Assessment of Municipal Solid Waste Disposal and Management Challenges in Major Cities in Nigeria: A Case Study of Uyo, Nigeria

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ABSTRACT

Open dumpsites are common features in cities in developing countries of the world, Nigeria inclusive. The wastes disposed of in these dumpsites can cause a number of public and environmental health risks including surface and groundwater pollution. The objectives of this research are to examine the causes and challenges facing the disposal and management of municipal solid waste (MSW) in major cities in Nigeria, with a view to proffering sanitary or scientific-based solutions to this problem. The method adopted was in-site observation of notorious dumpsites in the study area, interview with stakeholders, discussion with residents around the dumpsites and review of relevant literatures. The result of the investigation shows that unguided disposal and management of municipal solid waste are basically associated with lack of public awareness programmes, limitation in access to effective policies and enforcement on the part of the people and the government respectively, lack of qualified waste workers, poor funding, lack of biological and mechanical waste treatment plants/facilities, and non-usage of non-governmental organizations (NGOs) Schemes and community-based approaches in tackling the problem in an holistic manner. The study suggests new approaches that could be used to achieve sustainable and effective waste disposal and management which would support government's effort in improving solid waste management in Nigeria.

Keywords: *Municipal solid waste, management, policy, dumpsites, pollution.*

1.0 INTRODUCTION

Urbanization, consequent upon industrialization as well as changing lifestyles and consumption patterns are the key factors for per capita generation of waste in municipalities. According to Alok *et al.* (2015), it is estimated that on an average, there is generation of 400 grammes of waste (garbage) per person per day. Also, increasing income levels and consumerism has led to generation of more wastes. Due to increased urbanization and industrialization, disposal of municipal solid waste has also consequently increased, resulting in unplanned accumulation of nutrients to soil in some cases, with possible negative

environmental consequences such as eutrophication, land degradation, emission of greenhouse gases, production of phytotoxic substances and air pollution generated from the waste dumpsites. In Nigeria, municipal wastes densities generally range from 250-370km/m^3. Waste generation rate is 25 million tons annually and at a daily rate of 0.44 – 0.66kg/capital/day (Ogwueleka, 2009) as opposed to 0.7kg – 1.2kg/h/d in developed countries (Guangyu, 2002).

Municipal solid waste refers to solid wastes from homes, streets, shops, offices, industries, hospitals, markets, schools, and other public places. Other names for it are rubbish, refuse, garbage, trash, etc. The composition of the municipal solid waste is heterogeneous; it comprises biodegradable and non-biodegradable substances. The biodegradable portion of municipal solid waste is largely made up of kitchen and yard (domestic) waste, animal dung, agriculture waste, etc. while the complex non-biodegradable refuse consists of commercial wastes, industrial and municipal wastes, depending on their sources. After the removal of items not subject to microbiological decomposition (e.g glass, plastic, metal, rubber, textile, etc) and hazardous substances, such waste, after adequate preparation, may be used directly as fertilizer, subjected to methane fermentation, burned for generation of heat or electricity or it may be composted (Alok *et al.,* 2015). Biodegradable wastes are completely decomposed by biological processes either in presence or in absence of air. Non-biodegradable waste cannot be decomposed by biological processes. Non-biodegradable waste are of two types – recyclable waste which have economic values but destined for disposal but can be recovered and reused along with their energy value e.g. plastic, paper, old cloth, etc. Non-recyclable wastes are waste which do not have economic value of recovery e.g. carbon paper, thermo coal, tetra packs, etc (Alok *et al.,* 2015).

Management of municipal solid wastes should be viewed as the sole responsibility of municipality or government authorities. The management of wastes assumes importance in view of the environmental hazards they possess. Citizens, businesses, and industries are producers of wastes and the impacts of these wastes directly affect their health, environment, and quality of life. Uncollected waste can be a factor in the spread of diseases such as typhoid, cholera, hepatitis A, leptospirosis, filariasis, malaria, dengue, and chickengunya. Moreover, waste that is not properly disposed of causes serious environmental problems (Da Zhu *et al.,* 2008).

According to a United Nations Development Programme Survey of 151 majors of cities from around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal (UNPP, 1997). Typically one-to-two-thirds of the solid waste that is generated is not collected. The uncollected wastes is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insects and rodents, vectors, and spreading of diseases. Even waste that is collected is often disposed of in uncontrolled dumpsites or burned, thereby polluting water resources and the air (Da Zhu *et al.,* 2008). Indiscriminate dumping of wastes- industrial, commercial and household- such as food waste, paper, polyethene, textiles, scrap metals, glasses, wood, plastic, etc. at street corners and gutters, is still very common (Ayotamuno and Akuro, 2004) as seen in Figures 1 and 2 in the study area.

Climate change and the effects of greenhouse emissions have made solid waste management one of the most pressing environmental challenges globally as well as locally (Da Zhu *et al.,* 2008). It is an established fact that inappropriate solid waste management (SWM) practices such as improper incineration and uncontrolled disposal of waste are major

contributors to greenhouse gas emissions: the anaerobic degradation of waste in landfills produces methane, a gas that is 21 times more potent than carbon dioxide.

Since solid waste management is an activity in which public partnership or participation holds the key to success, this article is intended to help readers and stakeholders understand the various information, education, communication, and technology options available for combating the menace of improper waste disposal and management challenges in major cities in Nigeria, with the ultimate aim of achieving a clean, wholesome and healthy society.

2.0 MATERIALS AND METHODS

2.1 Study Area

Uyo is the capital city of Akwa Ibom State in Nigeria and presently occupies a total land mass of 1,250,00km^2 of which a substantial percentage is used for agriculture (Sluk – Ak, 1989).

Uyo is situated between latitudes $4^0\,32^1$ and $5^0\,53^1$ North and Longitude between $7^0\,25^1$ and $8^0\,25^1$ East. It covers a total land area of 8,412km^2 (AKSG, 2008). The location of Akwa Ibom is just North of the equator and within the humid tropics and its proximity to the sea makes the state generally humid.

On the basis of its geographical location, the climate of Akwa Ibom State can be described as a tropical rainy area which experiences abundant rainfall with very high temperature. The mean annual temperature lies between 25^{0}C and 29^{0}C and average sunshine cumulated to 1,450 hours per year, while annual rainfall ranges from 2,000mm to 3,000mm, depending on the area. Naturally, maximum humidity is recorded in July while the minimum humidity occurs in January (AKSG, 2008). As with every Nigerian coastal area, the state experience two (2) main seasons, the wet and dry season (Ogbemudia *et al.*, 2013).

2.2 Data Collection and Analysis

For this study, information and data collection were obtained via two means (sources) which include: primary and secondary sources.

(i) **Primary Sources:** This involves on-site observation of study area. An on-site field survey of the major waste dumpsites in the study area was conducted, and photographs were taken. Also, observations and discussion with residents near the dumpsites as well as environmental-minded individuals were also made and recorded.

(ii) **Secondary Sources:** Besides the primary sources of information, this study also relied on interviews granted to stakeholders, environmentalists, scientists, policy makers, urban dwellers, etc. Other secondary sources of information that was used include literatures (Journals, conference proceedings, textbooks, etc.).

3.0 RESULTS AND DISCUSSION

As a result of the interactions with the respondents in in the study area, it could be inferred that lack of domestic bins at homes, avoidance of compositing at home level, non-

prohibition of waste disposal on the streets, and lack of promotion of public – private partnership, are the most likely causes of MSW disposal challenges in Nigeria. Thus, major findings and discussions of the research are grouped into challenges and consequences as well as suggested waste management strategies (mitigation measures). The need for this research in the light of soil and water conservation cannot be overemphasized bearing in mind that wastes disposed of in dumpsites has the tendency of posing several public and environmental health risks including ground water pollution, heavy metals contamination in the soil, as well as the enhancement of greenhouse gas emission and volatile organic compounds (VOCs). Contamination of ground and surface water in urban areas in low-income countries with organic, inorganic and microbial pollutants due to contamination from leachate is a common and significant problem. Leachate formation is dependent on the water balance of landfill site and it takes place when the moisture content in waste cell exceeds its field capacity, the maximum moisture content that a porous medium is able to hold (Kamaruddin *et al.,* 2017). The responses by respondents revealed the challenges and the mitigation measures which shall be discussed under.

3.1 The Challenges

Integrated Solid Waste Management practices include source reduction, reuse, recycling, composting and landfilling. However, in Nigeria in general and in Uyo, in particular, landfilling still remains the most common method of solid waste management system. Nigeria currently has no functional waste management policy. Open dumpsites are common features in major cities in Nigeria, Uyo inclusive. The Akwa Ibom State Environmental Protection and Waste Management Agency (AKSEPWMA) has done a great job in cleaning up the Uyo municipality and environs. However, in most cities in Nigeria, heaps of garbage (refuse, waste, rubbish) are dumped on street corners, junctions, market places, drains, to be later conveyed to the major unsanitary, unscientific and unengineered dumpsite (landfills), usually left open on the streets for some days harbouring flies, fleas, mosquitoes, rodents, and constituting a major air pollution on the streets.

There have been a number of studies examining the risks posed by landfills and dumpsites (Adelopo *et al.,* 2018). These studies have examined a range of pollutants and also employed a range of approaches. For example, Adelepo *et al.,* (2018) focused on the heavy metal content of landfills. According to Singh *et al.* (2016), the municipal solid waste landfills are potential sources of groundwater, soil and plant pollution by heavy metals as well as the production of greenhouse gas (emission). Heavy metals can be particularly problematic because unlike organic pollutants, they do not degrade in the landfill or dumpsite. They can remain within municipality landfills for around 150 years, if leached at a rate of 400mm/year. Earlier researches by Mentore *et al.* (2018); Usoh *et al.* (2020) reveal that the movement of these heavy metals is largely determined by levels of rainfall which impacts upon the production of leachate. As the distance away from the dumpsite of landfill increases, the risk reduces.. In other words, landfill leachate is generated mainly due to the infiltration of rain water which percolates through the waste layers and accumulates at the bottom of landfills.

Typically, the organic fraction of municipal solid waste is both the key and most 'nutrient-rich' component of the leachate (UNEP, *et al.,* 2015; Gidarakos *et al.,* 2017, An *et al.,* 2012, Ugbemudia *et al.,* 2013).

The contamination of ground and surface water in Uyo and other cities in Nigeria with organic, inorganic and microbial pollutants due to contamination from leachate is a significant problem that calls for urgent intervention (Usoh *et al.,* 2020). Thus, there is urgent need for the state government to come up with engineered and controlled landfill site(s). The current move by the state government as evident in Figure 3 in this study is a positive move in the right direction. This is because this leachate not only can cause pollution of surrounding soil, surface waters, and ground water. They also result in the sealing and/or degradation of the soils, thereby reducing or inhibiting the overall functionality of the soil.

Furthermore, considering the disposal of hazardous waste, it is evident that Nigeria has laws and regulations that indicate recognition of the need for sustainable and sound management of hazardous wastes, what is required is a national hazardous waste management plan. Current disposal routes include burning (incineration), chemical treatment, fixation, burial and disposal into existing public waste infrastructure (waste dumps). Recovery processes are rarely employed. The communities living and working with hazardous substances especially in poor rural areas are at greatest risk from health and environmental impacts. Hazardous wastes and chemicals are frequently used in an unsafe manner and without understanding of associated risks. The risks these communities take is exacerbated by the circumstances of their relative poverty, lack of effective regulation systems, illiteracy and limited availability of appropriate information and training. Also, the reuse of empty containers of hazardous wastes for water storage are common in household and public places in Nigeria (Abba *et al.,* 2020).

Hazardous materials (wastes) are substances that are dangerous or potentially harmful to our health or the environment. They can be liquid, solid, gaseous, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes. Hazardous wastes are materials that are known or tested to exhibit one or more of the following four hazardous traits: ignitability (i.e. flammable), reactivity, corrositivity and toxicity (Abba *et al.,* 2020).

Wastes generated in hospitals, clinics, and industries usually contains toxic substances such as chemicals, packaging of medicines, radioactive, materials, disposable syringes, etc. Knowing too well that improper disposal of these wastes may lead to incidence of diseases, the hospital management board should corporate with relevant stakeholders in the waste management sector to ensure the collection, transportation and disposal of hazardous biomedical waste in order to avert the danger of spread of diseases. Instead of dumping biomedical on landfill sites, these wastes should be subjected to incinerators for treatment. However, it should be noted that if incinerators are not operated properly with standard specification to maintain sufficient residence time, residence temperature and turbulence, there can be more harm caused in the form of emission of toxic gases which constitutes severe air pollution problems.

In the light of soil and water conservation, one major problem with the illegal or unscientific disposal of toxic (industrial) waste such as sewage or untreated effluents released into lakes, rivers, is the contamination of surface and groundwater, thus endangering aquatic lives and making the water unsafe for drinking or irrigation purposes.

Presently, the practice in Uyo is that all the municipal solid waste (exception of metallic wastes) are being disposed of in the popular unsanitary/unscientific landfill, a low-buying area

where the waste is left uncovered, posing many environmental threats. The good thing, however, is that the site is not a residential area. Landfilling is supposed to be the last option of municipal waste management system, after waste processing, recycling, composting, etc. But because none of these options are available, every waste generated in Uyo seemingly ends up in the landfill. And this is the practice in many other cities in Nigeria. Ideally, municipal solid wastes should be disposed of in engineered landfills, not in open or unsanitary dumpsites (landfills). The sanitary or engineered landfills are meant to handle wastes and unused residues from processing plants (where wastes has undergone biological or thermal treatments) or other facilities when they cannot be further processed or recycled.

Figure 1: MSW dumped at Calabar-Itu Highway by Itam Market

Figure 2: Wastes dumped along Aka road in Uyo

Figure 3: Proposed Bio-remediation awareness

3.2 Mitigation Measures

The strategies to be adopted by the government and other stakeholders in environmental protection and management of soil wastes in Nigeria, involves:

Creation of Awareness, Attitudinal Re-orientation and Legislation Issues

From time to time, stakeholders concerned with SWM should organize seminars and workshops to enlighten the urban and rural dwellers on the need to maintain a neat and healthy environment by carrying out proper waste management practices. These workshops should include the following features:

- **Awareness and Attitudes Issues:** The people should be sensitized on issues concerning solid waste management. The masses should be educated on all steps in solid waste management, ranging from household waste collection/storage to waste segregation, recycling, avoidance of littering, willingness to pay waste disposal fees/charges, co-operation with the waste workers, to mention but a few.

- **Handling Institutions and Legislation Issues:** These issues include current and anticipated legislation and orders and the extent to which the laws are enforced. There should be a synergy of public-private partnership in waste management vis-à-vis the implementation of government policies. Put differently, solid waste management should be carried out within the confine of the policy, standards and regulation made by the government, and government at all levels should ensure that those policies are enforced.

  The contents of workshops organized should include mitigation measures such as identification of the causes of illegal waste disposal by all stakeholders and review of the various measures of mitigation, targeted to each stakeholder group. It should also serve as an avenue through which waste workers (headed by a public health scientist or an environmental engineer) and planners acquire training and capacity development. The workshop should be facilitated by legislature representatives such as the State House of Assembly and Federal House of Representatives, leaders of NGOs and religious organizations, as well as representatives from the Federal, State and Local Government Ministry of Environment.

  It is the believe of the Author that this interfacing/interaction among persons living around dumpsites, community leaders, local government area leaders, local state and Federal Ministry of Environment and agriculture workers, legislative and policy representatives, making a full representation of those affected by and influencing solid waste management, will ensure the development of innovative ideas and effective waste management strategies/programmes at the community, local, state and Federal government levels.

  Also, captains of industries, representatives from the hospitals management boards, market and community leaders should ensure that their subjects account for their waste generation and storage, segregation, collection and transport to a central or community bin (where there are no waste workers in charge of home-to-home waste collection), where the waste workers will now collect and transport the waste to the waste landfill site, recommended only for non-biodegradable waste. The Federal Ministry of Environment, together with legislative representatives should design public awareness programmes and policies that will curb environmental hazards.
- **Promoting Composting:** Composting has been practiced in developed world for centuries by farmers treating their own domestic and agricultural waste and returning it as compost to their fields (Da Zhu *et al*., 2008).

  Domestic urban waste still contains up to 55 percent biodegradable waste but is cut off from rural reuse and therefore is disposed of in drains or landfills. The uncontrolled degradation of organic matter is causing hygiene and environmental problems in many urban areas.

  Composting, in contrast, is a controlled biological treatment process in which microbes degrade organic waste under aerobic condition to a humus substance called compost. Compost is a stable, dark-brown, soil-like material. Contrary to popular belief, mature compost does not smell bad – it can smell as fresh as a forest floor. Compost contains important plant nutrients (such as nitrogen, potassium, phosphorus, etc) though usually not as much as animal manure or chemical fertilizers. It can also contain a range of beneficial minerals and is rich in humus and micro-organisms beneficial to plant growth (Da Zhu *et al.*, 2008; Miguel *et al.*, 1996; Abie *et al.*, 2016).

  Composting is beneficial in a solid waste management system because it reduces organic waste to 25 to 30 percent of its initial weight. If waste is composted

close to its source of generation (for example, at the household level or neighbourhood level) significantly less waste must be transported and disposed of.

Currently, composting plants operate in about 50 cities in India. They cover a large variety of capacity and technology. Large scale plants treating between 100 and 700 tons of mixed waste per day are capital intensive because of their high grade of mechanization. Composting of mixed waste should be avoided; research results show that compost from mixed waste barely meets national quality requirements for compost, owing to contamination with heavy metals and other pollutants (Da Zhu *et al.*, 2008).

The organic content of an average household waste, accounts for more than 70 percent of total waste (Da Zhu *et al*., 2008). Then, waste can be efficiently converted into valuable compost. This practice is capable of reducing disposal costs as well as prolongs the lifetime of landfill sites. It also can reduce the harmful environmental impact of landfill sites, since organic waste is responsible for groundwater contamination and methane gas emission. When organic waste is turned into compost, the soil in urban areas is improved (Da Zhu *et al*., 2008)). The onus is for government agencies and NGOs to provide land, water, and electrical connections to establish a community-based composting plants to augment the arduous task of manual composting by individual household levels. The government agency or NGO is saddled with the responsibility of providing technical assistance and formal training to help them manage, operate, and maintained the equipment and services, though maintenance culture is lacking in Nigeria.

Concerned citizens should be employed to handle jobs such as waste collections from zones (at a fee), waste separation, waste composting, and marketing of wastes to a number of businesses, such as farmers and fertilizer companies (such as the local fertilizer industry which was established by the Udom Emmanuel's led administration, located in Oku Abak, Abak Local Government Area of Akwa Ibom State).

It is the author's believe that this move is capable of creating job opportunities to our unemployed populace. This move will also help clean up our cities in Nigeria. However, it is pertinent to assert here that waste collection can pose a serious health hazard to the urban recuperators of the formal waste collection system, since they will be in direct contact with waste. Skin infection, respiratory problem (especially in this era of corona virus infection), cuts and scraps, could be common risks associated with the business. Thus, there arise the need to create awareness of health and hygiene to the waste workers (the scavengers inclusive) to avoid their chances of contracting infections through unsafe handling of wastes.

- **Promoting Recycling of Waste:** Waste workers could sort materials (wastes) and sell them in bulk either to intermediaries or directly to recycling industries. In many industrial countries (international examples), waste recycling is initiated, organized, and operated by the municipal authorities, supported by national policy. Segregation and recycling are enhanced by specific economic mechanisms. The leading principle is "the polluter pays", meaning that the more waste is generated the higher the cost is for the household or industry. Waste fees are paid according to weight or volume. Minimizing waste or segregating recyclables thus reduces the financial burden on the household. Given proper infrastructure that facilities recycling, people should be willing to invest more time in segregating and recycling and should also be motivated by the savings in their waste management bill.

  In the European Union, two-thirds of waste is landfilled. The European Union is now pursuing a policy of landfilling waste only as a last resort. Recycling levels

increases steadily from 7 percent in 1990 to 15 percent in 2002. High recycling and recovery rates have been achieved for paper, metal, glass, and rubber. Plastic has the lowest recycling rate because technical and economic barriers are high in this sector (Da Zhu *et al*., 2008). This recycling process will also help reduce the amount of waste send to the landfill by up to 25 percent, while diverting the green waste from the landfill site will reduce the total waste to be disposed of in the landfill site by another 15%.

4.0 CONCLUSION

To say that a clean city is a concerted effort by the government and the citizens is to say the obvious. Major cities in Nigeria, using Uyo as case study, with its high economic growth and rapid urbanization, requires rapid solution to the challenges related to mismanagement of municipal solid waste. It is an established fact that improper solid waste disposal methods and bad waste collection practices are major contributory factors to local episode of disease, regional water resources contamination, and greenhouse gases emissions as well as air pollution. Thus, this paper has addressed the challenges of waste disposal management in Uyo in particular and Nigeria in general, and proposed strategies for the improvement of municipal solid waste management system of the study area.

Since waste is generated by all humans, the ways and manner that waste is handled, stored, collected, transported and disposed of should transcend beyond the participation of one stakeholder but on the interest of all and sundries, but monitored and supervised by the stakeholders (i.e. government parastatals directly involved with the environment, such as the state/local ministries of environment). Thus, public involvement is a vital tool in waste management and disposal activities. The essence of the study was to make contribution and efforts at sensitivity the various stakeholders concerning this challenge and preferring solution. It is believed that the suggested measures will contribute in no small measure to averting the illegal, unscientific, unsanitary, and improper disposal and management of waste in major cities in Nigeria.

Throughout discussion on the study, recommendations were provided to improve current waste management practices in the study area. The study also highlighted suggested solutions to the challenge of waste management, focusing on the need to recycle non-biodegradable waste, composting of the biodegradable parts as well as incineration for energy recovery of wastes; separation of waste at source as to avoid the dumping of biodegradable waste at landfill sites. The author condemns the present practice of waste disposal and management in Nigeria where both the biodegradable and the non-biodegradable wastes are dumped at the various municipal waste sites. The author recommends composting for all biodegradable wastes. This is because composting helps to generate carbon – and nutrient-rich compost for soil fertility, against the present practice of landfilling biodegradable materials with its attendant problems of enhancing greenhouse effect.

Studies, including the research findings of Hudgins (1999) reveal that the landfill of biodegradable materials (wastes) presents a particular problem in that methane, a greenhouse gas with 25 times the effect of CO_2, may be produced under anaerobic conditions. However, such a “landfill gas” can be captured and used as a source of energy (gas) production.

5.0 RECOMMENDATIONS

As is done in developed economies, the following measures can lead to prompt and significant improvements of the MSW management system in Uyo in particular and Nigeria in general.

- Promoting the use of three domestic bins at home – one for biodegradable food waste, one for recyclable material, and one for toxic (hazardous) waste.
- Promoting composting at the household level. This is to say that households can easily compost their kitchen waste, leaves, grass clippings, vegetables etc. within their premises where space is available.
- Prohibiting waste disposal on the streets. Waste should be collected door to door or from nearby collection bins in order not to litter the streets and cause unnecessary pollution and its attendant problem to land and water bodies such as eutrophication.
- Promoting public-private partnership.
- Designing of engineered and controlled landfill sites: There is need to have engineered and controlled landfill site(s) in Uyo as well as in other major cities in Nigeria. Kudos to the Akwa Ibom State government for the current move towards bioremediation as contained in the publicity captured in Figure 3 in this article. Besides Bio-remediation, there is also need to engage the services of environmental engineers who should design and install facilities such as impermeable liners at the bottom of the dumpsites in order to prevent the leachate from reaching the aquifer thereby polluting the groundwater. Consequently, the leachate which contain essential plant nutrients such as carbon, nitrogen, phosphorus, potassium, and traced elements, can be harvested and used as fertilizers for optimum crop production.

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