

The State of Solid Waste Management in Port Harcourt City, Nigeria

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Abstract Although waste management is thought to be the organized and systematic channeling of waste through pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguards. Wastes management in Port Harcourt is far from the above definition as there are no proper techniques in place to ensure the orderly executions of the basic principles of waste management. Hence, garbage often litters the streets in some suburbs of the city. This paper examines the current waste management practice in Port Harcourt through personal observation and research materials from previous publications. It was found that, wastes are often burned or disposed of on landfills, open dumps and water bodies without prior treatment. The paper concluded by giving some recommendations which could improve the waste management situation of the city.

Keywords: Port Harcourt, wastes, particulate matter, odor

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1. Description of the Study Area

Port Harcourt, the capital of Rivers state is located at the southernmost part of Nigeria in the Niger Delta region of Nigeria (Figure 1). Rivers state has an estimated population of about 5,198,716 while the population of Port Harcourt is thought to be about 1,356,000 [1].

The city which was named after the then British Secretary

of state for Colonies, Lewis Harcourt, is characterized by two seasons; the wet/rainy season and the dry seasons. The wet season is characterized by heavy rainfall and occasional flooding in some coastal communities and urban centers. The wet season begins in April and end in November while the dry season starts late November to March. However, unlike some cities in the country Port Harcourt experience rainfall for most part of the year. The average temperature of the city ranges between 24°C and 30°C; therefore it is generally warm for most part of the year.



Figure 1. Map of Nigeria showing Port Harcourt city; Source: www.mapsofworld.com

Port Harcourt is a host city to a number of international and local companies at its industrial lay out in Trans Amadi and other areas of the city. The city also hosts some of the most famous markets in the Niger Delta region. A notable example is the oil mill market which attracts visitors and businesses from neighboring cities and states is located off Aba road at Rumuokwurusu community.

Port Harcourt which was originally a small settlement, expanded rapidly after the discovery of hydrocarbon. This rapid expansion has continued till today, hence communities such as Rumuokurushi, Oroworoko, Rumuola, Rumuokuta, Rumueme, Rumuobekwe, Woji, Mile 3, Elekahia and many more are now considered part of the greater Port Harcourt metropolis.

2. Introduction

Solid waste management has become one of the most significant challenges facing most environmental agencies in developing countries. Port Harcourt, the capital of Rivers state is no exception. The city is home to about 1 million people. Waste management in the city is very basic; it is not uncommon for residents to dump their wastes by the road side or simply burn them at the back of their houses. The waste management agency in Port Harcourt mainly relies on open dumps and old landfills for waste disposal. However, with the continuous environmental degradation, scarcity of land and the health hazard posed by inadequate wastes management. City authorities and environmental agencies have been under immense pressure to change their waste management strategy with a view to safeguarding the health of the populace. Consequently, the waste management agency is beginning to adopt different approach and strategies to ensure sustainability in waste management. More private sector participation is being encouraged in order to promote efficiency and accountability in the sector while government agencies are becoming restricted to policy making and enforcement. However, due to several factors waste management in the city still remain at a basic level.

3. Method and Rational for the Study

The current study is a review of waste management practice in the city of Port Harcourt. Therefore, secondary sources of information were utilized through books, journal articles and webpages of specific organizations. In addition, personal knowledge of this study area was also utilized. The study is borne out of the desire to answer questions such as; what are the common methods of waste disposal in Port Harcourt? What are the general trends of waste management in the city? What are the possible solutions to the wastes management crises in the city? In addition, to providing answers to some of these questions, the study will serve as an important source of information to people who may need to undertake a research of waste management in the city of Port Harcourt.

3.1. The Present State of Solid Waste Management in Port Harcourt

[2] Defined solid waste management as the application of techniques that will ensure the orderly execution of the functions of collection, transportation, processing, treatment and disposal of solid waste. A report [3] defines waste management as the organized and systematic channeling of waste through pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguards. Robinson added that, the ever increasing global concern on environmental health demands that waste be properly collected and disposed of in the most friendly and acceptable manner. This will minimize and where possible eliminate risk harm to lives and properties [4].

The current state of waste management in Port Harcourt is far from the above description as there are no techniques in place to ensure the orderly executions of the basic principles of waste management. Proper management cannot be achieved without a well- designed waste management plan [5]. According to [6] waste management planning strategies should advocate avoiding waste generation, using cleaner technology, promoting waste recycling and recovery, using suitable treatment for generated waste and adequate final disposal option.

The Government of Rivers state through the ministry of environment is responsible for waste management in the city [7] (Ogbonna et al., 2007). Successive government in the state, made very little effort in terms of waste management legislations and enforcement [8]. However, in recent time, remarkable improvements have been noticed.

In Port Harcourt today, wastes generated and gathered at source are disposed of in communal bins or communal collection points stipulated by the Government. These communal points are spread out at different location across the city. This system is patterned after the management system in developed countries, for example – the UK.

Unlike the system in Port Harcourt, the UK provides refuse bins to every household, in some cases; multiple bins with different colors are provided. This system enables wastes to be separated at source. In most councils, non-recyclable domestic wastes are dispose of in black bins while blue bins are for recyclable materials such as cardboard, newspapers and magazines etc. similarly, garden wastes are store in green [9]. This management system reduces energy and the cost of wastes separation in treatments facilities.

In Port Harcourt, however, a single communal bin is usually provided. Consequently, wastes of different components as shown in Table 1 are not separated at source and even at the point of disposal. As waste bins are not provided to individual household, collection can be very difficult. As a matter of fact, only a fraction of the total wastes generated are collected, this is because residents are sometimes reluctant to walk several miles to the stipulated collection points. Hence, they device other means of getting rid of waste. According to [1,2] on the average between 1.1kg and 1.25kg of solid wastes is generated per person every day in Port Harcourt. It was found that a total of 1,505,106 kg of solid waste was generated on a daily basis in the city [1].

Table 1. Sources and types of waste in Port Harcourt

Sources of wastes	Activities	Types of waste generated	Compositions	Current disposal method(s)
Commercial	Open markets, Hotels and Restaurants, Shops and other commercial activities	Plastics, Putrescible, Paper, Cardboard, Cans, Glass,	Biodegradable and non-biodegradables	Mainly landfill and open dumps, occasional burning
Domestic	Domestic activities from household.	Plastics, Putrescible, Electronics, Wood, Textile, Furniture, Cans, Glass	Biodegradables, wood products, textiles and other non – biodegradables wastes	Mainly landfill, Open dumps and open burning
Construction and Industries	Small scale manufacturing activities, chemical and hydrocarbon activities, construction and associated activities	Debris from demolition, concrete materials, packaging from construction materials, electrical and electronics, plastics, chemicals and oil field sludge	Asbestos, polymers, organic solvents from paints, asphalt, wood	Burying of waste, landfill and open dumps and sales of demolition debris for reuse.
Institutional	Schools – Universities such as Uniport, RSUST and other educational institutions.	Large volume of Papers. Cardboards, Putrescible, Electronics, plastics, cans, furniture materials etc.	Readily and non-readily degradable wastes	Landfill and open dumps

Table 2. Waste characterization in Port Harcourt, Source [1]

Waste composition	Mass (%)
Food waste	29.2
Paper	12.4
Plastics	9.9
Garden wastes (grasses, wood)	8.4
Glass	13.5
metal	17.2
Leather/rubber/textiles.	7.6
Others	1.8
Total	100

It appears that a large percentage (37.6%) of municipal solid wastes in Port Harcourt are made up of bio degradable materials (food and garden wastes). A substantial percentage (30.7%) comprises of inorganic substances such as glass and metals as revealed in Table 2. A similar survey [12] found that apart from the components in Table 2, 7.7% of sludge and expired chemicals or drugs were also produced. [1] Added that on the average, the wastes stream in Port Harcourt consist of 19.1% liquid, 66.6% volatile solids, 13.5% of fixed solids and 0.8% of other compounds. As a result of these mix in composition, [1,29] further argues that apart from the current disposal system in Port Harcourt, several other disposal options could be utilized in order to reduce the negative impact of the current disposal methods (landfills and open dumps) on the environment. For instance, [1] found that municipal solid wastes in the city are a rich source of energy. Likewise a laboratory experiment [29] found that a ton of organic waste in Port Harcourt will generate about 79600 liters of methane gas with an energy equivalent of about 1592000_kj. Therefore, it was concluded that the energy content of the wastes could be harnessed for the purpose of electricity generation.

3.2. Waste Disposal Practice in Port Harcourt

3.2.1. Landfill

Most of the landfill operations in Port Harcourt do not have the facilities for leachate collection and treatment.

The gases produced are not also captured; therefore most landfill sites in the city are major sources of pollution [10]. Very little is done to minimize odor by the operators, the main activities on these sites involves - spreading of waste with tractors and then covering the surface with clay. The sites are not properly engineered, neither are they fitted with appropriate liners. Hence, they pose a major threat to the surrounding communities as a result of pollution and odor. According to [11] landfill in its real scientific sense is rare in Nigeria.

It is a common practice for state government sanitation agencies/authorities to dump wastes in disused borrow pits before spreading them out on the pit with the aid of tractors. These sites are commonly referred to as landfills. However, an ideal landfill operation is described by [11], as a properly designed and controlled operation whereby solid waste are buried beneath the earth. The wastes, most oftentimes are pre-treated by fragmentation, sorting, bailing and incineration, are compacted in thin layers in cells by tract-type tractors or landfill compactor. Thereafter the compacted wastes (usually not exceeding 2.4m height in each cell) are covered progressively with layers of inert and relatively impervious materials (clay soil) to form a seal. Most landfill operation in Port Harcourt does not meet the above description. The operations are also in violation of the guidelines set by the Federal Environmental Protection Agency.

Some landfill sites in the city are located at Eneka village in the outskirts of Port Harcourt, Rumuokoro community along the East/West Road, Ada Gorge Road and several other locations.

The disadvantages of these ill managed landfills sites are enormous. They pose serious threat to the populace. Between Rumuokoro community and the University of Port Harcourt junction along the East/West Road alone, abandoned landfill sites can be seen by commuters. During the rainy season, leachates and other debris are carried by runoffs into nearby communities, causing pollution of open water bodies as well as underground water. It is worth noting that most of these communities rely solely on underground water, hence, “well” water are the most common source of water to many communities. A well is a hole, shaft, or excavation used for the purpose of extracting ground water from the subsurface [12].

The landfill operation at Eneka village is on an abandoned borrow pit; wastes collected from the catchment areas are deposited on the site. Leachate control is a major challenge for the operators of the landfill [13]. The fact that the borrow pit is a lowland area means that rain water usually settles at the pit, hence, contaminated water percolation is a possibility.

A properly operated landfill has some advantages. According to [11] landfill is one of the cheapest methods of solid waste disposal. They argued that landfills are particularly beneficial in restoring derelict land, quarries and borrow pits. Nevertheless, a proper management of leachate which is one of the most undesirable by-products of landfill is an essential requirement of a landfill. If unchecked or ill managed, leachate seriously pollutes natural water sources. In many developed countries, leachates are collected and treated before discharged into the environment.

4. Open Dumps

Figure 2 and Figure 3 are pictures of dump sites in different locations in the city. Open dump sites are the most common waste disposal methods in Port Harcourt and many cities in Nigeria. Open dump sites are found in several locations around the city, for example, Ngbomba road, Rumuokoro/Tank road, Ada George, Diobu, Iwofe, and Eljijji roads, to mention a few.



Figure 2. Dump site at Eljijji area of Port Harcourt, Source: Author 2017



Figure 3. Dump site at Iwofe area of Port Harcourt, Source: Author 2017

Open dumps develop when residence starts piling up wastes on empty lands or abandoned properties. Residents pile up their wastes on nearby land with the hope that, the waste management agency or their contractors will collect the waste before a large heap is formed. However, when collectors fail to respond quickly, a mountain of garbage is quickly formed as a result of the continuous deposition of

wastes by residents and passer-by. When such sites are noticed by people from other neighborhood, they also start conveying their wastes to the dump for disposal. Commuters also keep their wastes in their vehicle for disposal at the site. Huge volume of wastes is produced in Port Harcourt due to the large population and commercial activities. Hence, within a short period of time mountains of garbage (open dumps) are formed.

According to [7] most cities in Nigeria are characterized by heaps of garbage at junctions, streets and even in drainages as a consequence of indiscriminate dumping. It is therefore not unusual to come across a huge heap of waste by the side of a major road in Port Harcourt. In some cases, when the attention of the waste management authorities is drawn to the dumps, the sites are closed and sign post with inscriptions such as “No dumping of refuse” “this is not a dumping site” “private property” “dumping of refuse attract a fine” are erected to deter dumping of refuse.

The disadvantages of open dumps are similar to that of landfill. Leachates, gases and unpleasant odor are produced. A study [14] reveals that contaminants from these dumps can get into the food chain through several means including crops planted several miles from dump sites. According to the study, a number of factors - soil type and other environmental factors favor the growth of certain plant species which are palatable to animals especially cattle, goats and other freely roaming animals.

5. Disposal to Water Bodies

This is one of the oldest methods of waste disposal in Port Harcourt; it is not a very popular method of waste disposal in the city. Nevertheless, the practice continues unabated in some Riverine areas of the city. This method involves getting rid of waste by disposing them into the surrounding rivers, lakes and other water bodies without prior treatment. Due to the Deltaic nature of Port Harcourt, there are several water bodies in some parts of the city. A notable example is Nembe water front, which is host to a large market. It is not uncommon for traders to dispose their waste into the river.

6. Mass Burning

This method of waste disposal is commonly practiced among residence of Port Harcourt and other cities in Nigeria [15]. For the sake of convenience, some residence prefers to set fire on their waste rather than walk a few miles to the communal collection points. Generally, people are not aware of the dangers associated with this form of waste disposal.

Wastes disposed of in this manner are usually dry and are not separated. During the dry season farmers and land owners regularly set fire on their land after the vegetation as a quick means of getting rid of farm/garden wastes. The practice seems to provide a cheap option of disposing weeds, grasses and other debris on the land. Nonetheless, open burning can cause land and water pollution. The fumes produced during combustion might also pose a health risk to residence. Some landfill and dump sites

operators often set fire on their dump site as shown in [Figure 2](#) to reduce the volume of waste at the sites.

6.1. Some Implications of the Current Disposal Practice

Consistent dumping of refuse at sea can cause a reduction in the aquatic life and biodiversity of a water body. This is because wastes have high oxygen demand due. The biodegradable components of waste tend to use up available oxygen during decomposition thereby resulting in the migration of aquatic species that depends on oxygen for their survival [16]. Continued dumping of refuse on water bodies may results in the production of excess nutrient e.g. phosphorus, this nutrient build up may in turn lead to the growth of algae bloom and the production of cyanobacteria and eventually eutrophication.

Indiscriminate and uncontrolled burning of municipal wastes (as shown in [Figure 4](#)) emits several gases. These gases may have severe effect on the residence of an area after a prolonged period of time. The implication of open waste burning, disposal to water bodies, open dumps and inappropriate landfill on Port Harcourt are summarized below.



Figure 4. Waste burning, Source: Author 2017

6.2. Atmospheric Emissions

Inappropriate wastes and waste management could results to the emission of toxic substances [17]. For instance, uncontrolled burning has been associated with substances such as Hexachlorobenzene, Particulate matter, Dioxins amongst others.

6.3. Particulate Matter

Particulate matters are particles emitted as a result of inappropriate combustion of solid waste [17,18]. These particles come in various sizes and shape. Typically some particles are tiny micrometers small; these are usually almost invisible to the human eye and several times smaller than human hair. Some of the particles are so small that they could stay in the atmosphere for several days and could travel hundreds of miles. It is thought that the smaller particulates can travel deeper into the lungs. Generally, some particulate matters are made up of toxic heavy metals and cancer causing organic compounds.

Therefore accumulation of such substances might have severe health implications. Particulate matter scan also aggravate asthma attacks in asthma patients [18].

6.4. Dioxins

Efforts by the United Nations to reduce the global level of dioxins have led to a fall of these pollutants to about 10% of the level seen before and around 1970s. According to [19] dioxins are persistent pollutant whose half lives in human are greater than 7 years. Examples of dioxin include polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and some polychlorinated biphenyls (PCBs). Dioxins which are commonly produced from many combustion processes [20,21] can get into the food chains by depositing on plants which are consumed by animals. When food contaminated by these pollutants is consumed over time, they cause health hazard due to bioaccumulation. Dioxins are thought to have the ability to accumulate in the fat tissues of animals. According to [19] exposure to dioxins can result to immunotoxicity, neurodevelopmental and developmental effect as well as changes to steroid hormone, thyroid and reproductive functions. Although several processes including volcanic eruption and industrial processes contribute to global level of dioxins in the atmosphere, [19] argues that dioxins are also produced during the combustion of organic materials in the presence of halogens and chlorine especially in a low to moderate combustion.

6.5. Hexachlorobenzene (HCB)

Hexachlorobenzene (seen in [Figure 5](#)) are toxic substances whose vapor pressure and persistence in the environment combine to facilitate the long-range transport of HCB and its bioaccumulation effect. Due to the bioaccumulation and persistence of HCB as well as its potential toxicity, HCB is on many different lists for regulation and management [22]. Hexachlorobenzene are produced during the combustion of municipal solid waste, [23] added that HCBs are also produced during industrial processes such as the manufacture of perchlorethylene, chlorine, carbon tetrachloride, other chlorinated solvents and pesticides. Furthermore, Courtney pointed out that HCBs are used in the manufacture of nitroso rubber for tires. [24] Added that HCB has several uses in industry and agriculture. Traditionally, HCB was first introduced in 1933 as a fungicide on the seeds of onions, sorghum and crops such as wheat, barley, oats and rye.

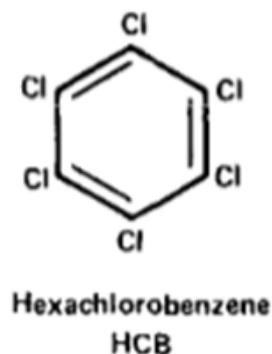


Figure 5. Hexachlorobenzene; Source [22]

According to [25] exposure to HCB, may cause scarring on the face and hands, enlarged thyroid and lymph nodes, nerve damage and central nervous system dysfunction. Nevertheless, one of the persistent health challenges to human from exposure to HCB is its association to liver disease.

It has been argued [26] that the soil contains a larger volume of HCB than air. Jonathan and others added that a significant amount of HCB can also be found in water in rivers, lakes and, in particular, seas. Although the concentrations of HCB in seawater are low, the volume of the oceans is very large, and therefore, oceans may be important sinks for HCB.

It should be recalled that wastes of all types (mixed wastes) are often burned openly for the purpose of volume reduction; this practice leads to emission of HCBs in addition to other toxic substances. As these substances are invisible to the human eyes and as since the level of awareness to the hazards associated with open burning of wastes is low. These practices might continue for many years to come.

7. Odor from Poor Landfills/Dumps

According to [27] of the five senses, the sense of smell is the most complex and unique in structure and organization. Human sense of smell is feeble compared to that of many animals. Nevertheless it is still very acute. We can recognize thousands of different smells, and we are able to detect odors even in small quantities [28]. Nevertheless, [27] argues that odor is evocative and not much is known about it.

Wastes produce odors, causing nuisance to nearby populations and contribute significantly to atmospheric pollution [29]. Due to the activities of microorganisms during decomposition, Hydrogen sulfide and other gases are produced; resulting in obnoxious smell, which is source of inconvenience for residence and communities. Food wastes, particularly with high moisture and organic matter content are likely to emit odors as a result of the decomposition process. Hence, the management of odor from decomposing wastes is needed [30]. Community odor remains one of the top three complaints to air quality regulators and government bodies around the U.S. and internationally. The majority of all air pollution complaints are odor related [27].

Most wastes dumping sites in Port Harcourt do not have odor management facilities. Hence, the sites are a complete nuisance to residence and passer-by. The poor odor management from waste disposal facilities might be one of the reasons why wastes and waste management are often viewed with levity.

8. Conclusion and Recommendation

The low life expectancy in Port Harcourt and Nigeria and the death rate after brief illnesses may not be unconnected with the poor waste management practice. Therefore, adequate attention must be given to waste management in order to safe guard human health. Ground water which is a major resource and the main source of

drinking water must be protected. Attention must be directed to activities capable of compromising the safety of water resources, be it surface or ground water. Since private boreholes are a norm in the city, effort should be made towards the capture and treatment of leachate due to its toxicity. The current practice of allowing leachate to percolate freely into ground water must be contained.

The concept of improved air quality must be embraced and effort should be made to check contaminants which could be absorbed into the food chain through soil contamination. An improved waste management is likely to improve the overall quality of life of residence though improved soil, water and quality. An improved waste management may lead to an increase in the life span of the residence over a period of time.

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