

Plastic Waste and Environmental Sustainability in Obio/Akpor Local Government Area, Rivers State, Nigeria

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Abstract: This paper examined plastic waste and environmental sustainability in Obio/Akpor Local Government Area of Rivers State, Nigeria. The study utilized both primary and secondary sources of data. The study used a descriptive survey design. The population of the study was the entire sixty communities of the Local Government Area. The sample size was made up of 12 communities which represent 20% of the study population. Simple percentage was used to analyze the data. The study revealed that the major sources of plastic waste generation are: household, commercial centres (companies and market), others are generated from institutional sources including: educational, social, health and religious centres. Plastic waste destroys the aesthetic quality of the area; blocks drains and canals causing flooding in the area, impact on the soil and affects the microbial diversity of the area. Revealed also is the fact that plastic waste dumped indiscriminately is responsible for the spread of diseases in the area. The study recommends that designated locations should be made available by the Local Government Authority for disposal of plastic waste and penalties should be imposed on defaulters who refuse to sort and bag their waste before disposal. More so, recycling of plastics will help to reduce the number in circulation.

Keywords: Plastic Waste, Environmental Sustainability.

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I. INTRODUCTION

The wide use of plastic has brought an increase in plastic waste, which springs up some economic, environmental and social issues. The environmental problems from plastic waste are exacerbated by the general property of plastics which includes its durability and non-biodegradable. When it is not well disposed, plastic gather around the city, clothing drains, threaten small animals, damage the soil and pollutes rivers (Hopewell, Dvorak & Kosior 2009).

Plastic is the general term for a wide range of synthetic and semi-synthetic organic solid materials. Plastics are polymers of high molecular weight. They are mostly derived from petrochemicals, but many are partially natural (Singh & Sharma, 2016).

Environmental sustainability can be defined according to business dictionary as the maintenance of the factors and practices that contribute to the quality of environment on a long term basis. Plastic usage worldwide has been on the increase in the recent times, as it is assumed to be convenient for packaging, storing and transporting of many products. According to Moore (2008), we live in the plastic age. Griffith (2010) also observed that plastics are becoming a part of human society and human environment is now characterized by plastics. Plastics play an important role in every aspect of our life; they are used for manufacturing everyday products such as beverage containers, furniture, water bottles, toys, kitchen wares, etc.

However, the current level of their usage and disposal generate several environmental problems. The amount of plastic waste generation has increased considerably. Urbanization and the increasing consumption of plastics have resulted in a rapid generation of plastic waste, thereby making it a major component of municipal solid waste.

Generally, plastic is the third component of solid waste stream after food and paper, (UNEP, 2009). These generated plastic wastes which end up in solid waste stream constitute a serious environmental challenge to municipal solid waste management authorities/agencies in most Nigerian urban centres. Plastic are light, durable, versatile and resistant to moisture, chemicals and decays, yet these properties can bring challenges to waste managers in local and national authorities (Hopewell 2009). Plastic waste is a major problem in most Nigerian cities. The Federal minister of environment, during his speech in a workshop held on December 2013 at Maitama Abuja, pledges to phase out the production and use of non-biodegradable plastic in Nigeria. He stated that the uncontrolled use of plastic materials and the indiscriminate disposal present a clear and imminent danger to our environment and Nigerians. He further emphasized that the indiscriminate disposal of plastic

waste has caused large scale of flooding of major Nigerian cities and villages in recent years, particularly in 2012 (Ishaku 2015). Mabogunje (1988) has observed that over the years, Nigeria has been characterized by industrialization and urbanization, which have however resulted to an increasing consumption and generation of plastic waste and other solid wastes, thereby compounding the problem of solid waste management in the country's urban centres.

As the use of plastics has increased over the years, they have become a larger part of the municipal solid waste stream. The federal minister of environment, Arch. Darius Ishaku, in 2015 disclosed that plastic wastes accounts for more than 20% of the municipal solid waste stream in Nigeria. The indiscriminate disposal of plastic waste constitutes a lot of environmental problems. The vast majority of the plastic wastes end up in the environment, clogging sewers and drains causing air pollution when burnt, posing a danger to marine life and causing death to livestock when inadvertently consumed, (National Environmental Management Authority NEMA, 2004). Other effects include littering the environment thus, reducing its aesthetic value, when burnt introduces harmful substances with toxic fumes that contain chemicals such as dioxin, furan, etc which have been linked with cancer. According to Njeru (2006), plastic bags are non-biodegradable and their presence in the agricultural fields decreases soil productivity. The improperly disposed plastic wastes have also been linked with the spread of malaria because; they provide breeding habitats for mosquitoes. Despite the environmental problems posed by plastic waste, both the government and the individuals have not taken adequate sustainable approach towards its management. Considerable amount of plastic waste are found in disposal sites, gutters, corners of the streets etc in the area when a majority of it can be recovered and recycled to yield income and reduce environmental degradation.

Obio/Akpor is an important industrial and commercial centre in Nigeria. The city's socio-economic activities have resulted in the increased rate of population growth which in turn has increased the problem of waste generation in the area.

The aim of this study is to examine plastic waste and environmental sustainability in Obio-Akpor Local Government Area of Rivers State, Nigeria. The study objectives are: to examine the sources of plastic waste in the study area and to investigate the perceived effects of plastic waste on sustainable environment in the study area.

II. THE STUDY AREA

Geographical Location and Extent

Obio/ Akpor Local Government Area of Rivers State is an urban settlement with its headquarters at Rumuodumaya. Geographically, the area is located within the tropical region between latitude $4^{\circ}45'N$ and $4^{\circ}60'N$ of the equator and longitude $6^{\circ}50'E$ and $6^{\circ}70'E$ of the Greenwich Meridian. Its total land mass is approximately 260km^2 , occupied by 115725 people as projected in 2017 (NPC, 2017). Hence, it has a high population density of 2,134 persons per km^2 . The area is bounded in the north by Ikwerre and Etche Local Government Areas, in the south by Port Harcourt City Council, in the east by Oyigbo and Eleme Local Government Areas and in the west by Emohua Local Government Area respectively. It is one of the twenty three Local Government Areas in Rivers State (Niger Delta). The area is one of the major locations of the oil and gas sector of the economy and the centre of commerce and industry in Nigeria (Poronakie, 2007).

Geology and Relief

The relief of Obio/Akpor is generally a lowland area with average elevation between 20 and 30 meters above sea level (Oyegun and Akpoghomeh, 2009). Its geology comprises basically of alluvial sedimentary basin and basement complex assemblages at its fringe areas linking Port Harcourt City and Degema Local Government Areas.

Climate

The area is characterized by semi-hot equatorial climate and relative humidity (Tamuno, 2008). It is typified by a uniformity of high temperature throughout the year, intense rainfall which occurs virtually every month of the year, seasonally variable and energetic in down pour with increasing continentality. This often graduates to thunder storm from its onset and cessation with variation in duration and amount between 2,000mm- 4,000mm in July through September (Ede, 2005). This high incidence of rainfall in the presence of low relief produced flooding in the area, particularly along the Ntaworba creek linking undulating areas of Rumuola, Rumueme, Rumuolumeni and Rumuodumaya.

Soil

The soil of the Niger Delta which encompasses Obio/Akpor Local Government Area of Rivers State (Nigeria), could be described as very scanty, heavily leached and acidic with relative low fertility (poronakie, 2015 Bell –Gam, 1990).

Vegetation

The vegetation of the study area is basically located on the three major ecological zones namely: Low-land rainforest, freshwater-swamp forest and mangrove forest indicating parts of the Delta of River Niger which is one of the world's largest wetland covering 70,000km (NDDC, 2006).

Development and Socio-Economic Activities

Obio/Akpor Local Government is influenced by urbanization whereby smaller communities have merged together and formed mega city. The reason is due to high influx of people to the area resulting in rapid growth of the population. This in turn, is largely due to the expansion of the oil and allied industries, which have also attracted many manufacturing industries to the area. The population of the city therefore increases on daily basis. The city is a major industrial hub, particularly servicing firms and businesses to the petroleum industry

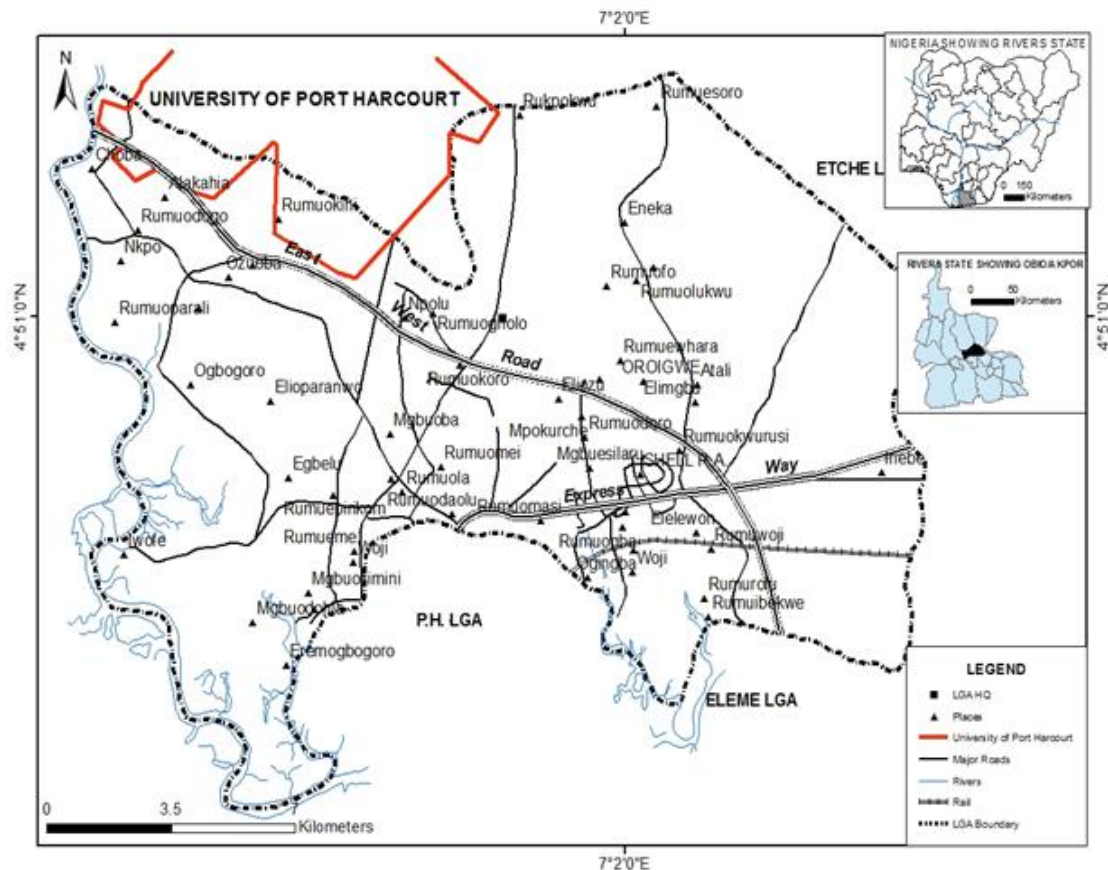


Figure 1: The Study Area

Source: GIS Unit, University of Port Harcourt, Choba, Nigeria

III. CONCEPTUAL CLARIFICATION

Plastic Waste Management

Plastic is the general term for a wide range of synthetic or semi synthetic organic solid materials. Plastics are polymers of high molecular weight. They are usually synthetic, most commonly derived from petrochemicals, but many are partially natural. A polymer may contain other additives like plasticizers, stabilizers, lubricant, UV absorbing material, flame retardants to improve performance. Plastics have permeated every facet of human life such as packaging, agriculture, water transportation, building construction, telecommunication, education, medicine, transportation, defense, consumer durables to name a few (Singh & Sharma, 2016).

Plastic waste is a problem for human habitats but it also has substantial impacts on wildlife habitat. Most documented effects are on the marine environment and once again, there is a lack of evidence on possible land-based impacts. Although plastic is often buoyant, it can sink to the bottom of the sea-pulled down by certain bottom-hugging currents, oceanic fronts or rapid and heavy fouling. Sediment may also help keep plastic on the seafloor. It is likely that once on the seafloor, plastic waste will change the working of the ecosystem. (Katsanevakis, 2006)

Approximately 200 billion pounds (that's 100 million tons) of plastic are produced every year. Some now say we have entered the "Age of Plastics." But all of these plastic chemicals are now finding their way into our bodies and the environment, where they are accumulating over time with potentially catastrophic biological consequences (Mercola, 2013).

There are two main types of plastics: **Thermoplastics** and **Thermosets**.

Thermoplastics soften when heated and harden on cooling. More than 80 per cent of plastics are thermoplastics, examples of which include:

- High Density Polyethylene (HDPE)
- Low Density Polyethylene (LDPE)
- Polyethylene Terephthalate (PET)
- Polypropylene (PP)
- Polyvinyl Chloride (PVC)

Thermosets - They are generally strong and resistant to heat, but melt the first time they are heated to a high temperature and harden (set) permanently when cooled. They can never be melted or reshaped again. They are used in situations where resistant to heat is important e.g on kitchen work surfaces, good quality plastic cups, saucepan handles and plug casings. Examples are:

- Polyurethane (PU)
- Epoxy
- Phenolic

Sources of Plastic Waste Generation in the Study Area

There are three major sources of plastic waste generation in the area;

1. Residential/ Household sources,
2. Commercial sources
3. Industrial sources

Residential/ Household sources: These are areas of accommodation and housing (where people live). Plastic bottles, bags, trays, plates, bowls, toys, kegs etc are mainly found in the household solid waste stream. Households are the biggest source of plastic wastes. Collection of waste plastics from this source appears to be difficult because of its heterogeneous nature and contamination with food particles.

Commercial Sources: These include wastes from business premises, sports, recreation/ entertainment centres etc. Plastic wastes recoverable from these areas include; shopping bags, plastic bottles (water/soft drink bottles), rubbish bags, crates etc.

Industrial Sources: Many industries abound in the area both large and small scale industries. Most of their production activities generate a lot of plastic wastes, such as plastic films, big shopping bags, drums etc. Industrial plastic wastes are homogeneous with commercial sources (Uzoma 2015).

Concept of Environmental Sustainability

Environmental sustainability has become increasingly important as we witness more extreme weather changes, global warming and environmental degradation.

According to UN commission on Economic Development in its 1987 Brudtland report titled our Common Future; sustainability is defined as that which meets the needs of the present without compromising the ability of the future generations to meet their own goals (United Nations 1987).

According to business Dictionary.com, environmental sustainability is defined as maintaining the factors and practices that contribute to the quality of environment on a long-term basis.

Another definition of environmental sustainability has been given by Daly (1973, 1974, 1992 & 1999) Daly & Cobb (1989).

1. Output role: Waste emissions from a project or action being considered should be kept within the assimilative capacity of the local-environment, without unacceptable degradation of its future waste absorptive or other important services.

2. Input rule:

- **Renewable Resource:** (e.g. forest, fish) harvest rates of renewable resources inputs must be kept with regenerative capacities of the natural systems that generate them.
- **Non-Renewable:** Depletion rates of non-renewable resource inputs should be set below the historical rate at which renewable substitute were developed by human invention and investment according to the Serafian quasi-sustainability rule.

Environmental Sustainability can also be seen as responsible interaction within the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality.

IV. THEORETICAL FRAMEWORK

Zero Waste Theory

The California integrated waste management board established a zero waste goal in 2001. The city and country of San Francisco's department of the environment established a goal of zero waste in 2002, which led to the city's mandatory recycling and composting ordinance in 2009. With its ambitious goal of zero waste and policies, San Francisco reached a record-breaking 80% diversion rate in 2010, the highest diversion rate in any North American city. San Francisco received a perfect score in the waste category in the Siemen's US and Canada Green city Index which named San Francisco the greatest city in North America.

Zero waste refers to waste management and planning approaches which emphasize waste prevention as opposed to end of pipe waste management. It is a whole system approach that for a massive change in the way materials flow through society, resulting in no waste. Zero waste provides guiding principles for continually working towards eliminating waste. Advocates expect that government regulation is needed to influence industrial choices over product and packaging design, manufacturing processes and material selection. Advocates say eliminating waste decreases pollution and can also reduce costs due to the reduced need for raw materials. Zero waste promotes not only reuse and recycling but, more importantly, it promotes prevention and product designs that consider the entire product life cycle. Zero waste designs strive for reduced materials use, use of recycled materials, use of increasing kind of materials longer product lives, reparability and ease of disassembly at end of life.

V. MATERIALS AND METHODS

Research Design

This study is a descriptive survey as it investigated issues relating to Plastic Waste and Environmental Sustainability in Obio /Akpor Local Government Area.

Nature and Sources of Data

The data for this study were collected through primary and secondary sources.

❖ Primary Sources

The primary data were collected from the data or information obtained from the structured questionnaire that were administered to the respondents.

❖ Secondary Source

The secondary information was obtained from published and unpublished work, journals, textbooks, local government areas (LGAs) documents, digital maps from GIS section, government documents that relates to the research and studies from other chosen areas.

Population of the Study

The study population is made up of the entire sixty communities that make up the study area with a population of approximately 268,516 (NPC, 1991). However, the researcher projected the population of 1991 to 2017 using the growth rate of 2.83% (NPC 2003). Hence, the population of the study is made up of 115725 persons.

Sample and Sampling Techniques

To get the sample size of the study, 20% of the sixty communities were randomly sampled. The researcher elicited information from one hundred households purposively from each of the sampled communities. The sampled communities include:

Table 1: Sample Size

S/N	Communities	NPC 1991	2017 Population Projected	Purposive Sample
1	Choba	10,968	22,696	100
2	Mgbu-Oba	2308	4768	100
3	Agip Estate (Rumueme)	456	942	100
4	Ogbogoro	9360	19, 336	100
5	Eliozu (Oro-igwe)	1,231	2,543	100
6	Rumuigbo	8,619	17,805	100
7	Iriebe	3549	7332	100
8	Rumuepirikom	8333	17,215	100
9	Rumualogu	1,528	3,156	100
10	Rukpoku	3,062	6325	100
11	Rumuosi	2039	4212	100
12	Rumuodumaya	4548	9395	100
	Total	56,001	115,725	1,200

Source: *Researchers' Fieldwork 2019*

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Method of Data Analysis

Data collected were analyzed using percentage

Simple percentage techniques are calculated using the formula:

$$\% = \frac{X}{N} \times \frac{100}{1}$$

Where; % = Simple percentage

X = Number of unit of responses

N = Total number of responses

VI. DATA ANALYSIS AND RESULT DISCUSSION

Table 2: Sources of Plastic Waste

S/N	Sources of plastic waste	A	%	D	%	Total
1.	Plastic wastes are mostly generated from households.	1080	90%	120	10%	1200
2.	Companies, markets generates plastic waste in the area.	1008	84%	192	16%	1200
3.	Plastic waste are also generated in commercial centres in the area.	1031	86%	169	14%	1200
4.	Plastic waste are generated by educational, social, health and religious institutions in the area.	1020	85%	180	15%	1200
	Total	4139	87%	661	13%	100

Source: Researchers' Fieldwork 2019

Table 2 shows the frequency and percentage distribution on sources of plastic waste. The result shows that 1080 respondents representing 90% which contributed that plastic waste are mostly generated from household. For plastic waste generated from commercial centres in the area 1031 respondents representing 86% affirms this source. plastic waste are generated by educational, social, health and religious institutions in the area, 1020 respondents representing 85% agreed with the assertion. Finally, companies, markets generate plastic waste in the area, 1008 respondents representing 84% accepted this view. Looking at the outcome of the percentages on sources of plastic waste, it was concluded that the greater number of respondents representing 87% agreed while the lesser number of respondents representing 13% disagreed. Therefore the researchers conclude that the source of plastic waste generation in the area are household, commercial centres (companies and market), and institutional centres (educational, social, health and religious).

Table 3: Perceived Effects of Plastic Wastes on the Built up Environment

S/N	Perceived effects of plastic wastes on the built up environment of the study area	A	%	D	%	Total
1.	Plastic waste block drains and canals causing flooding in the area.	1010	84%	190	16%	1200
2.	Plastic waste burnt indiscriminately pollutes the air in the area.	950	80%	250	20%	1200
3.	Plastic wastes destroys the aesthetic beauty of the area.	1020	85%	180	15%	1200
4.	Plastic wastes impacts on the soil and affects microbial diversity of the area	1000	83%	200	17%	1200
	Total	3980	83%	820	17%	100

Source: Researchers' Fieldwork 2019

Table 3 shows the frequency and percentage distribution of respondents on the perceived effects of plastic wastes on the built up environment of the study area. The result shows that 1020 respondents representing 85% were of the opinion that plastic waste destroys the aesthetic quality of the area. In plastic waste blocking drainages and canals causing flooding in the area 1010 respondents representing 84% agreed with this view. Plastic waste impacts on the soil and affects the microbial diversity of the area 1000 respondents representing 83% agreed to the assertion and finally plastic waste dumped indiscriminately are responsible for the spread of diseases in the area 950 respondents representing 80% agreed. In conclusion on the perceived effects of plastic waste in the area, the majority of the respondents representing 83% agreed while the rest 17% disagreed, indicating that plastic waste is responsible for flooding, spread of diseases, degrading of the aesthetic quality and impact on the soil quality of the study area. The respondents strongly subscribe to the view that most of the floods experienced in the area were as a result of blocked drains with disposed plastic materials.

VII. DISCUSSION OF FINDINGS

Table 2 presents research question on sources of plastic waste. The result shows that the sources of plastic waste generation in the area are; household, commercial centres (companies and market) others are generated from institutional sources including educational, social, health and religious centres. The analysis also showed that the bulk of plastics are sourced from households. It also means that management can really commence from the households.

Table 3 shows research question on perceived effects of plastic waste in the area. The result revealed that plastic waste destroys the aesthetic quality of the area; plastic waste blocks drains and canals causing flooding in the area, plastic waste impacts on the soil and affects the microbial diversity of the area and also plastic waste dumped indiscriminately are responsible for the spread of diseases in the area. It thus concludes that the perceived effect of plastic waste include flooding, pollution of air if burnt, adds poisonous substances to the atmosphere spread of diseases and destroys aesthetic quality of the area. These findings point to the fact that plastic waste has the potential to render the environment unsustainable.

VIII. CONCLUSION

The increase in the socio-economic activities in Obio/Akpor Local Government Area of Rivers state has increased the rate of plastic waste generation in the area. Effective and proper management of the materials have not been taken care of. This could be attributed/ to the failure of the municipal authority to recognize plastic waste as a resource to be harnessed. Based on the findings, plastic waste management models, production and disposal should move towards recycling. Increasing the consumption of biodegradable plastics can reduce the carbon footprint, pollution risks and greenhouse gas emissions from polymer usage, and the risk of cancer in the built up environment.

Based on the findings, that it distorts the aesthetic nature of the environment, blocks drains and silt canals, pollutes the air if burnt and destroys both aquatic and terrestrial life, plastic waste management models, production and disposal should move towards recycling. The sustainability of the environment is not guaranteed if there is continuous rapid increase in the production and indiscriminate disposal of plastics.

IX. RECOMMENDATIONS

Based on the findings of this work, the following recommendations are made:

1. Since the major sources of plastic waste generation in the study are household, commercial and institutional, there is need to educate the residents on sorting out their waste accordingly such as plastics, glass, metals and biodegradable materials for proper management.
2. Designated locations should be made available by the Local Government Authority for disposal of plastic waste. Plastic waste should be evacuated as quickly as possible when dumped in the environment by the residents because of its adverse effect.
3. Recycling of plastic waste should be taken seriously and sophisticated machines and equipment provided to help in the management of plastic waste
4. To reduce the excesses of littered plastic waste, the residents should use paper for packaging their products that can easily degrade when discarded.
5. Penalties should be imposed to defaulters who refuse to sort and bag their waste before disposal.

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