ASSESSMENT OF SOLID WASTE MANAGEMENT AT SELECTED SHOPS IN SELECTED MARKETS IN OWERRI, IMO STATE

BY

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Certification

This is to certify that this work **"Assessment of Solid Waste Management Practices at Selected Shops in Selected Markets in Owerri Municpal, Imo state" was** carried out by **Nwaobi, Alexander (20144918058)** in partial fulfillment for the award of Master's Degree in Public Health (Environmental Health and Safety) in the Department of Public Health, Federal University of technology, Owerri.

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DEDICATION

This work is dedicated to God Almighty.

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ABSTRACT

This is a cross-sectional study carried out in three selected markets in Owerri Municipal namely: Owerri Main Market, New Market and the Relief Market, with the aim of assessing the solid waste management at selected shops in selected markets in Owerri. The aim was achieved with six objectives including to assess the characteristics of the solid waste generated, to determine the methods of handling solid waste generated, to determine the pattern of Solid Waste Disposal, to determine the frequency of solid waste refuse dump removal, to determine the organs responsible for solid waste disposal and the level of government involvement and to rate solid waste management in the selected shops in the selected markets in Owerri, Imo state. This was done using a validated structured questionnaire and an observational checklist. Simple random sampling technique was used; selections were performed using the number of available shops at each market from the market masters registers, the shops were divided by the number of block lines at each market, using computer random number system, the included shops were randomly selected from each block line. Only one person (the shop owner or the most available senior person in the shop) was chosen per selected shop, at situations where some selected shops refused participation, the shops were randomly replaced using simple random without replacement mechanism to avoid selecting an already visited shop. The process continued until the required sample size was obtained at each market of study. Sample size of 370 markets traders were randomly selected from the study population. The sample size was determined at 95% confidence level using the Taro Yammane sample size formula. Where n=sample size required, e = 0.05 allowable error. Substituting for the numbers in formula: Taro Yammane, method used (Yammane, 1967). Sample size required n, e=0.05 allowable error. For Owerri Main Market n =126, New Market Owerri n= 77 and The Relief Market Owerri n = 197. Therefore, the total sample size n =96+77+197 = 370. The results showed that the most generated waste in the markets were plastic waste (86.5%) including used pure water satchets and used waterproofs and spoilt foods (69%). More than half (50.5%) of the waste were collected with nylon bags and packaged with same without segregation. The dominant means of waste disposal in the markets were burning 40.3% and open dumping 36.8%. The frequency of solid waste dump removal was predominantly weekly 42.2% with government being upto 75.7% responsible for solid waste disposal in the markets. The overall rating of solid waste management in the markets was overwhelmingly not satisfactory 90.3%. The study therefore concluded that solid waste management in these studied markets was very poor. Based on the findings of the study, it was recommended that strict environmental sanitary regulations be made in these markets with enforcement team to penalize defaulters of the regulations.

Keywords; Management, Regulations, Environmental, Strategies, Disposal, Waste.

CHAPTER ONE

1.0 Introduction

1.1 Background to the Study

Waste is any substance or material which requires to be disposed of as being broken, worn out, contaminated or otherwise spoilt and as such lost its usefulness (Anifowose et al., 2011). It could be in liquid or solid form and could be hazardous. These classification ranges from garbage or refuse from homes and other places where human or animal lives exist.

On the other hand, solid waste as described by State of Vermont Agency of Natural Resources Department of Environmental Conservation (2012) is any tangible and non-free flowing unwanted materials or substance that results from human activities. It is referred to as Municipal Solid Waste where its sources are generated from - commercial, agricultural, and industrial operations (Singh et al., 2011). To this end, population growth and economic development is a major contribution to solid waste generation in urban areas (The World Bank, 2019). Thus, Municipal solid waste is usually generated from human settlements, small industries, and commercial activities.

It has been recorded that, Nigeria generates over 32 million tons of solid waste yearly, and only a fraction is collected (Bakare, 2020). Most of these wastes are generated by households and in some cases, by local industries, artisans and traders in the markets who litter the immediate surroundings with nylons, paper packages, plastic wastes etc. Improper collection and disposal of municipal wastes has led to different levels of environmental challenge such as blockade of sewers, drain networks and the choking of water bodies (George, 2010).

Although, the country lacks a well-coordinated waste management system, Solid Waste Management (SWM) is under the purview of Ministry of Environment at the Federal and State levels and Environmental Health Department at Local Government level under established legislations and guidelines relating to waste management. Some of these legislations include: the Harmful Waste Act (Special Criminal Provisions, etc of 1988), the National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2007 (NESREA Act, repealed the Federal Environmental Protection Act of 1988), Environmental Impact Assessment act of 1992, National Environmental (Sanitation and Wastes Control) Regulations, 2009 and the National Environmental Protection Regulations (Pollution Abatement in Industries and Facilities Generating Waste). Drawing from the directive of the Federal Government to the states for the establishment of waste authorities, all states in Nigeria have established waste authorities under the Ministry of Environment (National Environmental Standards and Regulations Enforcement Agency, 2007). Some of these Waste Authorities include; Imo State Waste Management Authority (ISWMA), the Abuja Environmental Protection Board, Anambra State Waste Management Authority (ASWAMA), Lagos State Waste Management Agency (LAWMA), etc. The emergence of waste Authorities in most states in Nigeria has brought about several strategies best suitable for solving the problems of waste management in the state. These strategies include; The traditional waste management strategies consisting of waste generation, collection, transportation and disposal, the Waste minimization strategy consisting of waste reduction, reuse, recycle and recovery, and

technological strategy consisting of the application of Geographical Positioning Systems (GPS), Geographical Information System (GIS) and Remote sensing technologies.

1.2 Statement of the problem

In Africa, rapid urban growth has resulted to increased economic activities which have exacted massive pressure on cities, towns and surrounding areas (Aliyu & Amadu, 2017; Saghir 85 Santoro, 2018). The massive economic activities have led to increased urban waste generation leading to health hazards, underground water pollution, blocking of drainages and sewers, and have affected air and aesthetic qualities (Mazhindu et al., 2012).

The inability to properly manage these wastes generated in developing countries such as Nigeria creates great concern (Amasuomo & Baird, 2016).

The challenges on the management of waste being experienced by the waste management authorities in their jurisdiction have been captured by several scholars (Imam et al., 2008; Ogwueleka, 2009b; Solomon, 2009). They have identified these problems and recommended ways to solve the problems associated with waste management using the aforementioned strategies. Although these strategies worked for some time, however, it seems to be failing because of the large area of land to cover, the population of Nigeria, bureaucratic nature of government policies and its implementation, government jurisdiction and high dependence on capital (capital intensive) (Anestina et al., 2014). To this effect, this study was carried out to assess solid waste management strategies commonly adopted by selected markets in

Owerri Municipality.

1.3 Objectives of the Study

1.3.1 General Objectives

The general objective of the study was to assess solid waste management at selected shops in the selected markets in Owerri, Imo state.

1.3.2 Specific Objectives

1. To assess the characteristics of the solid waste generated at selected shops in the selected markets, in Owerri, Imo state.
2. To determine the methods of handling solid waste generated at selected shops in the selected markets in Owerri, Imo state.
3. To determine the pattern of Solid Waste Disposal at selected shops at the selected markets in Owerri, Imo state.
4. To determine the frequency of solid waste refuse dump removal at selected shops in the Selected Markets, in Owerri, Imo state.
5. To determine the organs responsible for solid waste disposal and the level of government involvement at selected shops in the selected Markets, in Owerri, Imo state.
6. To rate solid waste management at selected shops in the selected markets in Owerri, Imo state.

1.4 Research Questions

1. What are the characteristics of solid waste generated at selected shops in selected markets in Owerri, Imo state?
2. What are the methods of handling solid waste generated at selected shops in

the selected markets in Owerri, Imo state?

3. What is the pattern of solid waste disposal at selected shops in the selected markets in Owerri, Imo state?

4. What is the frequency of solid waste refuse dump removal at selected shops in the Selected Markets, in Owerri, Imo state?

5. What are the organs responsible for solid waste disposal and the level of government involvement at selected shops in the selected Markets, in Owerri, Imo state?

6. What is the rating of solid waste management at selected shops in the selected markets in Owerri, Imo state?

1.5 Research hypothesis.

The rating of solid waste management at selected shops in the selected markets in Owerri, Imo state is low.

1.6 Significance of the Study

The findings of this study shall add to the existing body of knowledge and serve as literature to other related topics.

The findings of this study shall reveal the nature and characteristics of waste generated at selected shops in selected markets in Owerri, Imo State.

The findings of this study shall reveal the pattern of waste handling and disposal at selected shops in the selected markets in Owerri, Imo state.

The findings of this study when harnessed properly shall inform government

decision on making policies and regulations for effective solid waste management at selected shops in the selected markets in Owerri, Imo state.

The outcome of this study shall raise awareness and improve environmental consciousness on the side of the traders and raise attitudinal change towards solid waste management in case of poor waste management at selected shops in selected markets in Owerri, Imo State.

1.7 Scope of the Study

The aim of this study is to assess the solid waste management at selected shops in the selected markets in Owerri. This study was delimited to:

1. Solid waste only generated at selected shops in the selected markets in Owerri municipality.
2. Market stalls occupants above 18 years, who are selling in the market stalls at selected shops in the selected markets in Owerri municipal.

The dependent variable of the study is the method of management of solid waste generated at selected shops in the selected markets, while the independent variable is the solid waste generated at selected shops in the selected markets.

CHAPTER TWO

2.0 Literature Review

2.1. Conceptual Framework

2.1.1 Solid Waste

Solid waste as described by State of Vermont Agency of Natural Resources Department of Environmental Conservation (2012) is any tangible and non-free flowing unwanted materials or substance that results from human activities. It is referred to as Municipal Solid Waste where its sources are generated from - commercial, agricultural, and industrial operations (Singh et al., 2011).

2.1.2 Composition of Solid Waste

The composition of municipal solid waste varies greatly from municipality to municipality (Kumar et al, 2016) and it changes significantly with time. In municipalities which have a well developed waste recycling system, the waste stream mainly consists of intractable wastes such as plastic film and non-recyclable packaging materials.

In developed areas without significant recycling activity, the waste predominantly includes food wastes, market wastes, yard wastes, plastic containers and product packaging materials, and other miscellaneous solid wastes from residential, commercial, institutional, and industrial sources. Most definitions of municipal solid waste do not include industrial wastes, agricultural wastes, medical waste, radioactive waste or sewage sludge (U.S. Energy Information Administration, 2010). Waste collection is performed by the municipality within a given area. The term residual waste relates to

waste left from household sources containing materials that have not been separated out or sent for processing (Welsh Assembly, 2005). Waste can be classified in several ways, but the following list represents a typical classification:

- **Biodegradable Waste:** Food and kitchen waste, green waste, paper (most can be recycled, although some difficult to compost plant material may be excluded)
- **Recyclable Materials:** Paper, cardboard, glass, bottles, jars, tin cans, aluminum cans, aluminum foil, metals, certain plastics, textiles, clothing, tires, batteries, etc.
- **Inert waste:** Construction and demolition waste, dirt, rocks, debris, etc
- **Electrical and Electronic Waste (WEEE) -** Electrical appliances, light bulbs, washing machines, TVs, computers, screens, mobile phones, alarm clocks, watches, etc.
- **Composite Wastes:** Waste clothing, Tetra Pack food and drink cartons, waste plastics such as toys and plastic, etc
- **Hazardous Waste:** Including most paints, chemicals, tires, batteries, light bulbs, electrical appliances, fluorescent lamps, aerosol spray cans, and fertilizers, etc
- **Toxic Waste:** Including pesticides, herbicides, and fungicides, etc
- **Biomedical Waste:** Expired pharmaceutical drugs, syringes, waste from hospitals, etc.

2.1.3 Solid Waste Management

Waste management (or waste disposal) includes the processes and actions required to manage waste from its inception to its final disposal ("United Nations Statistics Division, 2017) This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process and waste-related laws, technologies, economic mechanisms. Waste management practices are not uniform among countries (developed and developing nations); regions (urban and rural areas), and residential and industrial sectors can all take different approaches (Davidson, 2011).

2.1.4 Principles of Waste Management Waste Hierarchy

The waste hierarchy refers to the "3 Rs" Reduce, Reuse and Recycle, which classifies waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy is the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of end waste (Albert, 2011). The waste hierarchy is represented as a pyramid because the basic premise is that policies should promote measures to prevent the generation of waste. The next step or preferred action is to seek alternative uses for the waste that has been generated i.e. by re-use. The next is recycling which includes composting. Following this step is material recovery and waste-to-energy. The final action is disposal, in landfills or through incineration without energy recovery. This last step is the final resort for waste which has not been prevented, diverted or

recovered (United Nations Environmental Programme, 2013). The waste hierarchy represents the progression of a product or material through the sequential stages of the pyramid of waste management. The hierarchy represents the latter parts of the life-cycle for each product.

Life-Cycle of a Product

Product life-cycle analysis is a way to optimize the use of the world's limited resources by avoiding the unnecessary generation of waste.

The life-cycle begins with the design, and then proceeds through manufacture, distribution, and primary use and then follows through the waste hierarchy's stages of reduce, reuse and recycle. Each stage in the life-cycle offers opportunities for policy intervention, to rethink the need for the product, to redesign to minimize waste potential, to extend its use (United Nations Environmental Programme, 2013).

Resource Efficiency

Resource efficiency reflects the understanding that global economic growth and development cannot be sustained at current production and consumption patterns. Globally, humanity extracts more resources to produce goods than the planet can replenish. Resource efficiency is the reduction of the environmental impact from the production and consumption of these goods, from final raw material extraction to the last use and disposal.

Polluter-Pays Principle

The polluter-pays principle mandates that the polluting party pays for the

impact on the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the unrecoverable material.

2.1.5 Waste Handling Practices

A. Generation

Generation of solid waste is an inevitable act of human beings hence requires proper management. It involves those activities in which materials are identified as no longer being useful or of value which are either thrown away or gathered together for disposal (Babayemi et al. 2009). Waste generation according to Amadi (2010) depends on the culture, social status, eating habits of people and economic standing of a country. Increased generation of waste is associated with increase in population, changes in socio-economic status and lifestyle which require on-site handling and storage.

B. On-site Handling and Storage

This has to do with activities involving handling, storing and processing of solid wastes at or near the source of generation. Segregation and sorting is one of such activities.

Segregation and Sorting

This simply means ways or acts of separating and arranging different components of waste creating room for less strenuous and harmful collection

C. Collection

This has to do with picking of waste from point of generation to final disposal site using various methods

Solid waste Collection Methods Include

House to House Collection: Metal or plastic bins with lid or disposable bags used by house-holders are usually placed at strategic place for easy collection

Bulk Bin Collection: This could be heavy galvanized metal dustbin usually placed at centralized place for communal refuse collection and storage of household refuse before their removal to a final dumpsite by trucks.

D. Transfer

The reason for transfer of waste either to final dump sites or transfer station most times is to prevent proximity of people to accumulated waste with its attendant risks and ensure environmental sanitation.

E. Transportation

Transportation of waste according to Amadi (2010) is the movement of waste over a specific area by trains, tankers, trucks, barges, or other vehicles. Usually such vehicles are used to convey accumulated collected solid waste from point of generation to final dumpsites. The collection frequency is dependent on type and volume of refuse. In some areas it could be once in a weekly, twice a week, daily or even twice a day (Obionu, 2005).

F. Disposal

Solid waste disposal is the process of getting rid of solid waste collected. Disposal method depends on the physical characteristics of the locality including topography of the area, the character, quality and quantity of the waste and also the community (Obionu, 2005). Common disposal methods

include controlled tipping or land filling, sea disposal or dumping on the sea, dumping at transfer station, burying and dumping on farmland.

E. Treatment

The essence of treatment is to avert harmful nature of wastes and protection environment. Treatment method depends on the composition of the waste. Common treatment methods include incineration with the help of incinerators, use of mechanic destructor, composting, use of chemical, microwave and autoclave.

F. Recycling

Because some wastes have potential usefulness when properly treated, there is need to sort them properly in order to remove those that can be reused. This practice not only has public health relevance but also empowers people by adding meaningfully to their economy if properly conducted (Baechler et al. 2013). Recycling of cans, plastic containers, bottles, clothes, shoes and metal scraps usually done by scavengers improve their welfare and puts food on their table (Kreiger et al 2013).

G. Transfer Station

According to Liliana et al. (2012), transfer station means a building or processing site for the temporary deposition of waste. Transfer stations are predominantly used as places where local waste collection vehicles deposit their waste cargo prior to loading into larger vehicles. The larger vehicles will transport the waste to the end point of disposal in an incinerator, landfill or hazardous waste facility, or for recycling. Transfer stations may be located with material recovery

facilities and with localized mechanical biological treatment systems to remove recyclable items from the waste stream.

2.1.6. Waste Disposal System

A. Use of Sanitary Landfill

Sanitary Landfill is an engineered facility for disposing of solid wastes on land by spreading the solid waste in thin layers; compacting into smallest practical volume and covering it with a layer of earth at the end of each day or more frequently in a manner that guides against environmental pollution (Bhalergn, 1980). A landfill site is regarded as a site for the disposal of waste materials by burial and is the oldest form of waste treatment (Jang et al., 2003). Some landfills are also used as temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling).Typically, operators of landfills for non-hazardous waste meet predefined specifications by applying special waste management strategies. Landfill occurs as a result of land dumping of waste which is of various methods. Predominantly, it has to do with the mass dumping of waste into an allotted area, often a hole or side hill. It ensures compartment of dumped refuse with the help of large machines prior to discharging into units usually called cell. At completion of cell, it is then sealed with a plastic sheet and covered in several feet of dirt.

Advantages of Sanitary Landfill

i. Use of landfills for disposal of solid waste is simplest, cheapest and most cost-efficient (Amadi, 2010).

ii. It could be used for land reclamation

iii. It is a complete or final disposal method when compared with incineration and composting that requires additional treatment or disposal operations for residues, quenching water, unusable material, etc.

Challenges of Sanitary Landfill

i. Landfills have been reported to be a source of pollution which can intoxicate ground water because they often lack provisions for leachate collection and treatment, landfill gas and use (Al-Yaquot 2012). As a result, landfill gases escape into the atmosphere adding to greenhouse gas emission (Ray, 2005).

ii. In a place where land is scarce, suitable land may not be available within the economical hauling distance.

iii. Swift adherence to the sanitary landfill standard needs to be observed daily or at each operation to discourage open dumping practice and its health challenges.

iv. When located in residential area, it could provoke extreme public opposition.

v. A completed landfill settles and requires periodic Maintenance.

vi. Special waste management strategies applied in landfill Method.

vii. Ensure it does not waste land hence wastes are confined into least area of land as possible to ensure efficiency.

viii. Ensure also that wastes are compacted very well to minimize its volume and Cover the waste with layers of soil after daily or end of activities to guide against flies and other effects

Steps Involved In Landfilling Of Municipal Waste

i. Inspection of waste by personnel to ascertain composition of waste to detect wastes that cannot be dispose in landfill

ii. Tipping of acceptable waste into working face

iii. Wheel-cleaning facility could be used to clean up the waste conveying vehicle

iv. Spreading and compacting of the wastes on the working face with the help of compactor or bulldozers.

v. Covering of compacted wastes soil or any other alternative material at the end of operation.

2.1.7 Use of Composting

This simply refers to as the biological decomposition of refuse in the presence of air usually in form of oxygen as opposed to anaerobic decomposition of waste that happens in the absence of oxygen (Amadi, 2010).

2.1.8. Use of Incineration Method

Incineration is a thermal waste treatment method that involves subjection of solid organic wastes to combustion at a very high temperature in order to convert them into residual ash or gaseous products. Usually in enclosed equipment called incinerator.

A. Challenges of Incineration of Solid Waste

The essence of incineration process is to reduce weight of the solid waste and destroy pathogens, but this process produces ash that increases the levels of heavy metals, inorganic salts and organic compounds in the environment (Rajor et al., 2012; Xie and Zhu, 2013; Zhao et al, 2008, 2010). This solid Waste

ash may be a source of contamination to groundwater and soil if not properly handled. *Zhao* et al. (2008) did the chemical analysis of Medical Waste incinerator ash and reported that it contained large amounts of metal salts, like aluminum, calcium, iron, potassium, magnesium, sodium, with a concentration range of 1.8-315gkg-l and heavy metals, like silver, arsenic, barium, bismuth, cadmium, chromium, copper, manganese, nickel, lead, titanium, antimony, tin, strontium, zinc, with a vast range of 1.1-121,411 mgkg-1. *Zhao* et al. (2008) investigated the chemical properties, potentially mobility and bioavailability of rare earth elements in Medical Waste incinerator ash and showed that total rare earth elements in the ash ranged from 10.2 to 78.9 mgkg-1. Zhao et al. (2010) examined Medical waste incinerator ashes and found CaO, SiO2 and A12O3 as the main constituents and suggested that the ash could be recycled and used as construction material, but it must be treated at high temperature (850 °C-1000 °C) to destroy the polycyclic aromatic hydrocarbons (PAHs) before or during the recycling process. Bo et al. (2009) treated Municipal solid Waste incinerator fly ashes with supercritical water and found this experiment as effective treatment for hazardous elements detoxification in Municipal solid Waste. Bakkali et al. (2013) collected samples of fly ash from 16 hospitals to conduct a series of tests and showed that the samples were composed mainly of P2O5 (18%), SiO2 (17%), Na2O (16%), CaO (14%) and SOS (10%). Further, the ashes contained high concentrations of heavy metals, such as zinc, lead, chromium and nickel with a range of 0.5-2.5,071 mgkg-1. Rajor et al. (2012) suggested some uses of solid waste ash, as in cement

and concrete systems, agricultural fertilizer, road and asphalt. Further, leach ability studies of these metals should be done for proper management and utilization of a solid Waste incinerator ash. Liu et al. (2013a) applied a floatation process for removal of carbon and unburned carbon contents from incinerator ash that increased the loss on ignition of fly ash from 11.1% to 31.6% during conditioning process. Liu et al. (2013b) confirmed flotation technology as the most promising alternative for the treatment of solid Waste incinerator ash, operating at low costs. Yan et al. (2007) treated solid biomedical waste fly ash with a mechnochemical process with and without CaO, and found that polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) can be degraded. In the presence of CaO, the degradation efficiency increased. Kougemitrou et al. (2011)examined bottom ash and fly ash from Medical Waste incinerators and found very high concentration of hazardous elements. Their experiments highlighted that bottom ash can be disposed of in normal solid waste sites and fly ash can be embedded in concrete blocks as best waste management practices. A comprehensive environmental and health evaluation system should be developed for the effective and efficient management and disposal of fly ash (Xie andZhu, 2013).

2.2Empirical Framework

2.2.1Solid (Municipal) Waste in Nigeria

The management of municipal solid waste in Nigeria is a complex issue today owing to several factors including the rapidly increasing population, urbanization, increasing production rates and standard of living. This has

affected the waste generated in Nigeria both in terms of quantity of waste generated and the composition, coupled with increased diversity, the introduction of new materials and so on (Agunwamba, 2003). Ogboi et al. (2009) argued that the earning power and economic growth of the country have an impact on the composition of Municipal waste generated in Nigeria. In attempting to speed up industrial activities and boosting the economic development by most developing countries, they often fail to take note of the generation of waste resulting. Also, most developing countries usually spend a huge amount of financial resources in setting up certain waste management programs which do not often necessarily amount to the improvement of the waste management sector (World Bank, 2012). The research also highlighted that the high-income earners have the capacity of generating more packaging waste through their increased use of packaged products. This statement is validated by the world Bank report on waste producers as shown in figure 3 below. The substances making up municipal solid waste in Nigeria mainly includes organic substances, plastics, metals, textile, glass, rubber and paper (Ogwueleka, 2009), while emerging streams of waste in this section includes e-waste such as used mobile phones, computers and other forms of electronic devices (Charles, 2015).

In the past two decades, it is observed that there has been an increase in both the quantity and diversity of household waste in Nigeria. New packaging materials and packaging designs for instance have emerged; civilization has also improved making more Nigerian companies to switch from the use of traditional materials to the adoption of the latest competitive packaging methods for the sales of consumer

goods. The major stages of Municipal waste management in Nigeria includes the generation and immediate storage of waste in a mixed form, the collection and transfer of the waste by either formal or informal waste collectors, the sorting and treatment of collected recyclable wastes, material recovery processes and the final disposal of untreated waste. These stages differ in capacities with major gaps in most cases. For instance, the amount of generated household waste is found to be much higher than the amount of waste collected. Of the waste collected, the fraction of material recovery is minute. Hence, it can be stated that Nigeria currently runs a poor and ineffective waste management system (Charles, 2015).

Charles (2015) reported that an average of 0.5kg/capita/day is being generated in Nigeria, but more recent research conducted by Ike et al. (2018) revealed that there has been a significant growth in average waste generated per capital from 0.5kg/capita/day to about 0.65kg/capita/day. Waste generated per capital could be as low as 0.13kg/capita/day in some cities like Ogbomosho but as high as 0.71kg/capita/day in other cities such as Ado- Ekiti. The variation of data is possibly due to the earning power of individuals in those cities, eating habits and the price of goods, especially food items. The generation of waste could also vary with weather seasons, festive periods etc. However, most published researches have stayed consistent with the fact that of the total municipal waste generated annually, about 50 percent on an average is food or organic waste (Charles, 2015). Ike et al. (2018) made their research based on existing data and was able to successfully update some facts about waste generation and treatment in Nigeria by carrying out a new research in three

major cities in Nigeria including Minna (northern Nigeria), Birnin Kebbi (northern Nigeria) and Enugu (eastern Nigeria).

2.2.2 Status of Waste Collection, Recycling and Disposal In Nigeria

The proper collection, recycling and disposal of waste are very crucial and major stages of any waste management system. Previous studies have shown that about 30 to up to 60 percent of waste generated in Nigeria is not collected (Charles, 2015, Ogwueleka, 2009). There are several reasons to the poor waste collection rates including factors such as bad road networks, poor technical, management and economic performance of the waste management authorities, use of substandard and inadequate facilities, inability to optimize resources and collection routes, and on the part of the citizens, the refusal or non-corporation in the payment of waste collection bills (Ogwueleka, 2009). As established by (Oderinde, 2020), there exists presently no separation or pre-treatment for packaging and Municipal waste in Nigeria. Therefore, a mixed composition of waste exists during disposal. Most of this waste ends up in the streets, roadside drainages and illegal dumping sites due to poor or no waste collection platforms in some areas causing a huge environmental pollution with health risks. There also exists no properly engineered landfill site in Nigeria till date. Therefore, the waste disposed in dumping sites is not managed effectively. Most of these dumping sites are located close to major roads leading to the migration of some waste materials to the roads and streets. Matter et al. (2013) reported that due to the inadequacies in the collection of household waste in most developing countries, waste is often disposed in streets, open dumping sites,

rivers and drainages. This could lead to the degradation of soil, as well as the pollution of water and the atmosphere, leading to the spread of germs and diseases. However, Asim et al. (2012) added that the improper disposal of waste in streets and drainages make them readily available to be picked by waste collectors.

Ike et al (2018) reported that in the year 2010, two major Nigerian cities such as Lagos and Ibadan (both in the south-western regions of Nigeria) which used to be the centres of tourist attraction have now been ranked as part of the dirtiest and environmentally unsafe places to live in the world. Onitsha and Aba, which are south eastern cities and high in commercial trade activities, joined this list in the year 2015. The research also stated that the poor waste management and disposal situation is the case for most other cities in Nigeria as well leading to the littering of roads, drainage lines and the conversion of most vacant lands into illegal dumping sites. Onu (2012) established that there exist two primary methods for the collection of municipal solid waste in Nigeria presently. These include the door-to-door waste collection system and the dropping of waste at depots or communal waste disposal points. The collected waste is in mixed form due to the absence of a waste separation technique. Prior to collection, household waste is being stored in smaller units indoors (in most kitchens) in a mixed form. This implies that all forms of waste including organic waste are put together in a small waste bin. When the waste bin is full or at certain intervals depending on the households, the waste is transferred to a larger waste bin located outside the building where it is easily accessible by waste trucks. Households who have not registered with any waste collection

company also use these large storage containers and have their waste collected by the informal waste collectors (usually truck pushers). However, some other households prefer to keep their waste indoors in those smaller units and have it collected by truck pushers who do door-to-door collection (Charles, 2015).

There are health and environmental implications of the storage of waste in households whether internally or externally. Waste improperly stored, kept for too long or overflowing bins could pose serious health risks to household members and community dwellers at large. This happens when the bins become heavily contaminated, providing a breeding place for insects and germs and possibly a harbourage for diseases. Therefore, the government is lately encouraging the use of waste plastic bags as this would reduce the level of contamination. Secondly, the bagging of waste makes collection much easier since it now looks less irritating to the waste collectors. Typical waste bins in Nigeria include plastic bins, steel drums, sacks, polythene bags and paper bags. Being distinguished by the type of material used, the choice of bin by households depends on the nature of waste to be stored (wet or dry), the durability of the bin and its affordability (Charles, 2015).

Olukanni et al (2018) stated that over the years, there have been a drastic increase in the generation of municipal solid waste in Nigeria but there has not been a corresponding increase in waste management capacities by organizations and government authorities. Highlighted in the research is the fact that an upscale of financial and technical resources would help bring about a parallel growth rate on both ends. This also includes the active

participation and encouragement of recycling and material recovery processes by collection and waste management organizations at both private and government levels.

In the year 2014, a major news publishing house (Vanguard) published a report by LAWMA stating that Lagos state produces about 12,000 metric tons of waste per day. This huge amount of waste is beyond the capacity of LAWMA and other private waste management companies combined. Therefore, out of this amount, only about 20 to 30 percent gets collected and disposed or incinerated. See information provided by Vanguard publishing house (Olusunkanmi, 2014). Awosusi (2010) reported that most municipal waste management authorities are often faced with much more waste than they can handle leading to overwhelming situations. This often leads to break downs in their operations such as frequent damages of the collection trucks, inadequate manpower to carry out collection and treatment activities, poor payment of staff and so on. Ogwueleka (2009) also observed that most governmental waste management organizations are often faced with problems of insufficient funding and this in many cases would lead to the delay in the payment of staff. The staff embarks on strikes over the delay of their wages and the wastes in communities are left unattended to. Over the years, recycling activities, which comprises majorly of the collection, sorting, compaction and the export of waste to recycling companies are carried out by the informal waste collectors especially in the urban areas. Waste plastics, metals and clothing materials are collected by informal waste collectors, street bins and with the use of waste collector carts for door-to-door

collection activities. As much as this is an illegal and unhygienic way of waste collection and management, environmental pollution would have been much worse in Nigeria today without the informal waste collection system. (Oguntoyinbo, 2012). Wilson et al (2006) revealed that the main economic motive regarding the collection of waste by informal waste collectors is not in the charge they demand from households but on the income that they get when they resell the collected waste to either recyclers or other interested buyers.

CHAPTER THREE

3.0 Materials and Methods

3.1 Study Design

A cross sectional study design was used to carry out the study. A cross sectional study is a type of observational study that analyses data from a population or a representative subset at a specific point in time (Schmidt and Kohlmann, 2008).

In this study, the design was adopted to obtain and analyze data from respondents trading at selected shops in the selected markets in Owerri Imo State. Data obtained were analysed once, no follow up was done. According to market masters register at Owerri Municipal, there are 18 markets with three biggest markets of Owerri Main, relief market and new market.

3.2 Study Area

The study was carried out in Imo State. Imo state is located at Latitude 4° 45'N and 7° 25'E and Longitude 6° 50'E and 7° 25'Ewith an estimated projected population of 4, 978,758 (NPC, 2017) in an area of 5,100km^2 (Imo Government, 2010). The state is one of the states in the South -Eastern geopolitical zone. In the heart of the East, the state is bordered by Abia State, Enugu State, Anambra

State and River State to the South (Vanguard Nigeria, 2015). Owerri is a capital of Imo State set in the heart of Igboland, it consists of three local governments of Owerri Municipal, Owerri North and Owerri West with an estimated population of about 1,401,873 as of 2016 and approximately 100 square kilometers (40 sq mi) in area. The climate of Imo state Nigeria is tropical with the rainy season beginning in March and last until November (World Travel, 2017). The annual rainfall varies from 1500mm to 2,200mm (60 to 80 inches) (University of Northern IOWA, 2009) with an average annual temperature above 20°C (68°F) which creates annual relative humidity of 75% and reaching 90% in the rainy season. The dry season is experienced in two months from late December to Late February (World travels, 2017). The vegetation of Imo state is rain forest, characterized with palm oil trees and other economic tree for food and timber production.

3.2.1 Study Location

3.2.1.1 Owerri Main Market

The market is popularly known as Eke-Ukwu Owerri. It was located along ever-busy Douglas road in the heart of eastern heartland Owerri with increased commercial activities. The market had commercial banks close to it including United Bank for Africa, Citibank bank and Eco bank which help people around the market in performing their financial transactions. One of the major problems faced by the market is the issue of solid waste and its attendant environmental impacts as a result of the increased economic activities of traders in the market as suggested by Julius et al (2010).The common solid wastes generated on daily bases in the market include cartons, bottles, tins, cans,

rubber, leather, plastics, ceramics, cottons, woods, papers, polythene bags, sachet water nylon bags, vegetables, corn cobs , metals, cables, human hair attachment, needle, broken mirror, pins, bones and solid animal excreta (faeces), and solid waste itself may be contaminated with faecal matter. These conditions lead to a proliferation of vermin and disease vectors, and increase environmental health risks. The major commercial activities within the market includes buying and selling of goods and services like mobile phones and accessories, cosmetics, clothes, shoes, fashion accessories, etc. with minimal interest in food, beverages, vegetables and other perishables. It has less interest in automobile spare parts and repair, electrical and electronic gadgets, electronic spare parts and repair, metal and fabrication works, vulcanizing and design of automobiles.

3.2.1.2 The New Market

Located along tail of Douglas road by Aba road junction before Emmanuel college round-about Owerri, new market as popularly called is the hub for traders in the following business; auto-spare parts and repair, electrical spare parts and repair, electronic gadgets and repair, mechanical works, metal and fabrication works, vulcanizing and design of automobiles. The market is surrounded by commercial banks including fidelity bank, zenith bank and Eco bank to ease financial transactions of the traders. One of the major problems confronting the market is how to carefully tackle solid wastes generated on daily bases within the markets and manage them in a way that they do not cause harm, injuries and disabilities base on the composition of the waste generated within the market.

The common solid wastes generated in the market include Waste Electrical and

Electronics Equipment (WEEE), which According to Ongondo et al. (2010) can lead to adverse human health effects and environmental pollution because of presence of sources of harmful elements like Electronic scrap components, such as central processing units of computer, contain potentially harmful components such as lead, cadmium, beryllium, or brominates flame retardants. There are many sizes of buttons and coin cells of battery containing Lead, Mercury and Cadmium. Elements found in small amounts include cadmium, mercury, and thallium. Elements found in trace amounts include americium, antimony, arsenic, barium, bismuth, boron, cobalt, europium, gallium, germanium, gold, indium, lithium, manganese, nickel, niobium, palladium, platinum, rhodium, ruthenium, selenium, silver, tantalum, terbium, thorium, titanium, vanadium, and yttrium. Almost all electronics contain lead and tin (as solder) and copper (as wire and printed circuit board tracks), iron scraps, condemned tire, wheel, rod, papers, cartons, cables, rubber, nuts and screws, damaged spanner and tools, pills from wire, wood, spoilt stereo, 'fufu' used during repair of tires, nails and pins removed during vulcanizing.

3.2.1.3. The Relief Market

Located along Egbu road by God is good motors bus terminal Owerri, relief as popularly called is a commercial center for buying and selling of different kinds of food items, vegetables, fruits, fishes, meats including chicken, turkey, cow and goat both in wholesale and retail quantities. Life chicken, turkey and goat are sold as well in the market. As the name implies, it is structured to relieve the dwellers of Owerri the stress of congestion and difficulties of trying to get a

particular market for food items and other edibles, where they can exchange goods and services for money in an environment that not only ensure enhanced economic growth but ensure protection of life in healthy trading environment. But unfortunately, a visit to the market entrance gate alone will welcome one with escalation of offensive odour, stench and heaps of dump which will raise the level of conviction that there is urgent need to assess the solid waste management in the market with a view of highlighting the factors militating against effective and efficient solid waste management in the market, a reviewing the management strategies and making best recommendation on more proactive, effective and efficient solid waste management that will not only protect life, prevent diseases and injuries but ensure sustainable healthy trading environment. Common solid wastes generated within the market on daily bases include spoilt fruits, vegetables, fishes, meats, cartons, bottles, cans, rubber, sachet water nylon, polythene bags, plastics, ceramics, rags, papers, bones, feathers and colons of slaughtered chicken and turkey, faeces and clothed blood of slaughtered animals, damaged knife and woods. The common means of transporting solid waste generated in the market from point of generation to designated point of collection prior to evacuation is with the aid of wheel barrow and wheel truck which often times were also used to carry meats, fruits like apple and food items without thorough washing. Poor structural design and lack of adherence to architectural design of the market in building stores and indiscriminate raising of shanties within the market make it difficult for evacuator/truck to move into the market as promptly evacuate generated waste. Poor funding and lack of

adequate management personnel play role in determining the success.

3.3 Study Population

There were total of six hundred and nine (609) shops including 126 at Owerri main market, 95 at new market and 388 at relief market out of which three hundred and seventy (370) adult male and female traders above 18years selling at selected shops in the selected markets in Owerri Imo State were sampled. Allocation of selected sampled study population (shops) in the selected markets includes:

1. Owerri Main Market – Ninety six shops (96)
2. The New Market Owerri – seventy-seven shops (77)
3. The Relief Market Owerri – one hundred and ninety-seven shops (197)

Total sample size of 370.

3.4 Sample Size and Sampling Method

3.4.1 Sample Size

Sample size of 370 markets traders were randomly selected from the study population. The sample size was determined at 95% confidence level using the Taro Yammane sample size formula.

Thus:

$n = \frac{N}{1+N(e^2)}$ (Yammane, 1967). Where n=sample size required, N= number of market traders in each market, e=0.05 allowable error. Substituting for the numbers in formula:

Taro Yammane, method used n= N (Yammane, 1967). N = sample size required, N = number of market traders in each market, e=0.05 allowable error.

Owerri Main Market $n = \frac{126}{1+126(0.05)^2} = \frac{126}{1.315} = 96$

New Market Owerri: $n = \frac{95}{1+95(0.05)^2} = \frac{95}{1.2375} = 77$

The Relief Market Owerri: $n = \frac{388}{1+388(0.05)^2} = \frac{388}{1.97} = 197$

The Total sample size n =96+77+197 = 370

3.4.2 Sampling Method

Simple random sampling technique was used; selections were performed using the number of available shops at each market from the market masters registers the shops were divided by the number of block lines at each market .Using computer random number system, the included shops were randomly selected from each block line. Only one person (the shop owner or the most available senior person in the shop) was chosen per selected shop at situations where some selected shops refused participation, the shops were randomly replaced using sampling without replacement mechanism to avoid selecting an already visited shop. The process continued until the required sample size was obtained at each market of study.

3.5 Instruments for Data Collection

The instruments used for data collection were structured questionnaire and observational checklist.

A. The Questionnaire

The questionnaire (Appendix A) was modified with the help of supervisor in line with the specific objectives and constructed in an open and closed ended

manner. It has four sections; the first section assessed the socio-demographic characteristics of the respondents. The second section assessed the respondents' types of goods sold and activities carried out in the market. The third section examined the type of solid waste generated and method of handling/disposing. The fourth section assesses the respondent's participation in the general sanitation/clean - up exercise at the selected shops in the selected market.

B. Observational Checklist

The observational checklist (Appendix B) was modified with the help of supervisor in line with the specific objectives and was structured in an open-ended manner with eight variables to look-out for at selected shops in the selected markets with the aim of having indebt knowledge of the topic of discourse. The eight variables include:

- The litter container of the respondents at the selected shops in the selected markets.
- Garbage bag used in wrapping solid waste for disposal at the selected shops in the selected markets.
- Tools used in participating in the general environmental sanitation (clean-up) at the selected shops in the selected markets.
- Approved site for waste collection at the selected shops in the selected markets.
- Solid waste collection containers at the selected shops in the selected markets.

- ❖ Vehicle, wheelbarrows or pushing trucks used in transporting waste to the point of collection.
- ❖ Documents showing the legislation guarding solid waste management and penalties against defaulters.
- ❖ Records and proofs showing participation of market members in periodic sanitation exercise.

3.6 Validity of Instrument

The instrument was validated via face validity. The questionnaire and observational checklist were constructed with relevance to the topic, corrections were made by the thesis supervisor and final draft printed for the study.

3.7 Reliability of the Instrument

Parallel form reliability method was used to test the questionnaire. Two sets of the questionnaire of equivalent contents were offered to10 respondents in a similar population at the same time. Five was given to group A and the other five to group B. The two sets were retrieved and their results ranked. Spearman's rank co-relation method was performed and correlation of 80% obtained, which confirmed the instrument reliable.

3.8 Data Collection

3.8.1 Questionnaire Administration

Before the study started, the researcher and two research assistants (a Ph.D and MPH) paid courtesy visits to market masters and market union presidents to explain the aim and benefits of the study to them, and subsequently obtained their consents before the commencement of questionnaire

administration. The literate ones among them were allowed to fill the questionnaires themselves while for the non-literate ones, the questions was asked in the local dialects and their answers filled by the research assistants.

3.8.2Observational Checklist

The observational checklist was filled by the researcher. The assistance of the market authorities were explored where necessary.

Once the researcher sighted and affirmed the availability of waste management equipment or documents which are variables of interest in the study, the researcher ticks it in the observation checklist as being available.

3.9 Statistical Analysis

Descriptive method of data analysis was used to summarize the data characteristics. Frequency distribution tables were constructed to present the response on each variable and data expressed in percentage. Rating of solid waste management was done as listed out in the observation checklist and data presented in percentage.

3.10 Ethical Considerations /Informed Consent

This study was approved by:

i. FUTO School of Health Technology local ethical committee,

ii. Verbal informed consent was obtained from all the participants and market union members before being allowed to participate in the study.

CHAPTER FOUR

4.0 Results

4.1 Demographic Characteristics of Study Participants

There were a total of 370 that participated in this study of which up to half (197: 53.2%), were recruited from Relief market and slightly above one quarter (96: 25.9%) were obtained from Douglas Road/Owerri main market. The remaining (77: 20%) were from Owerri New Market.

The demographic characteristics of study participants are presented on Table 1. Their average (mean) age is 38.5 years at a corresponding standard deviation (sdev) of 5.9 years. The largest numbers of participants were the 3 1 - 4 0 years old (88: 23.8%) followed by the 21-30 years (74: 20.0%). Males were in all 220 (59.5%) while females were 150 (40.5%). Many of the participants were married (168: 45.4%) and 108 (29.2%) were singles. About half (186: 50.3%) had secondary education, 74 (20.0%) had tertiary education while 40 (10.8%) had no formal education.

Clear majority (270: 73%) were Christians while Islam, and the traditional religion were 62 (16.8%) and 38 (10.3%) respectively. Close to half (166: 44.9) were operating in a half shop while close to one quarter operate in an open space within the market premises. The goods dealt with in the markets include food items (27.3%), textile (24.3%), stationeries (23.8%), and others.

Table 1: Demographic Characteristics of Study Participants Demographic

Characteristics Frequency (n= 370) Percent (%)

Age (mean:38.5, sdev: 5.9)

Below 21	**50**	**13.5**
21-30	74	20.0
31-40	88	23.8
41-50	64	17.3
51-60	50	13.5
61 +	44	1.1.9
Sex		
Male	220	59.5
Female	150	40.5
Marital status		
Married	168	45.4
Single	108	29.2
Divorced	22	5.9
Widowed	26	7.0
Separated	46	12.4
Education Attained		
Primary	70	18.9
Secondary	186	50.3

Tertiary '	74	20.0
Non formal	40	10.8
Religion		
Christianity	270	73.0
Islam	62	16.8
Traditional	38	10.3
Market Involved		
Douglas Rd/Main Market	96	25.9
New Market	77	20.8
Relief Market	197	53.2
Shop/ business type		
Full shop/shops	74	20.0
Half Shop	166	44.9
Outside/Open place	92	24.9
Kiosk	38	10.3
Nature of business		
Food Items	101	27.3
Textile	90	24.3
Stationeries	88	23.8
Polymers	17	4.6
Electrical and Electronics Equipment	58	15.7
Others	**16**	**4.3**

4.2 Characteristics of Solid Waste Generated at the selected shops in selected markets

The characteristics of solid wastes generated at the selected shops in the selected markets were presented on Table 4.2. In the overall, the most generated waste found is the plastic waste (86.5%) including used pure water sachet waste and used waterproofs. Following were spoilt food waste (69%), spoilt drug and cosmetic waste (37.3%).

Plastic waste including sachet and waterproof waste was highest in the Douglas road or Owerri main market (94.8%), and it also remained very high in the other two markets at 83.1% and 83.8% respectively for \new market and Relief Market. On the other hand, food waste was highest in the Relief market (78.7%) followed by the Douglas road Main market (70.8%). Automobile waste materials were found mostly at the Owerri New market (72.7%).

Table 2: Characteristics of solid waste generated in the studied markets

Solid waste generated	Douglas Rd/Main Market (n=96)	New Market (n-77)	Relief Market (n=197)	Total (n=370)
Food waste	68(770.8)	35(45.5)	145(78.7)	258(69.7)
Spoilt drugs, cosmetics	69(71.9)	17(22.1)	52(26.4)	138(37.3)
Textile waste	53(55.2)	19(24.7)	54(227.4)	126(34.1)
Waste of electrical and electronic	43(44.8)	33(42.9)	24(12.2)	1000(27.0)
Equipment automobile waste	8(8.3)	56(72.7)	4(2.0)	68(18.4)
Plastic waste	91(94.8)	64(83.1)	165(83.8)	320(86.5)
Others	16(16.7)	7(9.1)	27(13.7)	50(39.5)

Multi responses allowed

According to the table 2 above in line with specific objectives, the study shows that the most generated waste found is the plastic waste (86.5%) including used pure water sachet waste and used waterproofs. next were spoilt food waste (69%),spoilt drug and cosmetic waste (37.3%). Plastic waste including sachet and waterproof waste was highest in the Douglas road or Owerri main market (94.8%),

and it also remained very high in the other two markets at 83.1% and 83.8% respectively for new market and Relief Market. On the other hand, food waste was highest in the Relief market (78.7%) followed by the Douglas road Main market (70.8%). Automobile waste materials were found mostly at the Owerri New market (72.7%).

4.3 Methods of Handling Solid Waste Generated at the selected shops in the selected Markets

4.3.1 Solid Waste Collection

On Table 4.3, more than half (50.5%) of the waste in selected markets in Owerri are collected with nylon or polybag (44.8% in Douglas Rd/Main Market, 48.1% in New Market and 54.3% in Relief Market), while 34.1% were collected from dustbin (30.2% in Douglas Rd/Main Market, 40.3% in New Market and 33.5% in Relief Market). There were up to 8.1% solid waste that are refuse heap outside the shops (13.5% in Douglas Rd/Main Market, 6.0% in New Market and 6.1% in Relief Market).

Table 3: Solid Waste Collection at the selected shops in the selected Markets

Solid Waste Collection	Douglas Rd/Main market (n=96)	New Market (n-77)	Relief Market (n=197)	Total (n=370)
Dustbin	29(30.2)4	31(40.3)	66(33.5)	126(34.1)
Polybag (Nylon)	3(44.8)	37(48.1)	107(54.3)	187(50.5)
	7(7.3)	4(5.2)	8(4.1)	19(5.1)

	13(13.5)	5(6.0)	12(6.1)	30(8.1)
Others	**4(4.2)**	**0(0.0)**	**4(2.0)**	**(2.2)**

Table 4: How Solid Waste Materials are packaged before disposal at the selected shops in the selected markets

Table 4 contained how solid waste materials are package before disposal at the studied markets. Over half (50.8%) of the solid waste materials comprising of 51.0% in Douglas Rd/Main Market, 46.8% in New Market and 52.3% in Relief Market are stored altogether in a nylon bag without segregation. Also, 28.4% (29.2% in Douglas Rd/Main Market, 9.1% in New Market and 35.5% in Relief Market) store all in waste bin. Only 7.8% in all separate the solid waste materials in different nylon bags before putting inside waste bin. This practice was highest at New market at 16.9%.

Solid Waste Collection	Douglas Rd/Main Market (n=96)	New Market (n-77)	Relief Market (n=197)	Total (n=370)

Separate & store in difference nylon bags	15(15.6)	21(27.3)	12(6.1)	48(13.0)
Store all together in nylon bag	49(51.0)	36(46.8)	103(52.3)	188(50.8)
Store all in waste bin	28(29.2)	7(9.1)	70(35.5)	105(28.4)
Separate them in different nylon bags and store inside waste bin	4(4.2)	13(16.9)	12(6.1)	29(7.8)

4.3.3 Solid Waste Disposal Pattern at the Selected shops in the selected Markets

The responses for solid waste methods of disposal are displayed on Table 4. 5. Many (40.3%) of the solid waste generated in the studied Owerri markets are burned within the market premises, with up to 36.8% usually dumped in one place in the market. Those who responded that the waste are removed through waste collectors were 50 (13.5%), while another 29 (7.8) responded that the solid wastes are usually dumped anywhere in the market.

Table 5: Solid Waste Method of Disposal at the selected shops in the selected markets

Disposal Pattern	Douglas Rd/Main Market (n=96)	New Market (n-77)	Relief Market (n=197)	Total (n=370)

Removed through waste collectors	10(10.4)	4(5.2)	36(18.3)	50(13.5)
Dumped anywhere in the market	10(10.4)	4(5.2)	15.7.6)	229(7.8)
Dumped in one place in the market	40(41.7)	31(40.3)	65(33.0	136(36.8)
Burned within the market premises	36(37.5)	35(45.5)	78(39.6)	149(40.3)
Recycled	0(0.0)	3.(3.9)	3.(1.5)	6(1.6)

4.6 Frequency of Solid Waste Refuse Dump Removal at the selected shops in the Selected Markets

The frequency of solid waste refuse dump removal at the studied markets was such that only 8.6% comprising of 10.4% at Douglas road main market, 2.6% at New market and 10.2% at relief market, responded that solid waste refuse dumps are disposed daily in the markets. Those who responded for weekly disposal were 42.2% (highest with 52.1% at Douglas road main market), while 11.9% (13.5% at Douglas road main market), and 28.4% (37.7% at New market), respectively responded that they are disposed once in a fortnight (2 weeks) and once in a month (Figure 4.1).

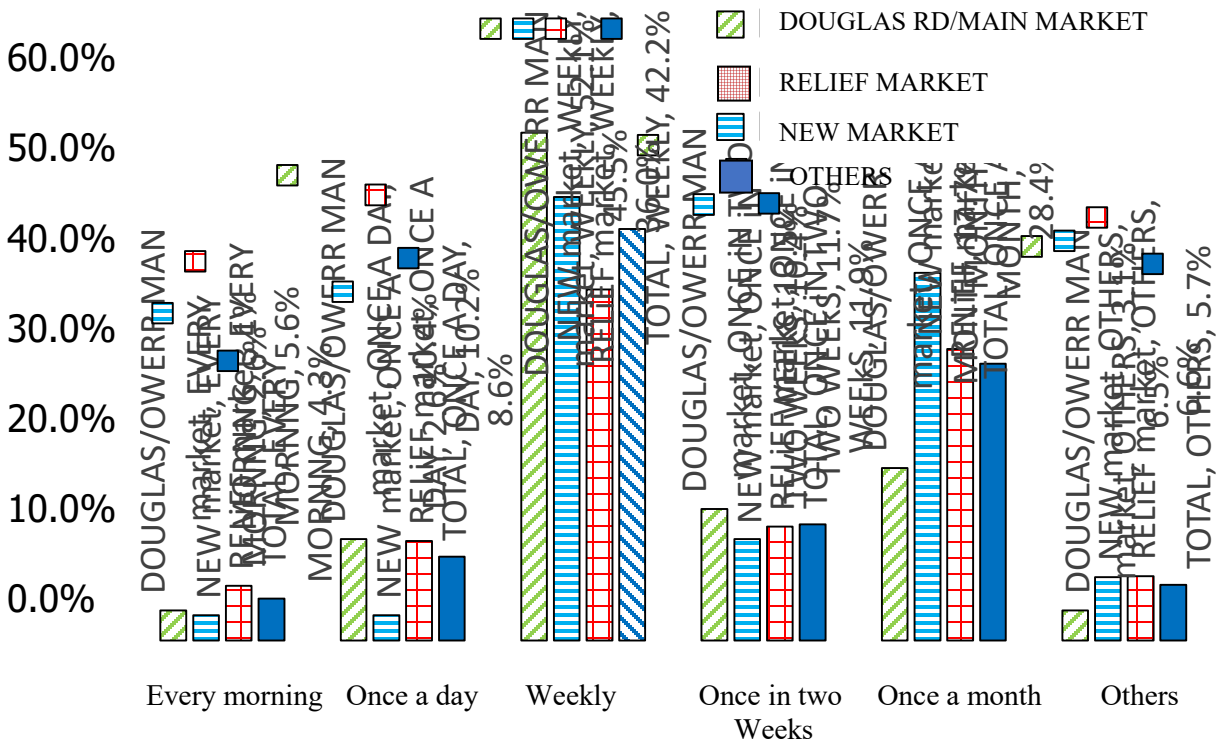

Figure 4.1: Frequency of Solid Waste Refuse Dump Removal at selected shops in the selected Markets

Table 7: Organs responsible for solid waste disposal and the level of government involvement at the selected shops in the selected Markets

On Table 4.6, the government has up to 75.7% responsibility for solid waste disposal in the studied Owerri markets. Others include 14.6% for market volunteer or other volunteers,

5.4% for market union leaders, 2.7% for Non-Governmental Organisations and 1.6% for other Non-Governmental agencies.

Table 7: Organs of Solid Waste Disposal and the Level of Government Involvement in the selected Markets in Owerri

Organs of Waste Disposal	Frequency	%
Government	280	75.7 14.6
Market Volunteer or other Volunteer	54	1.6
Volunteer		
Market union Leaders	20	5.4
Non-Governmental Organization	10	2.7
Non-Governmental Agency	6	1.6

4.8 Rating for Solid Waste Management at the selected shops in the selected Markets

The Solid Waste Management level at the selected shops in the Selected Markets were carried out by the researcher from responses from the respondents, overwhelmingly (90.3%) rated not satisfactory by the studied group. In the main market (Douglas Road), only 10.4% rated the solid waste management as satisfactory. Similar poor ratings were obtained at new market and relief market with lowest rating obtained at the relief market (New market: 13.0%; Relief market: 8.1%).

Table 8: Rating for Solid Waste Management at the selected shops in the selected Markets

Disposal Pattern Rating	Douglas Rd/Main Market (n =96)	New Market (n =77)	Relief Market (n=197)	Total (n=370)
Satisfactory	10 (10.4)	10 (13.0)	16 (8.1)	36(9.7)
Not Satisfactory	86 (89.6)	67 (87.0)	181 (91.9)	334 (90.3)

CHAPTER FIVE

5.0 Discussion, Conclusion and Recommendation

Discussion

From the study it was seen that the most generated water was plastic water including pure water sachets and water proof "waste (86.5%) in Owerri main market. In our environments, today nylon sachets has been the predominant waste, this is because of the indiscriminate dumping of empty sachets of nylon used in packaging drinking water by consumers. Also nylon sacks is commonly used for packaging goods in our markets, this have contributed greatly in the composition of water generated. This is finding is inline with the research by Mugo (2017) which found plastic bags to be the predominant waste (65%) in a market in Kenya. Also Mochache, Yogon and Wakindki (2020) in their study reported plastic waste as the predominant waste composition in a study of market town household solid waste management in Kenya. In contrast to the finding of this study, Tanko and Sawyer (2018) reported kitchen waste to be the predominant solid waste generated in Kaduna metropolis and as such incriminated it to be responsible for air pollution in Kaduna metropolis since the waste are organic and biodegradable. The study by tanko and Sawyer (2018) have been supported by previous study by Anyanwu and Adefila (2014) which reported food waste as the most generated solid waste in Kabru, Nasarawa State. The discrepancy in the nature of waste in this study and those in Kaduna and Nasarawa states respectively was due the settings of the study. This study was carried out in the markets as opposed to households as seen in the study in Kaduna and Nasarawa respectively. It is therefore expected

that, the nature of the predominant waste materials be plastic wastes. It is also evident in the outcome of physical inspection of the dump sites in the markets that most of the solid waste materials seen were nylon sachets and sacks. These sachets have been responsible for blocking of drainages and water ways in the markets. The second most dominant waste material reported in this study was food waste (69.7%). Food waste resulted from spoilt food materials sold in the markets. Food waste is organic and biodegradable as a result, responsible for the awful spell in the market places. The smell and dirty environments resulting from food spoilage is characteristic in the relief market were vegetables, meats, fruits and other organic food stuffs are sold. Furthermore Automobile (72.7%) and electronic waste (42.9%) were (42.9%) found to be dominant in the new market. New market Owerri has always be known to be the commercial centre for automobile spare parts sales & repairs and electronic sales &repair. It is therefore, characteristic of the market to produce metal scraps resulting from automobile and electronic repairs. The dominant means of waste collection in the market was with nylon (poly bag). The proportion of solid waste collected with nylon(poly bags) within the selected markets were, Owerri main market 44.8%, new market 48.1% and relief market 54.3%. These findings are in line with previous studies by Oyelola and Babatunde (2008) which reported that some households in Lagos metropolice store solid waste with plastic (nylon) sacks. They also reported that market waste generated by restaurants and cafeteria classified as organic waste were stores and collected with nylon and plastic sacks (Oyelola and Babatunde, 2008)

This study further reported some stall traders using waste bin/dust bin to collect and store waste. It was seen as the second dominant method after nylon. Anyanwu

and Adefila (2014) also reported collection and storage of waste with dust bin in some parts of Nasarawa State. Contrary to using nylon/plastic sacks or dustbin, some methods were also observed in the markets, these methods were dumping refuse heap in the stalls and outside the store and cleaning them later. Physical inspection of these methods noted that, these methods are more practiced in Owerri main market and relief market respectively. Sometime these heaps of dustbin are not cleaned immediately or the whole day. These have been reported to be the attraction of rodents and insects pests (Udoh and Inyang, 2016). It is evident in some studies that rat infestation in market stalls is mainly because of poor waste management (Udoh and Inyang, 2016, Usman and Kumar, 2015) as seen in Owerri main market and relief markets, where physical heap of organic waste matters are dumped awaiting evacuation by relevant authorities. These has led to economic loss due to activities of pest and most times these pests pose thereat to the health of consumers who are the final users of the products. The most dominant method of waste disposal in the selected market was open burning within the market premises 40.3%. This method have been reported in other previous studies to be the most common method of disposing waste not only in the market but also in the neighborhoods (Uwadiegwu, 2013). Respondent's reasons focusing these methods have been the ease and affordability in managing their generated solid waste. Dumping waste in one place in the market is another common practice seen in Owerri main market and new market, 41.7% and 40.3% respectively. Several other studies have also reported open dumping as a common waste disposal method in some states in the country. Similar to the reasons given by respondents in the selected markets, after dumping in one place within the

markets, state waste management Authorities come often to evacuate the heap of dumped waste. These heaps of waste generated are mostly seen where government authorized dumping of waste including in the market places. The disadvantages with the heap of waste have been the encouragement of pest and vectors of diseases in the market premises, emission of offensive odour and degrading the aesthetic value of the environment. Physical inspections of where the heaps are located in the market places shown that, whenever the waste management authorities fail to evacuate the waste generated, the market authorities resort to burning of the waste heaps resulting to a devastating air pollution in the market atmosphere. Few traders that have reported disposing their waste through waste collectors, only did that to evacuate their waste from their shops after which the collectors dispose the waste at the central dumping place which either will be evacuated by waste management authorizes or burnt by the market authorities. However, there are proportions of the traders that reported to recycle their waste in New market (3.9%) and relief markets (1.5%). During inspection at the new market for physical observation, recycled waste seen were old automobile vehicle batteries, iron scraps and metal containers which are being scouted by agents of dealers on used items and scraps. Also inspection at the relief market for physical observation of recycled waste, shown different types of waste collected for recycling. These waste were plastic bottles and containers, which were being collected and used t orepackage products like palm oil, kerosene and most often locally produced beverages known as zobo or kwunu. Other recyclable wastes were empty cartons, papers, used baskets of tomatoes and empty sacks of grain.The commonly reported frequency at which waste refuse dumps are evacuated at the

selected market were weekly 92.2% and monthly 28.4%. The generation of waste in these markets was influenced by the increment on the number of people trading in the market. The findings of this study is in line with the finding of previous study by Oderinde (2020) which reported 59.5% most prevalent weekly evacuation of waste in some selected zones in Nigeria. Also, Tanko and Sawyer (2018), in their study in Kaduna State reported weekly evacuation of solid waste at dumpsites. Respondents in the market further stated that, although there was scheduled time for evacuation, often times the waste collection containers get filled and most times waste litter on the floor, before the next scheduled date for evacuation. Littered waste as a result of over filled collection containers have reported to be the cause of drainage blockages and in some places where the containers kept on the road are the cause of traffic (Rigasa, Abdulkarim, and Badamasi, 2015). Such traffic scenes have been reported by traders in Owerri main market along Douglas road, and also in the relief market along one of the major entrances. This study reported that Imo State government has the major responsibility of evacuating waste at dumpsite 75.7%. Other studies have also incriminated governments as being responsible for removing waste (Saghir, and Santoro, 2018). This has made government a major key player in the management of solid waste. Government roles in the management of solid waste include designating points of collection, transportation either to transfer to loading station where sorting is done or to the incinerating facilities, sanitary landfill or the final disposal points (Saghir, and Santoro, 2018). For the role of government to be effective and efficient, there must be enough and well maintained equipments such as trucks, tippers, pay loaders, bulldozers, compactors etc. Adewole (2009) has reported solid waste collection, transportation and disposal epileptic. Such

scenario has been seen in the disposal of solid waste in the selected market, thereby reporting negligence on the side of the government. Other major organs reported by the respondents to be involved in waste disposal in the selected markets were volunteers 14.6% and market union leaders 5.4%. Market volunteers are people who voluntarily opted to help in cleaning the environment during sanitation days. In some places, it is mandatory that occupants of buildings participate in the monthly sanitation exercise in the locality. Also, the role of market union leaders are to be funding the sanitation exercise and ensure that collected waste refuse are taken to the collection points. The rating of the solid waste management in the selected market is very not satisfactory (90.3%). This could be as a result of inefficiency on the part of Government as the main role player resulting from inadequate number of vehicles, lack of spare parts, dearth of fund, poor technical know-how, poor maintenance practices, insufficient funding and lack of motivation. These have bedeviled the agency responsible for disposal and collection of waste (Adewole, 2009). Sometimes the blames for low rating are shifted to the side of other side of the organ responsible for waste management in the markets. For instance sometime people may not volunteer for the sanitation exercise or not mandated where applicable. This negligence attitude leaves the market waste unattended causing awfully smelling unpleasant environments and dumpsites in the markets.

Conclusion

The study assessed the solid waste management at the selected shops in the selected markets in Owerri, Imo state. It was assessed that the managements of solid waste at the selected shops in the studied markets were poor with very low

rating. Negligence of solid waste management authorities to evacuating solid waste at collection centres in the respective markets have left the sites unbearable to behold. Some market authorities have resorted to burning of solid waste at collection centres to reduce the mounting of heap of solid waste at the location, this in turn cause a devastating air pollution within the market.

Recommendations

Against the backdrops resulting from the findings of this study, it is therefore necessary to recommend that:

1. Sanitation exercise be made mandatory for every shop trading within the selected markets.
2. Market authorities be given access to alert waste management authorities promptly for evacuation of filled collection containers within the selected markets.
3. Environmental regulations be strengthened within the selected markets to guide against indiscriminant dumping of solid waste.
4. Task force team to be empowered to sanction defaulters of the regulations.

REFERENCES

Adewole A. T (2009): Waste management towards sustainable development in Nigeria: A case study of Lagos state. International NGO Journal Vol. 4 (4), pp. 173-179.

Agunwamba, J. C (2003): Environmental Assessment Analysis of Scavengers; Activities and Recycling in Some Cities of Nigeria. In: Journal of Environmental Management, Vol. 32, No. 1, pp. 116-127, Springer-Verlag New York Inc.

Albert, R (2011): The Proper Care and Use of a Garbage Disposal. *Disposal Mag*

Aliyu, A. A., & Amadu, L. (2017). Urbanization, cities, and health: The challenges to Nigeria - A review. *Annals*

Amasuomo, E., & Baird, J. (2016). Solid Waste Management Trends in Nigeria. *Journal of Management and Sustainability,* 6(4), 35-44. https://doi.org/10.5539/jms.v6n4p35.

Anestina, A., Adetola, A., & Irhivben, B. (2014). Performance Assessment of Solid Waste Management following Private Partnership Operations in Lagos State, Nigeria. *Journal of Waste Management.* 1-8.

Anifowose, Y. B., Omole, K. E., & Akingbade, O. (2011). Waste Disposal Site Selection using Remote Sensing and GIS: A Study of Akure and its Environs, Southwest-Nigeria. *Proceedings of the Environmental Management Conference, Federal University of Agriculture, Abeokuta, Nigeria* (pp. 2-9). Abeokuta: Federal University of Agriculture, Abeokuta.

Asim, M., Batool, S., Chaudhry, M. (2012): Scavengers and their role in the recycling of waste in South Western Lahore. In: Journal of Resource, Conservation and Recycling 58, 152-162.

Awosusi, A. (2010): Assessment of environmental problems and methods of waste management in Ado-Ekiti, Nigeria. In: Journal of African Research Review, Vol. 4 No. 3b, pp. 331-343.

Bakare, W. (2020). Solid Waste Management in Nigeria. Retrieved March 31, 2020, from https://www.bioenergyconsult.com/solid-waste-nigeria/

Charles C. N. (2015): Status of municipal solid waste generation and disposal in Nigeria. In: Management of Environmental Quality: An International Journal, Vol. 26 Iss. 1 pp. 53 - 71. http://dx.doi.org/10.1108/MEQ-08-2013-0092.

George, O. (2010). Social effects of poor sanitation and waste management on poor urban communities: a neighbourhood- specific study of Sabon Zongo, Accra. *Journal of Urbanism: International Research on Place making and Urban Sustainability,* 3:2, 145-160,DOI: 10.1080/17549175.2010.502001https://www.bioenergyconsult.com/solid-waste-nigeria/https://www. worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management.

Ike C. C., C. C. Ezeibe, S. C. Anijiofor, N. N. Nik Daud (2018): Solid waste management in Nigeria: problems, prospects, and policies. In: Journal of Solid Waste Technology and Management volume 44, No.
2.

Imam, A., Mohammed, B., Wilson, D. C., & Cheeseman, C. R. (2008). Solid waste management in Abuja, Nigeria. *Waste Management,*28(2),468-472.https:/ /doi.org/ 10.1016/j.wasman.2007.01.006.

Imo state government (2010): About Imo state. Imo state, Nigeria. Imo government.

Kumar, S; Dhar, H; Nair, V. V.; Bhattacharyya, J. K.; Vaidya, A. N.; Akolkar, A. B. (2016). "Characterization of municipal solid waste inhigh-altitude sub-tropical regions". *Environmental Technology*. 37 (20):2627 2637. doi: 10.1080/09593330.2016.1158322

Matter, A., Dietschi, M., Zurbriigg, C. (2013): Improving the informal recycling sector through segregation of waste in the household: The case of Dhaka Bangladesh. In: Journal of Habitat International 38, 150-156.

Mazhindu, E., Gumbo, T., & Gondo, T. (2012). Waste Management Threats to Human Health and Urban Aquatic Habitats - A Case Study of Addis Ababa, Ethiopia, *Waste Management - An Integrated Vision,* Intech Open, DOI: 10.5772/48077. Available from: https://www.intechopen.com/books/waste-management-anintegrated vision/waste-management-threats-to-hurnan-health-and-urban-aquatic-habitats-a-case-study-of-addisababa-ethiNational Bureau of Statistics. (2018). *Demographic Statistics Bulletin* (p. 7). Abuja, FCT: National Bureau of Statistics.

National Environmental Standards and Regulations Enforcement Agency. (2007). National Environmental Standards and Regulations Enforcement Agency (Establishment) Act. Retrieved March 31, 2020, from http://extwprlegsl.fao.org/docs/pdf/nigl20569.pdf

National Population Commission (NPC, 2017). 2017 Primary Health Care, priority tables, *population.gov.ng*

Odorinde D. (2020) Characterization of collection and recycling systems for packaging and food waste in Nigeria. Msc. Thesis submitted to the department of Engineering. FH Campus Wien

Ogboi, E. and Kperegbeyi, J. I. (2009): Waste generation and its environmental consequences in Ika urban and rural environs of Delta State Nigeria, Bioscience Research Communications, vol. 21, no. 5, pp. 229-236.

Oguntoyinbo O. (2012): Informal waste management system in Nigeria and barriers to an inclusive modern waste management system: A review. In: Journal of Public health 126, 441- 447.

Ogwueleka, T. C. (2009b). Municipal solid waste characteristics and management in Nigeria. *Iranian Journal of Environmental Health Science &, Engineering,* 6(3), 173-180.

Olukanni D; Anne Aipoh O.; Inibraniye H. (2018): Recycling and Reuse Technology: Waste to Wealth Initiative in a Private Tertiary Institution, Nigeria. In: MDPI Recycling Journal 3, 44; doi: 10.3390/recycling3030044.

Olusunkanmi Akoni (2014): Lagos generates 12,000 tonnes of garbage daily. Vanguard Publishing house. Available online at: https://www. vanguardngr.com/ 2014/07/lagos-generates-12000-tormes-garbage-daily/.

Onu Benefit, Trevor Price, Suresh S., Samuel Ebie (2012): Solid waste management: A critique of Nigeria's Waste Management Policy. In: The international Journal of knowledge, culture and change management. Volume 11. ISSN 1447-9524. Owd. publication/ 18041l_.Saghir_UrbanizationAfrica_Web.pdf?o02H MOfqh99KtXG60bTacIKKmRvkO

Rigasa, Y. A., Abdulkarim, B. I., Badamasi, A. G. (2015). Waste management services: A strategy for the integration of 'Almajiri' into current waste management action plans of urban centres in northern Nigeria. *Biological and Environmental Sciences Journal for the Tropics,* 12(1), pp 558-565.

Saghir, J.,&Santoro, J. (2018). *Urbanization in Sub-Saharan Africa:Meeting Challenges by Bridging Stakeholders.* Retrieved from https://csis-prod.s3.amazonaws.com/s3fspublic/

Schmidt C.O and Kohlmann, T (2008). When to use the odds ratio or the relative risk. *International journal of public health. 53 (3): 165*-167.doi.-10.1007/s00038-008-7068-3

Singh, R. P., Singh, P., Arouja, A. S. F., Ibrahim, M. H., &Sulaiman, O. (2011). Management of Urban Solid Waste: Vermincomposting a sustainable option. *Resource. Conserv. Recycl. 55,* 719-729.

Solomon, U. U. (2009). The state of solid waste management in Nigeria. *WasteManagement,*29(10),2787-2788. https://doi.org/10.1016/j.wasman.2009.06.030

State of Vermont Agency of Natural Resources Department of Environmental Conservation. (2012). *Solid Waste Management Rules*(8thEd.,Vol.1). RetrievedfromHttps://Dec. Vermont.gov/sites/dec/files/wmp/SolidWaste/Docum ents / SWRule. fmal_. Pelf

The World Bank. (2019). *Solid Waste Management.* Retrieved from Vanguard, Nigeria (2015): Exploring the resource control option-Imo state, vanguard.com

Udoh, I. B., & Inyang, S. A. (2016). Purview of Public Solid Waste Collection , Disposal and Management

Practices in Akwa Iborn State. *International Research Journal of Environmental Sciences,* 5(7), 55-63.

United Nations Environmental Programme (2013). *Guidelines for National Waste Management Strategies Moving from Challenges to Opportunities . United Nations Environmental Programme*

United Nations Statistics Division (2017) Environment Statistics", *unstats.un.org.*

U.S. Energy Information Administration (2010): Municipal Solid Waste. U.S. Energy Information Administration

Usman, A. A., & Kumar, M. (2015). Site suitability analysis for waste disposal in Kano Metropolis, Nigeria (Using multi-criteria evaluation, AHP, and GIS techniques). International Journal of Scientific & Engineering Research, 6(11), 1072-1081.

Uwadiegwu, B. O. (2013). Strategies for Effective Urban Solid Waste Management in Nigeria. *European Scientific Journal, 9(8),* 296-308.

Welsh Assembly (2005) Mechanical Biological Treatment, Environment Countryside and Planning Website, Welsh Assembly

Wilson, D., Velis, C., Cheeseman, C. (2006): Role of informal sector recycling in waste management in developing countries. Habitat International 30, 797-808.

World Bank (2012): What a Waste: A global review of solid waste management. Available online at http://www.worldbank.org. Last accessed 12.05.2014.

APPENDIX A

Approval Letter

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF HEALTH TECHNOLOGY
DEPARTMENT OF PUBLIC HEALTH

P.M. B. 1526
OWERRI - NIGERIA
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VICE-CHANCELLOR: PROF. Francis Chukwuemeka Eze, KSJI.
B.Sc. (Nig.), M.Sc. (Dundee), Ph.D. (Nig.), FSESN, FNIP, FIIAN

Dean: Prof. I. N. S. Dozie, B.Sc., M.Sc. (Nig.) Ph.D (Jos)
Head of Department: Rev. Sr. (Prof.) E. T. Oparaocha, B.Sc. (UST), PGDE, M.Sc. Ph.D (Ibadan), Cert. REthics; Ind. Hyg. (Harvard).

OUR REF: FUT/SOHT/PHT/CS.006/VOL.1 **Date:** October 27, 2016

YOUR REF:

TO WHOM IT MAY CONCERN

Sir,

LETTER OF INTRODUCTION

The bearer **Nwaobi Alexander Okechukwu** with Reg. No.20144918058 is an MPH Student of the Department of Public Health. As part of requirements for graduation, every student is required to carry out a well articulated research.

Accordingly, **Nwaobi Alexander Okechukwu** is seeking to carry out his research on the the topic "Assessment of solid waste management at the selected shops in selected markets in Owerri

We would appreciate your kind assistance towards the realization of this compulsory requirement for his graduation.

Please give him the necessary assistance he requires for a successful programme.

HEAD OF DEPARTMENT PUBLIC HEALTH 27/10/16

Rev. Sr. Prof. E. T. Oparaocha
HOD, Public Health

APPENDIX B
QUESTIONNIARE

Assessment of Solid Waste Management at the selected Shops in the selected Markets in Owerri

Please read carefully and complete this questionnaire to the best of your knowledge, to reflect true status and position of solid waste management in this market, thereby contributing towards ensuring effective and efficient solid waste management

Kindly thick the right option [✓] and/or specify appropriately.....

SECTION A: ***BIODATA***

1. Gender (a) Male [ ] (b) Female [ ]
2. Marital Status (a) Single [ ] (b) Married [ ]
3. Age Range (years) (a) Below 21 [ ] (b) 21-30 [ ] (c) 31-40 [ ]
(d) 41-50 [ ] (e) 51-60 [ ] (f) 61 and above
4. Educational attainment (a) Informal [ ] (b) Primary [ ] (c) Secondary [ ]
(d) Tertiary [ ]
5. Are you a trader in Owerri? (a) Yes [ ] (b) No [ ]
6. If yes, in which of the markets (a) Owerri Main Market [ ] (b) New Market [ ]
(c) Relief Market [ ] (d) Others [ ] please specify.....

SECTION B: ***ACTIVITIES IN THE MARKET***

7. In what section of the market are you staying for your business?
(a) Zone 1 [ ] (b) Zone 2 [ ] (c) Zone 3 [ ]
8. How can you describe that place you are staying for you business? (a) Full shop/shops [ ] (b) Half Shop [ ] (c) Outside/Open place [ ] (d) Kiosk [ ]
9. What is the nature of your business? (a) Goods only [ ] (b) Services only [ ]
(c) Both Goods and Services [ ]
10. What type of goods and/or services do you deal on? (a) Food Items [ ]
(b) Textile [ ] (c) Stationeries [ ] (d) Polymers [ ] (e) Electrical and Electronics Equipment [ ] (F) Others [ ] Please specify.....

SECTION C: ***SOLID WASTE GENERATION AND STORAGE***

11. What category of Solid Materials do you discard in the market? (a) Spoilt food [ ] (b) Spoilt drugs, cosmetics and metals [ ] (c) Food items and fruits [ ]
(d) Waste of Electrical and Electronic equipment [ ] (e) Packaging materials [ ]
(f) Others [ ] Please specify.....
12. What category of solid waste materials is commonly discarded in the market? (a) Waste of Electrical and Electronic Equipment [ ] (b) Food Waste [ ]
(c) Automobile scraps and metals [ ] (d) Rubbish [ ] (e) others [ ] please specify.....
13. How do traders package such solid Waste materials before disposal in this market? (a) Separate & store in different nylon bags [ ] (b) Store all together

in nylon bags ☐ (c) Store all in waste bin ☐ (d) Separate them in different nylon bags & store inside waste bin ☐
(e) Others ☐ please specify.....

SECTION D: *SOLID WASTE COLLECTION AND DISPOSAL*

14. Are there government approved waste collection points in this Market?
(a) Yes ☐ (b) No ☐
15. If yes, rate their management (a) Satisfactory ☐ (b) Fair ☐ (c) Not Satisfactory ☐
16. Where do traders normally dump their solid Waste in this market?
(a) On the road side ☐ (b) Inside gutter ☐ (c) Inside approved collection point ☐ (d) Inside bush ☐ (e) others ☐ please specify.....
17. Whose responsibility is it to handle solid waste in this market?
(a) The individual ☐ (b) Government ☐ (c) Both
18. What are the methods of solid waste management in this market?
(a) Gathering the solid waste ☐ (b) Open dumping ☐ (c) Collection and transportation to final dumpsite ☐ (d) All of the above ☐
(e) None of the above ☐ please specify.....
19. Presently who is in charge of solid waste management in this market?
(a) Imo ENTRACO ☐ (b) VinPat Nigeria Ltd
(c) Imo state government (d) others ☐ please specify.....
20. Kindly rate their operation
(a) Satisfactory ☐ (b) Fair ☐ (c) Not satisfactory ☐
21. How do solid waste materials generated in the course of business get to general collection point? (a) Individuals dispose them ☐
(b) Hired labourers dispose them ☐ (c) Others ☐ Please specify.....
22. by which means? (a) Carrying them with hands to collection point ☐
(b) Using wheel barrow/truck ☐ (c) Both ☐ (d) others ☐ Please specify.....

SECTION E: *PERCEPTION ABOUT SOLID WASTE MANAGEMENT*

23. How does solid waste management affect the daily activities in the market?
(a) Affects sales ☐ (b) Affects customers' visitation ☐
(c) All of the above ☐ (d) none of the above ☐ please specify.....
24. How does it affect health of traders and the market environment at large? Could cause (a) Breeding site for flies, rodents and other disease agents ☐
(b) Disease outbreak ☐ (c) Odour ☐ (d) Blockage of gutters and other drainage systems ☐ (e) All of the above ☐
(f) None of the above ☐ please specify.....

SECTION F: ***PAST AND PRESENT REDUCTION EFFORTS***

25. Are there functional toilet facilities in this market?
(a) Yes ☐ (b) No ☐
26. If yes, rate their management (a) Satisfactory ☐ (b) Fair ☐
(c) Not satisfactory ☐
27. If no, what are the defecation and disposal methods practiced in the market?
(a) Defecating inside nylon bags and throwing them into waste bin/gutter/waste collection point ☐ (b) defecating in nearby bushes/gutter ☐ (c) Others ☐
please Specify.....
28. What are the measures put in place in the past to reduce solid waste in the markets? (a) Provision of galvanized metal dustbin at central collection point ☐
(b) Making of sanitation laws ☐ (c) Setting up of Taskforce committee ☐
(d) Introduction of mandatory general sanitation day ☐ (e) All of the above
(f) Some of the above ☐ please specify.....
29. What are the present efforts put in place to reduce solid waste to the least minimum level in the market? (a) Addition of more galvanized metal dustbin at central collection point(s) ☐ (b) Review of sanitation laws ☐ (c) Reshuffle of Membership of Taskforce committee ☐ (d) Sustenance of mandatory general sanitation day ☐ (e) All of the above ☐ (f) some of the above ☐
please specify.....
30. What are the general efforts made by government towards ensuring proper solid waste management in this market?
(a) Provision of waste bin, toilet facilities and prompt disposal of solid waste to final dump site ☐ (b) Mandating of its agency to carry out the task ☐ (c) Contracted it to private firm for effective and efficient management ☐ (d) Setting up committee to check the activities of people in charge of solid waste management in the market ☐ (e) All of the above ☐ (f) some of the above
please specify.....

SECTION G: ***WAY FORWARD***

31. What do you think Government should do to solve the problem of solid waste in this market in particular and other markets in Owerri?
(a) Increase awareness to raise consciousness ☐ (b) review sanitation laws ☐
(c) Overhaul its management strategies and committees to accommodate more innovative ideas and professionals respectively ☐
(d) Introduction of mobile waste collectors in the market ☐
(e) Engage professionals in key areas of solid waste management ☐
(f) Empowering appropriate taskforce to perform optimally ☐
(g) Specify the role of various stakeholders involved in solid waste management in the market ☐ (h) Hand over the entire issue of solid waste management in the market to competent private organization ☐
(i) All of the above ☐ (j) others ☐ please specify.....

APPEND IX C

OBSERVATIONAL CHECKLIST

Assessment of Solid Waste Management at the Selected Shops in the Selected Markets in Owerri Imo State Nigeria

Evidence-based

- Document showing Number of visitors and traders ☐
- Document showing architectural design of the market including Solid Waste Dump site (if any) ☐
- Document showing grouping of the market (in Zones) ☐
- Document showing number of lock-up shops ☐
- Presence of Approved Waste Collection Point(s) ☐
- Presence of heap of solid waste within the market ☐
- Document showing legislation guarding solid waste management ☐
- Demonstration of solid waste management going on within the Market ☐
- Demonstration of at least one effect of solid waste within the market ☐
- Presence of functional toilet facility within the market ☐
- Presence of galvanized metal dustbin ☐
- Presence of taskforce committee ☐