the Survival of Ogoni People (MOSOP), the Ijaw Youth Council (IYC), the Movement for the Survival of Ijaw in the Niger Delta (MOSIEND), the Environmental Right Action (ERA), the Pan-Niger Delta Resistance Movement, the Movement for Reparation to Ogbia (MORETO) etc. Over the years, the activities of these movements have changed from their conceived peaceful formation to violent ones.

Before the Amnesty Programme of Late President Musa Ya'adua, if the communities in the Niger Delta were not in conflict with the multinational oil companies over land rights or compensation for environmental degradation, they were in dispute with the government over oil wealth and resource control or they were in conflict with one another over claims to ownership of oil fields. Therefore, the situation in the region was not whether there was trouble, but it was a question of when and where (Garba, 2004). The amnesty programme indeed brought some relative peace in the region in particular and the country at large, but the truth however is that fiscal centralization, which resulted to militancy, had severe costs on the Nigerian economy. The question then is, how are these cost measured and analyzed? This is the question the study is set to find answers to.

Theoretical Framework

The discussion in this section specifically centers on fiscal decentralization and fiscal centralization in relation to economic growth. Following Markus, (2004) and Susan, (2006), we examine the dimension and the potential impact of fiscal centralization and fiscal decentralization on economic growth. The theoretical overview tries in particular to depict precisely the various channels through which fiscal centralization and fiscal decentralization influence economic growth. The theoretical justification of fiscal centralization is based the following arguments:

External Effects and Economies of scale

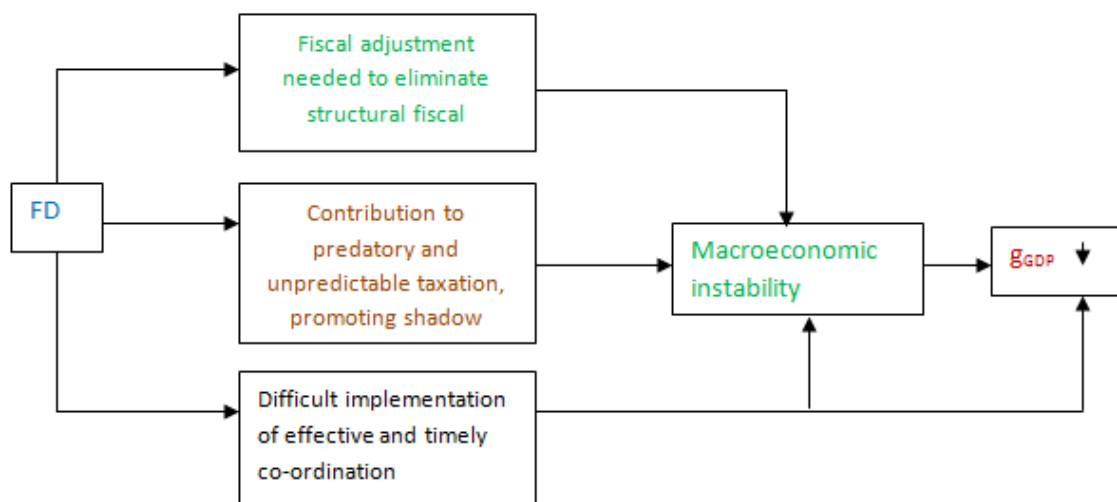
The realization of economies of scale and the internalization of external effects are often considered the main factors for fiscal centralization, especially with respect to the central provision of public goods where average costs can be reduced with increasing output (Ola, 2001, and Parker and Judith, 2006). From empirical investigation, this position does not have a unanimous acceptance among researchers. Samekal, (2001) argues that, for the decreasing costs reason, fiscal centralization recommendation is not tenable because the information costs for the local citizens, the control costs for the central level and lack of accommodativeness would rather increase the overall costs. In terms of internalization of externalities, central government deals with inter-jurisdictional externalities (pollution abatement) and regulates natural monopolies based on national networks, while local levels tend to control activities that have a regional limited impact (Hemming and Spahn, 1997). Hooghe and Marks (2001) argues further that, externalities arising from the provision of public goods too vary immensely. So, in order to internalize

these multifaceted externalities, multilevel governance is needed. Based on the above empirical findings therefore, the link between fiscal centralization and economic growth depends on the nature of the economy, the type of externalities and the economies of scale in question.

Markus (2004) argues that if externality effects are satisfactorily internalized through fiscal centralization, structural imbalances within the economy will be reduced and chances for faster economic growth can be enhanced. Also, cost reductions at the sub-national levels should, *ceteris paribus*, allow for more growth enhancing investments.

The situation in Less Development Countries (LDCs) is different from the relationship explained above. Given the structural fiscal imbalances in developing economies and the difficulties involved in the implementation of effective coordination within the economy, Markus (2004) argued further that the ‘imposition’¹ of fiscal decentralization would result to macroeconomic instability. The scenario would eventually result to negative growth effects. This argument is depicted in Figure 1 below.

Figure 1: Stabilization Task, Co-ordination Problems



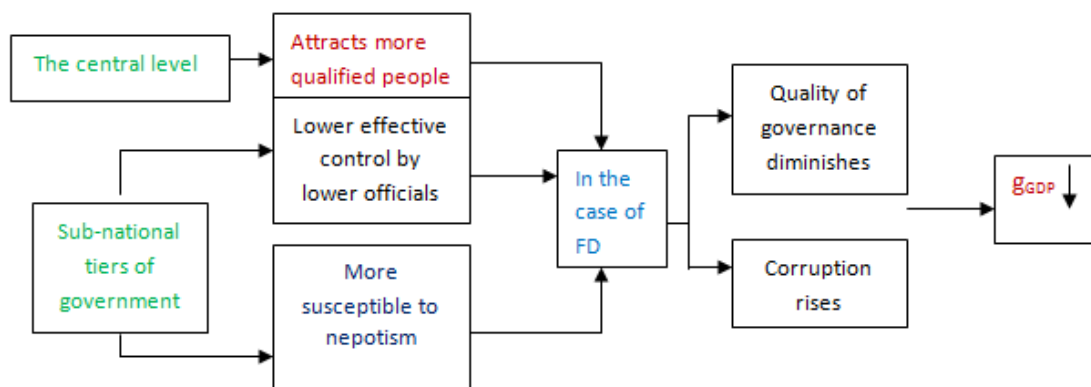
From Figure 1, fiscal adjustments are needed to eliminate structural imbalances among different levels of governments, especially in developing economies. In reality, fiscal matters usually show imbalances among the levels of governments in LDCs. In Nigeria’s case, these issues are well documented². Also fiscal adjustment is a constitutional issue which is subject to serious debates. More so, the parties involved usually take positions that are reluctant to shift grounds, so it becomes difficult to arrive at a consensus on such issues. Hence, the needed fiscal adjustments are hardly met and the imbalance among the levels of governments persists. Fiscal decentralization may create perverse incentives and may even worsen structural imbalances. Supplemented by the potential contribution of fiscal decentralisation to predatory and unpredictable taxation, macroeconomic instability could arise. Accompanied by co-ordination difficulties, considerable negative effects on growth could be the consequence.

¹ By imposition of fiscal decentralization it means a situation where fiscal variables in LDCs are not fully decentralized but policies are handled as if such fiscal matters are decentralized.

² See Akpan H. Ekpo (1999), Abachi (2007),

Quality of Governance and Corruption The quality of governance and the level of corruption under fiscal decentralization system would result to negative impact on growth, particularly in developing economies. The discussion is based on the works of Prud'homme (1994), Tanzi (1995) and Markus (2004) as depicted in Figure 2 below.

Figure 2: Quality of Governance and Corruption



Their argument is that decentralization can increase disparities, jeopardize stability, undermine efficiency and encourage corruption. In terms of the quality of governance, the central level attracts more qualified people because of better career opportunities and salaries and would therefore achieve a higher quality of governance. The lower levels on the other hand experience scarcity of qualified personnel and that seriously impedes decentralization efforts. As for corruption, they argued that local elites (and indeed national politicians) usually get improved access to public resources via decentralization, which eventually increases opportunities for corruption.

If fiscal centralization is in place, the qualified people would improve the quality of governance and with less corruption in the system; economic growth will be the result. However, the implementation of fiscal decentralisation leads, *ceteris paribus*, to a lower quality of governance and/or to more corruption (Fisman and Gatti, 2000), what in turn impedes proper economic growth.

On the other hand, many factors are advanced to support fiscal decentralisation as being responsible for economic growth. Some of these include the following:

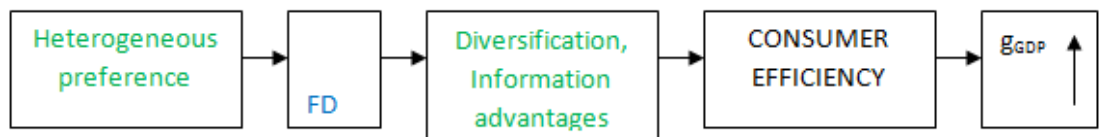
Heterogeneous Preferences

The presence of heterogeneous preferences in a country is viewed by Oates (1972) as a strong case for decentralization. His decentralization theorem justifies the existence of different governments by demonstrating that given non-homogenous preferences, the public goods supply should be diversified. The main assumption being that the central government is unable to diversify its supply and there are no spillovers. According to the correspondence principle, the jurisdiction determining the level of provision of each public good should precisely include the set of individuals consuming it. In other words, it asserts that each public good should be provided by the jurisdiction that has control over the minimum geographic area that would internalize the benefits and costs of each provision.

Markus (2004) believes that when population groups are smaller, the demands of any randomly chosen household will be closer to the demand of the average household in the group. Economic welfare will thus be improved, as the provision of services for each

group is closer to each member household's optimum. Therefore, a uniform level of public services offered in each community is inappropriate. "Pareto efficiency can be raised through fiscal decentralization" (Thießen, 2000). Cremer, Estache and Seabright (1994) put it that "each type of good should be provided by a level of government enjoying a comparative advantage in accounting for the diversity of preferences in its choice of service delivery." To sum it up: a strong case in favour of decentralization can be deduced from the consideration of the diversity of local preferences. However, Hemming and Spahn (1997) and Ter-Minassian (1997) contended that it is unrealistic to possess complete knowledge of the citizen's tastes and "the administrative weakness at the sub-national level, especially the lack of modern and transparent public expenditure management systems" could offset the expected efficiency gain from decentralization induced by heterogeneous preferences.

Figure 3: Decentralization Theorem



If decentralisation attempts are able to satisfy these different preferences, positive economic growth effects may occur. Efficiency gains, the diminution of information, transaction and control costs as well as the realization of comparative advantages may be the source of these positive growth effects.

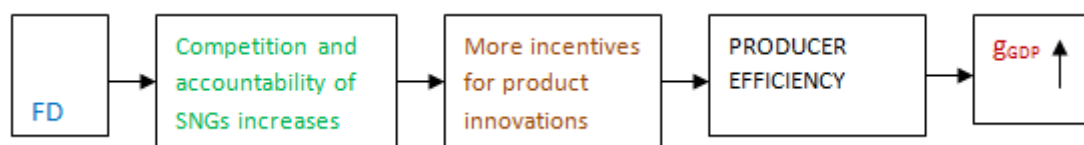
Inter-jurisdictional Competition

Inter-jurisdictional competition is another theoretical case for fiscal decentralization. According to Markus (2004), the degree of mobility of regional population, the regional propensity to innovate (approximated by the region's share of total patents issued within a country), the degree of inter-jurisdictional economic integration, or the degree of openness (measured by the ratio of the trade volume to GDP) would steer the competition.

With respect to trade and economic integration, empirical works provide diverse suggestions. On the one hand, explaining the fact that small countries can prosper when trade is liberal and markets are open, Alesina and Spolaore (2003) concluded that economic integration and political disintegration go hand in hand. Hence, economic integration is expected to increase fiscal and political autonomy. A positive impact of economic integration on fiscal decentralisation should be the consequence. On the other hand, Letelier (2003) argued that "trade oriented economies tend to concentrate a large proportion of taxes on the hands of the central government through the collection of import and/or export tariffs and other related duties". Accordingly, a negative impact of openness on fiscal decentralisation should be expected. Stegarescu (2003) tests the hypothesis that by increasing the market size and the benefits of local provision of public goods and taxes, economic integration could have triggered the recent process of decentralisation. His results found for OECD countries are consistent with a strong decentralising effect of economic integration as well as of trade openness.

The channels explaining the relation between inter-jurisdiction competition and economic growth is hereby explained and illustrated.

Figure 4 : Productivity Enhancement Hypothesis



Decentralized government systems enforce competition between the different authorities and strengthen political and organizational innovation. They can realize efficiency gains by utilizing their comparative advantages and by dividing labour efforts corresponding to the respective local resources (Markus, 2004, Raffaele and Emanuela, 2004; Susan, 2006). Positive economic growth effects can therefore be expected. In other words, Figure 4 depicts the productivity enhancement hypothesis, which indicates that fiscal decentralization enforces not only inter-jurisdictional competition but also the accountability of Sub-national Governments (SNGs), what, in turn, gives more incentives for product innovations of governments. Higher efficiency in the supply of public goods enhances economic growth.

Leviathan Model

The Leviathan Model is also used to make a case for fiscal decentralization (Brennan and Buchanan 1980). The leviathan based assumption contends that decentralization limits the expansion of the central government's structure and competition between jurisdictions. In other words, the model posits that if taxes and expenditures are greatly decentralized, total government's intrusion into the economy, *ceteris paribus*, should be smaller.

Figure 5: Leviathan Restraint Hypothesis

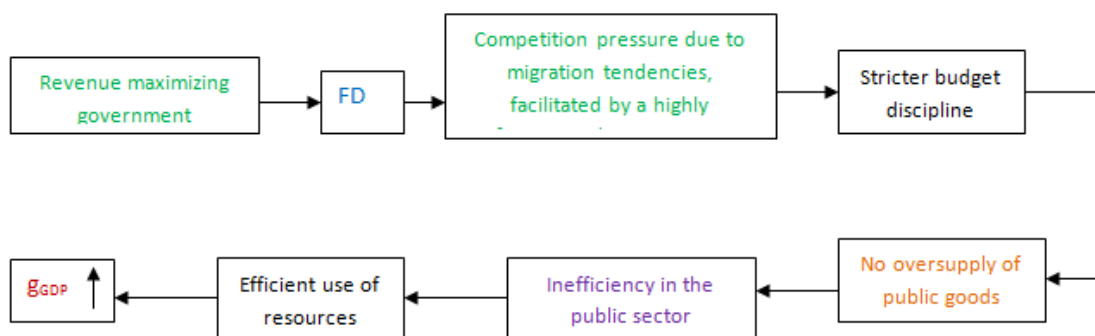


Figure 5 above illustrates the Leviathan-restraint-hypothesis. We start the analysis with the works of political economists who consider the effects of inter-jurisdictional competition and to check the relationship between a fragmented territorial structure and the size of the public sector (Kirchgässner and Schaltegger, 2002): The connection between government expenditures and revenues is strengthened by the existence of a fragmented system, stricter budget discipline is effected and therefore a diminution of the size of the public sector can be expected (Markus, 2004). Thus, an oversupply of public goods and inefficiency in the public sector can be prevented (Thießen, 2000). Fiscal decentralisation triggers inter-jurisdictional competition and stricter budget discipline. Decreasing inefficiency is the consequence, having, in turn, positive effects on economic growth.

These conclusions of political economists are based primarily on the “*central policy failure*”-theorem: imperfect information, rent-seeking politicians as well as lobbying-activities of interest groups characterize the Leviathan-behaviour, which leads to a sub-optimal consideration of local preferences and hence to welfare losses. This influence of vested interest can only be enforcement of the political responsibility of the government, what, in turn, can be reached satisfactory through decentralization.

Figure 6: Dispersion of Vested Interests

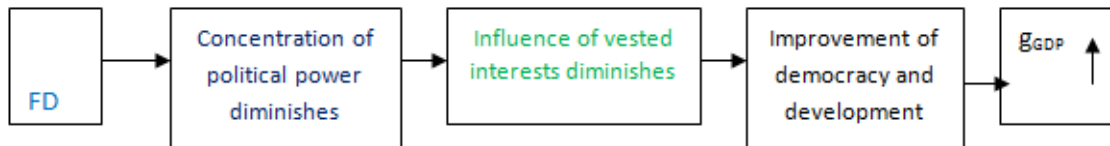


Figure 6 show that fiscal decentralization diminishes the concentration of political power at the central level. Vested interests can be weakened and democracy can be augmented. The favourable effects from democracy on economic growth include maintenance of the rule of law; free markets, small government consumption, and high human capital.

Methodology

The methodology is conceptualized in order to achieve the main objective of measuring and analyzing the cost of fiscal centralization in Nigeria. The various costs of fiscal centralization to the country considered in the paper include the following: (i) the cost of shut-in of oil production (ii) cost of damage to infrastructure (iii) the increase in expenditure on defence and internal security (iv) damages during military attacks and counter attacks (v) illegal oil bunkering (vi) loss of lives. For convenience, we group these cost items into three broad categories. These are:

- (i) Oil related costs. The costs elements under this group include the cost of shut in of oil production, military damages and illegal oil bunkering.
- (ii) The expenditure allocation costs are the expenditure on defence and internal security and
- (iii) Social/Human costs. The cost elements here include cost of damages to infrastructure and loss of lives.

The total cost of the above listed cost items are presented algebraically as follows:

$$TC = f(CIS, DI, \Delta DE, MD, BKN, LOL) \text{-----} 1$$

Where,

- CSI = Cost of shut in of oil production
- DI = Replacement costs for damaged facilities
- ΔDE = Expenditure on defence and internal security
- MD = Military damages
- BKN = Illegal oil bunkering
- LOL = Loss of lives

The conflicts in the Niger Delta Region were violent and took different forms and dimensions. It was either the militants were at war with the government security agents, or they were in contestations with the oil companies or the communities were at war

among themselves. In all these, massive destruction of lives and properties was usually the end result. But since the exact number of people lost in such confrontations can not be correctly ascertained and their monetary value can not be estimated, we exclude loss of lives from equation 1

Therefore;

$$TC = CSI + DI + \Delta DE + MD + BKN \quad \text{-----} \quad 2$$

Each of these costs is measured and the monetary value indicated. Detail of how the costs are measured is presented in Table 1, Appendix 1

Cost Analysis

We use the information from Table 1 to estimate the costs of fiscal centralization in Nigeria. The listed cost items (except loss of lives and damaged facilities) are estimated from 2001 to 2008.

Oil related costs

- (i) Shut-in of oil production

Militants' activities usually force oil companies to shut down production. That started when the agitations in the Niger Delta took violent dimensions. So many instances involving the amount of crude oil lost have been reported (Garba, 2004, Hassan, 2007, Fagbadebo and Osaretin, 2010). A summary of shut in of oil production and the amount of oil lost is presented in Table 2

Table 2: Shut in of oil production (2001 to 2008)

| Year | Incidence and Daily costs |
|------|---|
| 1997 | Shell Company declares majeure at Bonny Terminal due to local protests and disrupted 210, 000 barrel of crude oil per day |
| 2002 | Chevron declares force majeure on its exports for 10 days due to protests and fire. Between 300,000 and 400,000 barrels per day were halted. The cost is between \$0.076 billion and \$0.10billion for 10 days. Before the fire, about 110,000 barrels per day interrupted by protestors |
| 2003 | Chevron, Texaco, Royal Dutch/Shell, Total and Elf shut in operations due to militancy. That affected 768,000 barrels per day in the Western Niger Delta and 50,000 barrels per day in the Eastern Niger Delta |

Source: Garba (2004),

Table 2, indicates that the barrels of oil lost due to shut in of oil production kept increasing as the activities of militants intensified. To obtain the trend of crude oil lost from 2001 to 2008, we assume that the crude oil lost was 210,000 barrels per day from 2001 and 2002. From 2003 to 2008, we estimate the loss of crude oil due to shut in of oil production to be 250, 000 barrels per day. Based on these estimates, we obtain a trend of barrels of oil lost from shut in of oil production from 2001 to 2008 as shown in Table 3

Table 3: Estimated costs of shut in of oil production (2001 to 2008)

| Year | Estimated loss of oil per day (barrels) | Annual loss of oil (barrels) | Oil Price (\$/barrel) | Annual Cost (\$'billion) | Exchange Rate (N/\$) | Cost in Naira (N'billion) |
|------|---|------------------------------|-----------------------|--------------------------|----------------------|---------------------------|
| 2001 | 210,000 | 76,650,000 | \$ 24.5 | \$ 1.88 | 111.2312 | 209.1 |
| 2002 | 210,000 | 76,650,000 | \$ 25.4 | \$ 1.95 | 120.5782 | 235.1 |
| 2003 | 250,000 | 91,250,000 | \$ 29.1 | \$ 2.66 | 129.2224 | 343.7 |
| 2004 | 250,000 | 91,250,000 | \$ 38.7 | \$ 3.53 | 132.8880 | 469.1 |
| 2005 | 250,000 | 91,250,000 | \$ 57.6 | \$ 5.26 | 131.3000 | 690.6 |
| 2006 | 250,000 | 91,250,000 | \$ 42.8 | \$ 3.91 | 127.4000 | 498.1 |
| 2007 | 250,000 | 91,250,000 | \$ 41.5 | \$ 3.79 | 125.83 | 476.9 |
| 2008 | 250,000 | 91,250,000 | \$ 40.2 | \$ 3.67 | 126.50 | 464.3 |

Source: Computed by Author.

Given that there are 365 days in a year, we multiplied the estimated loss of barrels of oil per day by the number of days to generate the series for annual loss of barrels of oil from 2001 to 2008. Oil prices and exchange rates are obtained from CBN Statistical Bulletins. By multiplying international oil prices by annual loss of barrels of oil, we obtained the annual costs of shut in of oil production in Dollars. Again, by multiplying the annual costs (\$'billion) by their respective exchange rates (N/\$), we obtained the equivalent values in Naira for the respective years.

(ii). Illegal oil bunkering

Bunkering is the illegal siphoning of oil from oil pipes. Militancy in the Niger Delta Region made illegal bunkering of oil to thrive and it became the key source of funds for the militant groups. Several militant warlords have either publicly or privately admitted involvement¹. According to a report of the Brussels based International Crisis Group, Nigeria losses anywhere from 70,000 to 300,000 barrels per day to illegal bunkering, the equivalent output of a small oil producing country. In its annual report in August 2006, Shell Nigeria estimated illegal bunkering losses at 40,000 to 60,000 in 2004 and from 20,000 to 40,000 barrels per day in 2005. These estimates and their financial equivalent at the appropriate oil prices are presented in Table 4

Table 4: Illegal Oil Bunkering by Militants.

| Year | Estimated barrels per day | Oil Price (\$/barrel) | Estimated costs per day (\$billion) | Estimated Annual Costs (\$billion) |
|------|---------------------------|-----------------------|-------------------------------------|------------------------------------|
| 2004 | 40,000 – 60, 000 | \$38.7 | \$0.00155 - \$0.0023 | \$0.565 - \$0.84 |
| 2005 | 20, 000 – 40, 000 | \$57.6 | \$0.0012 - \$0.0023 | \$0.37 - \$0.84 |
| 2006 | 70, 000 – 300, 000 | \$42.8 | \$0.0030 - \$0.013 | \$1.095- \$4.69 |

Source: Ogbadebo and Osaretin, 2009

From Table 4, the estimated annual costs resulting from bunkering increased from \$0.37 billion - \$0.84 billion in 2005 to \$1.095 billion- \$4.69 billion in 2006. Taking the average of the ranges from the estimated annual costs, we have \$0.985, \$0.61 and \$2.89 for 2004, 2005 and 2006 respectively. We assume that bunkering activities were not so severe from 2001 to 2003, so assigned annual costs of \$ 0.5. From 2007 and 2008, despite the intensity of the militia activities, we assume however that the 2006 value

prevailed in these years. We therefore obtain a series from 2001 to 2008 as presented in Table 5

Table 5: Costs through illegal oil Bunkering

| Year | Annual Cost (\$'billion) | Exchange Rate (N/\$) | Cost in Naira (N'billion) |
|------|--------------------------|----------------------|---------------------------|
| 2001 | \$0.50 | 111.2312 | 55.6 |
| 2002 | \$ 0.50 | 120.5782 | 60.3 |
| 2003 | \$0.985 | 129.2224 | 127.3 |
| 2004 | \$0.61 | 132.8880 | 81.1 |
| 2005 | \$ 2.89 | 131.3000 | 379.5 |
| 2006 | \$ 2.89 | 127.4000 | 368.2 |
| 2007 | \$ 2.89 | 125.83 | 363.6 |
| 2008 | \$ 2.89 | 126.5 | 365.6 |

Source: Computed by Author

(iii). Military Damages

In Nigeria, all forms of violent protests are usually handled by the security agents. In the Niger Delta too, military formations are usually directed to intervene in pretests and agitations by the militants. Specifically, there was the crushing of Adaka Boro rebellion in the 1960s, the Major Okutima Internal Security Task Force of the 1990s, the Odi invasion of 1999, the Joint Task Force of 2003, the Operation Restore Hope, led by Brigadier General Elias Zamani and the use of the Mobile Police Units of the Nigerian Police at several instances to restore peace which often resort to destruction of properties and killings.

Attacks by the Niger Delta militants on the oil industry as well as individuals both Nigerians and expatriates, have been massive. The militant groups were fighting for a greater share of the region's oil wealth after the purported decades of neglect. From January 2006 to August, 2007, there were 59 major attacks. In all those attacks, the Joint Task Force intervened to combat the militants' activities and the destruction was massive. The confrontation between the militants and the government security agents led to a minimum loss of 600, 000 barrels of crude oil per dayⁱⁱ, besides the destruction of properties and lost of lives (Fagbadebo and Osaretin, 2010). That means there was a minimum loss of \$9.37 billion from January to December, 2006 and \$6.02 billion from January to August, 2007 and \$9.15 billion in the whole of 2007.

This period was the period of intense, continuous and sustained fighting between the militants and government security formations. Prior to 2006, there were cases of military combats with the militias, but the cases were not as severe as the ones reported in 2006/2007. We therefore assume an annual cost of 1.5 US dollars from 2001 to 2003 and 1.8 US Dollars from 2004 to 2005. We also assume that there were no militants' activities that could warrant military intervention from September to December of 2007, so the cost from January to August is maintained for 2007. Assuming again that the cost of military damages in 2008 was 2.5 US Dollars and given the exchange rate of the Naira, the costs from 2001 to 2008 are presented in Table 6.

The oil related costs are summarily presented in Table 7

Table 7: Summary of Oil Related Costs (N Billion)

| Year | Shut in of Oil Production | Illegal Oil Bunkering | Military Damages | TOTAL |
|--------------|---------------------------|-----------------------|------------------|---------------|
| 2001 | 209.1 | 55.6 | 166.8 | 431.5 |
| 2002 | 235.1 | 60.3 | 180.9 | 476.3 |
| 2003 | 343.7 | 127.3 | 193.8 | 664.8 |
| 2004 | 469.1 | 81.1 | 239.2 | 789.4 |
| 2005 | 690.6 | 379.5 | 236.3 | 1306.4 |
| 2006 | 498.1 | 368.2 | 1193.7 | 2060 |
| 2007 | 476.9 | 363.6 | 757.5 | 1598 |
| 2008 | 464.3 | 365.6 | 316.3 | 1146.2 |
| TOTAL | 3386.9 | 1801.2 | 3284.5 | 8472.6 |

Source: Compiled from Tables 3, 5 and 6

Table 7 shows the totals from costs of shut in of oil production, illegal oil bunkering and military damages. As revealed from the table, the total costs of oil related costs items from 2001 to 2008 is eight thousand, four hundred and seventy three billion Naira. This is hug loss of revenue to the government.

Expenditure Allocation Cost

Records for this aspect of cost which concerns the expenditure on defence and internal security are readily available in CBN Statistical bulletin. Evidence indicates that from 1960 – 1967, there were provisions for defence and internal security, from 1968 – 1993, there was none. Within that period, the provision for internal security was made under general administration. But from 1994 to date, within the period of intense militancy in the Niger Delta region, adequate provisions were made for defence and internal security. In other words, militancy makes the government to provide and spend more money on defence and internal security. As expected, the expenses on defence and internal security keep increasing as militancy in the Niger Delta Region keeps intensifying.

The expenditure on defence and internal security increased steadily from 1994 to 1998. From 1999 to 2008 however, the increase was continuous and astronomical, indicating the excessive expenditure allocated to maintain security in the country. It suggests that if there were no militancy, the trend seen from 1994 to 1998 would have continued to 2008. To obtain the excess expenditure allocated to combat militancy in the Niger Delta Region, a univariate time series model for government expenditure on security (GES) was usedⁱⁱⁱ. The actual series of the variable (GES) from 1980 to 1998 was used to forecast the trend values from 1999 to 2008. The difference between the actual expenditure on defence and internal security and the trend from 1999 to 2008 represents the excess expenditure allocated to combat militancy. The result is presented in Table 8.

Table 8: Expenditure Allocation Cost of Militancy

| Years | Actual Expenditure on Defence and Internal Security (GES) (N' million) | Forecast Values of Expenditure on GES (N' million) | Difference Between the Actual and the Forecast Expenditure on GES (N' million) |
|-------|--|--|--|
| 1999 | 96475.6 | 17631.29 | 78844.31 |
| 2000 | 74511.9 | 17687.32 | 56824.58 |
| 2001 | 107136.1 | 17732.51 | 89403.59 |
| 2002 | 164892 | 17768.96 | 147123 |
| 2003 | 138596.1 | 17798.36 | 120797.7 |
| 2004 | 195524.6 | 17822.07 | 177702.5 |
| 2005 | 195214.3 | 17841.2 | 177373.1 |
| 2006 | 185340.9 | 17856.63 | 167484.3 |
| 2007 | 241923.5 | 17869.07 | 224054.4 |
| 2008 | 206913.2 | 17879.11 | 189034.1 |

Source: Computed by Author

Social/Human Costs

(i) Cost of Damages to Infrastructures

In the course of fighting in the Niger Delta Region, many infrastructures were destroyed. In 1990, a protest in Umuechem, east of Port Harcourt led to the police destroying or badly damaging 495 houses. In March 2003, the militants were engaged in fierce gun battles with the government security forces. The clashes saw several village communities such as Okerenkoko, Ogbobene, Benikrukru, Inikorogha, Oburu, Kunukunama, Opuedebubo, Oporoza, Kokodiagbene, Tebujor and many more, invaded by the military and many houses, and other properties were destroyed. Other items such as vehicles, market stalls, electricity, etc were destroyed. The monetary value of replacing such damages can not be estimated but it is important to acknowledge that such costs are incurred.

(ii) Loss of Lives

As explained earlier, the incessant combats between the military formations and the militants resulted to loss of lives. On October 30th and 31st, 1990, a protest at Shell's facility at Umuechem, east of Port Harcourt led to the police killing some eighty unarmed demonstrators. In 1992, at the insistent of Shell, some youth were killed in Bonny during a peaceful demonstration against the activities of the oil company. In January 1993, about 300,000 Ogoni organized protestors protested against the activities of oil companies in the area and their action was followed by repeated harassment, arrests, and killing of Ogonis by the Federal government troops. On January 11, 1999, Ijaw women who were engaged in a peaceful demonstration against the marginalization of their people in Port Harcourt were violently tear-gassed, beaten, stripped, and detained by a combined team of policemen and soldiers. Also, the Warri wars of 2003 were allegedly instigated by the activities of some oil companies and Nigerian Naval officers and many people died in the process. The exact number of people lost in the combat between the government security agents and the militants can not be correctly ascertained and the monetary value may not be estimated but it is a huge cost to the country that must be acknowledged.

Generally, if N8472.6 billion were not lost to militancy, the money accruable to the levels of governments would have been much higher. They would have been able; *ceteris paribus* to embark on growth oriented programmes at all levels of governments that would have enhanced the growth of the Nigerian economy.

It is also noted that majority of the states in Nigeria can not survive without the monthly support of the Federal Government exception of Lagos State in recent times. Rather than develop locally based resources, the states now wait for the Federal Government, in the name of allocations from oil revenue every month. It implies therefore that fiscal centralization in Nigeria has stifled local initiatives. The whole attention is on the federally collected revenue so much that efforts to develop solid minerals at the states and federal levels are not accorded any priority. Other sources of revenue are also not vigorously exploited. As Ajefia, (2007) rightly asked; *what happened to the groundnut pyramids, the cotton, the plywood, the rubber, the timber, the cocoa and the palm oil/kernel which the governments of the former four regions depended upon to fund their respective economic and infrastructure development programmes before the advent of Oil?* It is clear therefore that the present fiscal centralization has not only killed the initiatives to exploit new sources of revenue but has also brought about a total neglect of former viable revenue sources.

Also, the system has promoted inefficiency and fostered a sense of over dependence on the Federal Government. In fact, it has created a situation, a system or mechanism that makes lower levels of governments depend on the sharing of federally collected revenue every month. As states and local governments depend almost entirely on revenue sharing without production and increased economic activity, economic development in the country can not be assured. This system cannot be sustained, especially with the increasing costs it generates in the Nigerian Economy.

Findings from the study generally revealed that the estimated oil related costs- (costs of shut in of oil production, illegal oil bunkering, and military damages) from 2001 to 2008, sum up to about N8472.6 billion. The revenue allocated to defence and internal security has been increasing, particularly from 1999 to combat militancy in the Niger Delta Region, and damages to infrastructure and loss of lives constitute other devastating cost to the Nigerian economy.

Conclusion and Recommendation

The thesis of the study was that the cost of maintaining fiscal centralization in Nigeria is positive and increasing. The outcome of the study indicates that the costs involved in maintaining fiscal centralization in Nigeria was indeed very high. The oil related costs, expenditure allocation costs and social/human costs are all positive and increasing.

Based on the conclusion drawn from the study, we recommend that the government should evolve economic and political actions that will completely eliminate militancy and all its associated costs. This may require constitutional changes to the structure of the federalism and greater effectiveness and efficiency in the delivery of public goods and services at all levels of governments. The aspect that requires further

study is the examination of the impact of these costs on the macroeconomic variables in Nigeria or on the growth of the Nigerian economy.

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End Notes

ⁱ According to European University Centre for Peace Studies (EPU) research report, bunkers consider the practice a defensible means of providing funds for sustaining the crisis and providing for aggrieved and impoverished residents of the communities in the region. Specifically, one day's worth of illegal bunkering – at 100, 000 barrels and \$15 per barrel - will buy quality weapons and sustain a group of over 1000 militants for two months.

ⁱⁱ This loss of crude oil is mainly from breakdown of oil pipes in the course of fighting and purposeful attacks on oil tanks and storage facilities by militants.

ⁱⁱⁱ The model is specified as $GES_t = \alpha + GES_{t-1} + \mu_t$

Appendix 1

Table 1: Costs Measurement and Data Sources.

| Cost Elements | Measurement Indicators | Data sources |
|--|--|---|
| Shut in of oil production | <ul style="list-style-type: none"> i. Oil companies declaring force majeure ii. Shut down operations due to protests and fire iii. Combats between militants and security agents iv. Barrels per day of crude oil lost was noted v. From oil price and barrels of oil lost, shut in costs were estimated. | Published works, News papers, and relevant web sites. |
| Replacement costs for damaged facilities | <ul style="list-style-type: none"> i. Incidences of severe fighting were examined ii. Destroyed and damaged infrastructures listed iii. The extent of damage made assessed and iv. Costs of replacement estimated. | Web sites, published works and news papers |
| Illegal oil bunkering | <ul style="list-style-type: none"> i. Available incidences of oil bunkering within the period of militancy were listed ii. The barrels of oil lost through bunkering noted iii. Using the annual oil price with the estimated quantity of oil lost through bunkering, costs were estimated. | Published works, web sites, and news papers |

| | | |
|--|--|---|
| Expenditure on Defence and Internal Security | <ul style="list-style-type: none"> i. Both capital and recurrent expenditure on defence and internal security were noted. ii. The information was obtained as reported in official sources of data in the country. | CBN Statistical Bulletin (various years) |
| Military damage | <ul style="list-style-type: none"> i. Military combats with the militants were noted ii. Particular events that led to military formation of Joint Task Force and the use of Mobile Police Units of the Nigerian Police Force will be noted. iii. Particular amount of damages were estimated | Published works, web sites and news papers. |
| Loss of lives | <ul style="list-style-type: none"> i. From the fighting, we shall know the estimated number of lives lost from the militants, the security agents, the armless communities and expatriates if any. | Published works, web sites and News papers. |