

WASTE MANAGEMENT AND WATER QUALITY ISSUES IN COASTAL STATES OF NIGERIA: THE OGUN STATE EXPERIENCE

David Olugbenga Omole
Covenant University, Nigeria

Solomon Isiorho
Indiana University-Purdue University, USA

ABSTRACT

Waste dumping and inadequate waste management efforts are having adverse impact on the environment and humans in Nigerian coastal cities. Nine of the 36 states in Nigeria border the Atlantic Ocean. Twenty-five percent of the Nigerian population is found in the coastal states. These states, with the exception of Lagos, Ogun and Ondo, are more prone to petrochemical wastes arising from petroleum exploration. Field investigations, surveys and literature searches were conducted in order to accomplish the task of this research. Field studies included testing for dissolved oxygen, biological oxygen demand, nitrates, phosphate, total solids and pH.

Keywords: coastal zone, solid waste, effluent, water quality, ogun state

INTRODUCTION

The coastal areas of Nigeria have been in the limelight in recent times due to civil unrest and the heavy environmental pollution resulting from oil prospecting activities. The coastal states in Nigeria are Akwa-Ibom, Bayelsa, Cross-Rivers, Delta, Edo, Lagos, Ogun, Ondo and Rivers. The traditional member states of the oil producing states are Akwa-Ibom, Bayelsa, Cross-Rivers, Delta, Edo and Rivers States. Other coastal but non-oil producing states are Lagos and Ogun States. However, oil pollution is not the only environmental threat to these coastal States. Other forms of solid and liquid wastes equally threaten the livelihood of residents of these areas. For certain reasons, development, job opportunities, government attention and commercial activities are concentrated in coastal locations than inland locations all over the world. This phenomenon, which is best explained by anthropologists and sociologists, is also the case in Nigeria. It is estimated that one-quarter of Nigerian population live in the coastal zone represented by nine states (UNEP, 2007). However, going by the 2006 census (FRN, 2007), 37.2 million representing 26.6% of the total population live in the coastal zone. It goes without any doubt that there would be a correlation between the total national population and gross national waste generated. However, the national waste distribution is not gaussian but skewed with the peak waste generation tilting toward the coastal states (Table 1). The high population density, high precipitation, heavy trash loads on water ways and low-lying nature of the coastal states lead to flooding problems in Nigeria. Lagos State alone accounts for more than 60% of all the industrial activities in Nigeria (FEPA, 1995). Sources of industrial wastes in this particular state originate from textile, food processing, metallurgy, rubber/plastics, pharmaceuticals, paints and chemicals in order of notoriety. Wastes generated from most of these industrial activities are characterized by hazardous wastes. Moreover, 80% of all wastewater coming from these industrial outfits never get any form of treatment (FEPA, 1995). Ogun State is the nearest state to Lagos state. Lagos State is actually bounded in the north by Ogun State, the west by Benin Republic and the south by the Atlantic Ocean (Figure 1a). By reason of this proximity and

congestion problems in Lagos State, Ogun State has shared in the good and ill fortunes of Lagos State. Many industries have relocated from Lagos State to boundary communities like Ota (Figure 1b). New industries are also springing up at a high rate in Ota although the target market is Lagos State (Longe, Omole, Adewumi and Ogbiye, 2010).

Table 1: General information on Nigerian Coastal Area
(Coastal States and their relative Population Density)

s/n	Coastal State	¹ Population 2006 Census	² Land Area (km ²)	Density (Persons /km ²)	³ Rural/Urban Ratio	² Economic Activities
1	Akwa-Ibom	3,920,208	8,421	466	70/30	Oil & Gas, Agro-Allied Industries, wood work & furniture, Soap & detergent manufacture, metal works, Hide & Skin, Lumbering & Sawmilling, Arts & Crafts.
2	Bayelsa	1,703, 358	⁴ 21, 100	81	-	Oil & gas, Coastal Tourism, Agriculture, Aquaculture, Palm Oil milling, Local gin making, Carving & Weaving, Trading.
3	Cross-Rivers	2, 888,966	23, 074	125	25/75	Petrochemicals, Wood processing, Agriculture, Aquaculture, Quarrying & Cement manufacture, Rubber & Latex, Metal processing
4	Delta	4,098,391	17, 011	241	30/70	Oil & gas, petrochemicals, wood processing, Foam manufacturing, Metals & Alloys
5	Edo	3,218,332	15,650	206	30/70	Agriculture & Fishing, Petrochemicals, Breweries, Plastic manufacturing, Lumbering & Sawmilling, Quarrying
6	Lagos	9,013, 534	⁵ 3577 (787 is water)	2,520	10/90	Textiles, Food processing, Foam & asbestos, Pharmaceuticals, Metals & Alloys, Shipping.
7	Ogun	3,728,098	16,720	223	66/34	Textile, Breweries, Lumbering & sawmilling, Foam, plastics & Rubber manufacture, Quarrying.
8	Ondo	3,441, 024	14,769	233	61/39	Agriculture, Lumber & Sawmill, Oil & gas, Quarrying, sand mining.
9	Rivers	5,185,400	11,225	462	-	Petrochemical, Oil and Gas, Foam manufacturing, Metals and Alloys, Pharmaceuticals.

¹FRN (2007); ²UNEP (2007); ³1991 Official Census Data; ⁴BCFAC (2008); ⁵LSG (2008)



Fig. 1a: Map of Nigeria showing some Niger Delta communities, Lagos, Atlantic Ocean, and neighbouring countries.



Fig. 1b: Location of Ota in Ogun State

Flooding Effects

A common feature of the coastal zone is the relatively low elevation of the area with respect to other parts of the country. The water tables in these areas are relatively higher (Kehinde & Longe, 2003). Precipitation is higher and runoff volume is higher. However, seepage capacity is reduced because of the readily saturated nature of soil, which in turn leads to high runoff volume. As run-off water approaches larger water bodies at its downstream course, its velocity is decreased with a resultant dumping of sediments. The waste disposal habits of Nigerians also contribute to flooding. Most of the drainage ditches are full of sediments, refuse, garbage, trash and domestic wastewater. Therefore, when precipitation occurs, the run-off easily floods roads and homes and cause land pollution. These ultimately lead to economic and environmental damages of high proportions.

Land pollution

It is not uncommon to find solid waste on the streets and it appears that the sanitation authorities do not pay particular attention to the cleanliness of the neighbourhoods. If the residents of the densely populated areas of Lagos and Ogun States continue with the haphazard nature of waste disposal, the situation would most likely pose health hazard for people. It is of great concern that the municipal authorities do not take the waste disposal issue very seriously and take steps to address the problem (Adelegan, 2004; Longe, Ukpebor and Omole, 2009). It is common to see refuse-stuffed sacks along roadsides and water channels in Ogun and Lagos States. This practice is done in the hope that the municipal authorities would collect them (Figures 2 and 3). Unfortunately, these sacks are left there for weeks at a time.

The amount of waste generated from households and commercial establishments are on the increase at an alarming rate and the wastes are not being collected and disposed in a manner that would protect the health and safety of the public. These abandoned wastes create nausea, eyesores and a good breeding ground for germs and bacteria right in the city centers. Visitors, investors and tourists visiting these areas for the first time would likely find the sceneries completely repulsive and offensive. Some of the factors responsible for this unsocial and irresponsible habit of unsanitary waste disposal can be attributed to overpopulation, poverty, government insensitivity, government negligence and ignorance on the part of the populace. Many who were born and live under these unsanitary conditions for years have come to accept the situation as the norm thus perpetuating the problem.



Figure 2: Solid wastes dumped into a stream channel in the coastal city of Ota.



Figure 3: Solid waste dump and land pollution in city center of Ota, Ogun State

Ground and Surface water contamination

It was estimated that 40.1% of Nigerians derive their sources of water from groundwater sources (Ahianba, Dimuna and Okogun, 2008; FOS, 2001). A breakdown of this study shows that between 1998-1999, 28.27% use water from hand-dug wells and 11.83 % got their water from boreholes. Other studies also show that 33.82% of Nigerians resort to surface water sources to meet their domestic water supply needs (Ahianba *et al.*, 2008; FGN, 2000; FOS, 2001). This category of people is exposed more to the risks from the effects of flooding and solid waste dumps. Transported sediments and leachates from wastes (especially biological wastes) could easily contaminate both surface water and groundwater. Therefore, it is worrisome that the health of people who depend on these sources of water could be jeopardized as a result of the complacent attitude of environmental regulatory agencies to ill-advised waste disposal methods. The effect of waste disposal on the water quality near an urban area in Ogun State, Nigeria was examined.

METHOD

The Study Area

Ota, an urban area with a 2006 census population of 526, 565 (NBS, 2006), is the largest city in Ogun State. The city is located between latitude 60 30'N-60 50'N and longitude 30 02'E-30 25'E, with an elevation of 53m above mean sea level. Several rivers traverse the area that includes rivers Iju, Imojiba, Ogun, Abesan and Illo. The river Illo runs along the Lagos-Ogun boundary for about 24 kilometers. The field survey covered a distance of about 2km situated between Dalemo in Sango-Ota and the former Tollgate area (Figure 4). Ota is about a 10- minute drive from Lagos-Ogun State boundary.

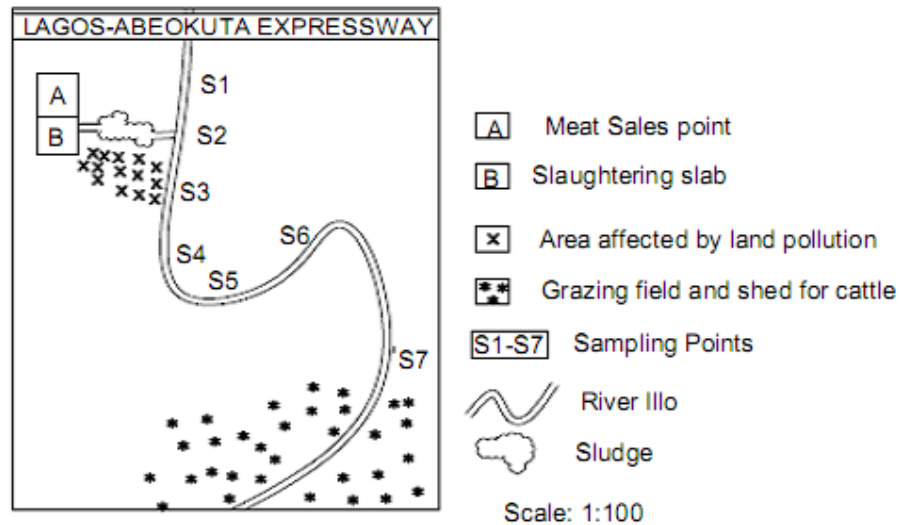


Figure 4: Map showing the study area

Field Studies

Field studies were carried out in Ogun State using field investigation, surveys and literature searches. The water quality of River Illo in Ota, Ogun State was examined in 2006. Segments of this river traverse major urban centers as well as rural areas, and people are known to use the water for drinking, laundry, cooking, car washing and bathing. Several industries discharge their wastes without treatment into the river. Also, some individuals dispose human wastes into the same river. The field studies included testing for dissolved oxygen (DO), biological oxygen demand (BOD), nitrates, phosphate, total solids and pH along a segment of the river that borders an abattoir. This study examines the effect of abattoir effluents on the water quality of River Illo that eventually empties into the nearby lagoon. Water samples were taken from seven sites: one upstream from the abattoir, one adjacent to the abattoir, and the remaining sites, downstream from the abattoir (Figure 4). The study was conducted before the arrival of the rainy season in March 2006. The results from the study are presented below.

RESULTS & DISCUSSIONS

The results of the study are presented in Table 2. The pH of the river water is slightly acidic, the DO is low and the total solids are slightly above the World Health Organization standard. Nitrate level and conductivity values were low. In summary, the water quality indicators such as pH, nitrates, phosphate and conductivity are within the acceptable limits, but, the DO, BOD, and total solids are not within the WHO acceptable standards. DO range between 0.01 mg/l and 4.6 mg/l with a mean value of 2.24 mg/l compared with the limits of 5.0 mg/l for aquatic life. A range of 140 mg/l to 670 mg/l was determined for BOD with a mean value of 312.9 mg/l whereas the limit for drinking water is 15 mg/l. Also, total solids ranged between 447.5 mg/l and 1071.5 mg/l with a mean value of 608 mg/l. The acceptable limit, however, is 500 mg/l. The sample point S2 shows the water quality to be poor as seen from the low dissolved oxygen, the high BOD, and total solids values. Also, the high phosphate values suggest that high nutrient values are being added to the river at the abattoir sampling point. A very poor practice by the butchers is the washing of animal entrails directly inside the surface water body and also the exposure of animal bones and sludge to surface water (Figure 5). This tends to increase the suspended solid and phosphate contents of the river. Likewise, this practice tends to increase the risk of transferring zoonotic diseases to people

who drink and cook with water from the river (Olugasa, Cadmus and Atsanda, 2000). Infectious and parasitic diseases topped the list of 10 causes of morbidity in a statistic released by the Federal Ministry of Health (1986). Among these types of diseases are Coli Bacillosis, Salmonellosis, Brucellosis and Helminthes (Cadmus, Olugasa and Olugasa, 1999; Omole, 2010). Abattoir operators are promoting an increase in public health risk through the release of these organisms into water bodies on a daily basis. The concern is not only for the surface water but also for the groundwater.

Table 2: Water Quality Parameter Tested for in Illo River, Ota, Ogun State.

s/n	Sampling point	Sampling Distance (m)	DO (mg/l)	BOD (mg/l)	pH	Conductivity (µs/cm)	Nitrate (mg/l)	Phosphate as PO ₄ (mg/l)	Total Solids (mg/l)
1	S1	-10	4.60	170	6.7	105	0.15	0.05	447.50
2	S2	0	0.01	670	6.8	196	0.09	3.05	1071.50
3	S3	10	0.39	270	6.6	143	0.15	0.09	507.70
4	S3	20	2.70	270	6.5	153	0.14	0.16	601.90
5	S5	30	3.70	140	6.9	150	0.10	0.15	473.70
6	S6	50	0.39	380	6.8	176	0.17	0.19	771.90
7	S7	100	3.90	290	6.2	113	0.22	0.07	471.30
Mean			2.24	312.9	6.64	148	0.15	0.81	608.29
WHO limit for Drinkin water			5.0	15	6.5–8	1400	20 ^a	-	500 ^b

KEY: ^a FEPA Guideline Value

^b WHO acceptable level for Groundwater quality



Figure 5: Surface water pollution at a Public Abattoir

It is established that there is interaction between groundwater and surface water. When surface water is polluted, it impacts ground water and vice-versa. A study carried out on a hand-dug well in the vicinity of Olusosun Sanitary Landfill in Lagos revealed that groundwater in that vicinity was generally acidic with a mean pH value of 4.66 (Longe & Enekwechi, 2007). Heavy metals such as cadmium, iron, chromium and copper were also found to be higher than their standard limits. This heavy pollution status is a pointer to the possibility that combined disposal of hazardous and biological wastes are being practiced at the landfill site. It also suggests that the presence of industrial effluents being discharged from companies in Ikeja environs is adversely impacting groundwater resources.

Implications of the Environmental Degradations on Sustainable Development

The primary threats to the environment as highlighted in this study include reduction in surface and groundwater quality as a result of industrial and agricultural activities as well as flooding as a result of indiscriminate waste dump. These problems touch on all three constituent parts of sustainable development namely environmental, economic and socio-political sustainability (United Nations, 1987).

Environmental sustainability demands that natural capital (the sum total of nature's resources) should not be used up faster than it can be replenished (Dasgupta, 2007). One of such natural capital is fresh water supply. It had been reported that less than 1% of all freshwater supply in the world is readily available for human use (Adekalu, Osunbitan and Ojo, 2001; Omole and Longe, 2008). This fresh water supply is comprised of all surface water resources like rivers, streams, lakes and brooks. The indiscriminate and unregulated discharge of industrial and agricultural wastes such as the abattoir effluent into surface water leads to the depletion this natural resource (Longe *et al.*, 2010). This is a direct contradiction of the very essence of the principles of sustainable development as presented by the Brundtland commission which defines sustainable development as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Hasna, 2007; United Nations, 1987). These industrial and agricultural concerns have their own needs met by getting rid of their wastes but this is being done at a greater cost to the environment and the society. Similarly, the inefficient management strategies being employed at the Olusosun landfill has led to the contamination of groundwater supply through the leaching of toxic substances into the underground water source. Many persons have no other source of potable water supply than these surface and groundwater sources (Longe *et al.*, 2010). Persons go ahead to consume such water unawares of the pollution to the detriment of their health.

In addition, the problem of flooding in coastal states also has a negative impact on the economic and socio-political sustainability of the affected region. This is because whenever flood events occur, lives, homes and businesses are lost. These losses translate to economic tsunamis that impact on the already impoverished populace. This impact is translated into other social problems such as the developments of slums, an increase in unemployment rate and increase in crime rates. While flood events could be brought about by natural circumstances such as low elevation of the region, low water table and high precipitation, it is obvious that human factors also contribute significantly to this potentially disastrous phenomenon. Flood is often effectively controlled when drain channels are free of blockages. However, the indiscriminate dumping of solid wastes in open channels and waterways contribute significantly to the frequent flood events (Figures 6 and 7). Naturally, flowing water will follow the path of least resistance but when the channels are packed full with solid wastes, the storm run-off water changes its course and subsequently flows into human habitats thereby causing avoidable disaster.



Fig. 6: Major Road in Ota, Ogun State, taken over by flood



Fig. 7: Flooded roads and homes in Ota, Ogun State

CONCLUSION AND RECOMMENDATION

Coastal states of Nigeria have issues bordering on waste management difficulties as a direct consequence of congestion arising from population drift to the coastal areas. The more people in an area, the higher the waste generated. Also, because most excess runoff water drained from up country head for the Atlantic Ocean, the coastal states have become a flood zone. Parts of the coastal areas are also endowed with crude oil deposits. Exploitation of this natural resource and degradation of the environment have left many residents of these areas impoverished. Abattoirs have adverse impact on water quality. The generation of waste, collection and proper disposal, and the health and economic effect resulting from the inadequate waste disposal should be addressed at all levels if any reduction in waste products, proper disposal and societal obligations are to take foot hold. There is the need to involve all stakeholders.

The following suggestions are therefore offered to ameliorate the situation:

- i. Indigenes of oil producing states ought to be encouraged in their traditional farming and fishing practice (Table 1) through state grants which would help them relocate to areas not currently polluted by oil.
- ii. Agriculture should be subsidized and encouraged as practiced in developed countries. Infrastructures and amenities like electricity and pipe-borne water should not be features in cities alone but much more in the rural areas. This will stem the trend of population drift to urban centers from rural communities.
- iii. Persons who consume water from surface water sources should be informed about possible upstream pollutions by other users. They should be encouraged to imbibe the habit of treating water before consumption.
- iv. Government should come to terms with its duty of enforcing environmental laws. Pollution should never be encouraged indirectly by bearing full cost of waste management. People should be made aware of their social responsibility of caring for the environment. Part of the means of achieving this is charging a fee for wastes generated to complement the waste management effort of government.
- v. Drainage ditches should be cleared regularly to allow unrestricted storm water passage. This proactive step could prevent damage of assets worth billions of Naira.
- vi. Education at all levels should be encouraged. Hopefully, this would lead to a better environment.

ACKNOWLEDGEMENT

The authors are grateful to Covenant University, Ota and Indiana University Purdue University, Fort Wayne for their support. Ese Esan is also appreciated for editing this paper.

REFERENCES

- Adekalu, K.O., Osunbitan, J.A. and Ojo, O.E. (2001). 'Water Sources and Demand in South Western Nigeria: Implications for Water Development planners and Scientists.' *Technovation* 22 (12): 799-805.
- Adelegan, J.A., (2004). 'The History of Environmental Policy and Pollution of Water Sources in Nigeria (1960-2004): The way forward.' Available at http://web.fu-berlin.de/ffu/akumwelt/bc2004/download/adelegan_f.pdf. [Accessed 26 February 2008].
- Ahianba, J.E., Dimuna, K.O., & Okogun, G.R.A., (2008). 'Built Environment Decay and Urban Health in Nigeria.' *Journal of Human Ecology*, 23(3): pp. 259-265.
- BCFAC (Bayelsa Council for Arts & Culture), (2008). Background information. Available at <http://www.bayelsaartsng.com/sub1.htm>. [Accessed 8 May 2008].
- Cadmus S.I.B., B.O. Olugasa and G.A.T. Olugasa (1999). 'The Prevalence of Zoonotic Importance of Bovine Tuberculosis in Ibadan, Nigeria' in *Proceedings of 37th Annual Congress of the Nigerian Veterinary Medical Association*, pp 65 –71.
- Dasgupta, P. (2007). 'The idea of sustainable development.' *Sustainability Science*, 2(1):5-11
- FEPA (Federal Environmental Protection Agency), (1995). *Strategic Options for the Redressing Industrial Pollution*, volumes 1&2. Nigeria.
- FMH (Federal Ministry of Health), (1986). *National Health Policy Report*. FMH, Nigeria.
- FOS (Federal Office of Statistics), (2001). *Annual Report 2000*. FOS, Abuja.

FRN (Federal Republic of Nigeria), (2007). *Legal Notice on Publication of the 2006 Census Report*. FRN official Gazette, 4 (94): 1-8.

FGN (Federal Government of Nigeria), (2000). *Water Supply & Interim Strategy note*. Available at: http://siteresources.worldbank.org/NIGERIAEXTN/Resources/wss_1100.pdf [Accessed 10th February 2012].

Hasna, A. M. (2007). 'Dimensions of sustainability.' *Journal of Engineering for Sustainable Development: Energy, Environment, and Health* 2 (1): 47–57.

Kehinde, M.O., & Longe, E.O. (2003). *Engineering Geology*. Leihmich Associates, Lagos.

LSG (Lagos State Government), (2008). Information for Lagos Visitors. Available at http://www.lagosstate.gov.ng/c/portal/layout?p_1_id=PUB.1095.4. [Accessed 8 May, 2008].

Longe, D.O. Omole, I.K. Adewumi and A.S. Ogbiye (2010). 'Water Resources Use, Abuse and Regulations in Nigeria.' *Journal of Sustainable Development in Africa, Vol. 12(2)*: 35-44.

Longe, E.O., & Enekwechi, L.O., (2007). 'Investigation on potential groundwater impacts and influence of local hydrogeology on natural attenuation of leachate at a municipal landfill.' *International Journal of Environmental Science & Technology*, 4 (1): 133-140.

Longe, E.O., Ukpebor E.F. and Omole D.O. (2009). 'Household Waste Collection and Disposal: Ojo Local Government Case Study, Lagos State, Nigeria.' *Journal of Engineering Research, vol. 14(4)*: 1-12.

NBS, (2006), *2006 Population Census*. National Bureau of Statistics, Federal Republic of Nigeria. Available at <http://www.nigerianstat.gov.ng/nbsapps/Connections/Pop2006.pdf>. Accessed 10th Feb., 2012

Olugasa, B.O., Cadmus, S.I.B., & Atsanda, N.N., (2000). 'Actualisation of Strategies for Beef Quality Control in South-Western Nigeria' in *Proceedings of the 10th International Congress on Animal Hygiene*, Vol. 1, pp. 67-71, July 2-6, 2000, Wijd Bij Vaasted, Animal Health Service, Maastricht, The Netherlands.

Omole D.O. (2010). *Water Quality Modelling: Case study of the Impact of Abattoir Effluent on River Illo, Ota, Nigeria*. LAP Lambert Academic Publishing GmbH & Co. KG, Saarbrücken, Germany.

Omole, D.O. and Longe, E.O. (2008). 'An Assessment of the Impact of Abattoir Effluents on River Illo, Ota, Nigeria.' *Journal of Environmental Science and Technology, 1 (2)*: 56-54.

United Nations. 1987. *Report of the World Commission on Environment and Development*. General Assembly Resolution 42/187, 11 December 1987.

UNEP (United Nation Environment Programme), (2007). *The Status of the Nigerian Coastal Zones*. Available at <http://www.unep.org/AbidjanConvention/docs/THE%20STATUS%20OF%20THE%20NIGERIAN%20COASTAL%20ZONES%20version%202.pdf> [Accessed 10th Feb., 2012].

ABOUT THE AUTHORS:

David Olugbenga Omole is affiliated with the Department of Civil Engineering, Covenant University, Canaanland, Ota, Ogun State, Nigeria.

Solomon Isiorho is affiliated with the Department of Geosciences, Indiana University-Purdue University, Ft. Wayne (IPFW) Fort Wayne, IN 46805, USA.