

**EVALUATION OF PHYSICAL WASTE  
SEPARATION IN THE MANAGEMENT OF  
SOLID WASTES IN BONNY**

**BY**

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**CERTIFICATION**

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## **DEDICATION**

This work is dedicated to Almighty Allah, The Beneficent, The Merciful.

## **ACKNOWLEDGEMENTS**

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## **ABSTRACT**

Solid waste management as a core environmental health function has persistently caused challenges to many policy makers, professionals and societies especially in developing countries. Lack of proper planning, urbanization and population growth, negative behavior and attitudes of humans to solid waste management, poor funding of solid waste management programs, inadequately trained personnel are some of the factors that have been attributed to this menace to public health importance. Awareness and implementation of solid waste management are however still alien to Bonny Island.

As a preliminary study aimed at laying background for further research into solid waste management in Bonny Island, data was collected from Greener Bonny, the dedicated Bonny Local government agency managing the solid wastes. It was discovered that waste separation is not strongly practiced in Bonny community. The plastic bottles separated are just for economic benefit while the periwinkle shells and some construction wastes are reused for construction.

The raw data were analysed using linear extrapolation and useful information collected was graphically represented. The volume of wastes generated weekly was obtained to be 84,200 litres and the daily volume by 2031 was predicted to be about 14,000 litres. The study shows that attitude of Bonny residents towards waste separation is poor and the current waste management practice is unhealthy, costly and environmentally unfriendly. It also shows that Government and Waste management authorities are not doing enough to promote it.

# CHAPTER ONE

## INTRODUCTION

### 1.0 Background of the Study

Solid waste management as a core environmental health function has persistently cause challenges to many policy makers, professionals and societies in developing countries. Several factors have been attributed to this menace to public health importance and these include factors such as inadequate involvement of trained professionals such as environmental scientists, environmental health officers and environmental engineers in the process, lack of proper planning, urbanization and population growth, negative behavior and attitudes of humans to solid waste management, poor funding of solid waste management programs, inadequately trained personnel, lack of political will on the part of policy makers and apathy of trained professionals (Amadi, 2011). Improperly managed waste from the household and communities is a serious health hazard which causes the spread of infectious diseases. Waste unattended to attracts flies, rodents, and organisms that cause prevalence of diseases (Amadi, 2009). Wet waste decomposes and releases bad odor, resulting in unhygienic conditions of immense public health risk Excessive Solid waste generated should be handled with utmost care and professionalism so as to ensure its efficient management (MSDU, 2006).

Municipal solid waste is heterogeneous and this makes its management complex but with a well-developed scientific systematic design, adequate public enlightenment, community participation and appropriate legislation put in place for solid waste segregation from the primary point of generation (source), solid waste reduction, re-use, recycling and recovery becomes a very easy task and the. Large streams of solid waste generated in towns and cities could be re-

used to generate substantial financial, environmental and social gains through waste recycling and or energy recovery (ICPE, 2004). But due to improper management plans and conservation, non-existence recycling practices and absence of deliberate policies, potentially marketable solid waste materials are disposed at insanitary landfills (ICPE, 2004).

## **1.2 Statement of the Problem**

The waste around Bonny Island in Bonny Local Government Area of Rivers State and its environs, apart from being unsightly, destroys the aesthetic value of the environment and constitutes nuisance such as odor, creates breeding ground for pests (rodents, vermin, vectors, etc.) and air and water pollution. The issue becomes even more critical because an important step in solid waste management which is waste separation at the source of generation has been overlooked. The wastes are not segregated since useful (recyclable) and non-useful wastes are packed together. Therefore, the urgent need for an efficient solid waste management strategy to address this menace that has defied all strategies of policy makers cannot be overemphasized. Waste separation at the source of generation is key to efficient solid waste management. It is the process that facilitates waste reduction and maximizes material recovery in the community towards achieving zero waste status.

## **1.3 Aim**

The aim of this research is to encourage physical separation of composite waste into its various components.

The objectives of the research include;

- To assess the knowledge, attitude, and practice of waste separation in the Area.

- To identify ways of improvement of solid waste management in Bonny Island.

## **1.4 Significance of the Study**

To a large extent, solid waste management efficiency depends on the way different people understand the danger and the good of maintaining environment safe and their capacity but also the commitment of public and private sectors as well as the involvement and participation of the communities themselves in supporting the whole concept. It also depends on the useful information and lessons from current best practices in the provision of this important service. Such information and lessons can be obtained only through research and studies; hence this research can assist in the improvement and performance of solid waste management in the settlements and to identify opportunities for separation techniques in the field of solid waste management. Particularly, this study is useful to the different stakeholders including planners, administrators and private waste collectors, and in one way or the other contributes to future policy interventions in solid waste management sector of the area Bonny and Nigeria at large.

Few more significance of the study includes:

1. The major significance of this study is that it will help in no small measure to maintain efficient and effective waste management system of the study area.
2. Furthermore, it will help in improving the environmental condition of the study area.
3. Finally, the findings of this study will also form the basis for further investigations in this study area.

## **1.5 Scope of the Study**

The study will consider solid waste produced mainly in Bonny Island. It will also study and examine physical separation and existing solid waste management practice in Bonny.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 What is Waste?**

The concept of waste is tricky to define (Lardinois and Van de Klundert, 1995). The definition of post-consumption materials as resources in the wrong place at the wrong time incorporate the idea of 'wastes' being resources left over from initial consumption (Lardinois and Van de Klundert, 1995). There is a problem with this definition because not all wastes can properly be regarded as resources. Many hazardous and toxic materials cannot be safely recycled or reused. In any one society, there will always be materials that cannot be used as resources for various reasons. What is a waste is considered from the point of view of the waste generator so *it* is mainly a subjective matter. Waste is what the person responsible for discarding the material regards as waste (Lardinois Van de Klundert, 1995). General waste is any material for which a specific owner ceases to have use for it. It is also any unwanted or discarded material, in solid, liquid or gaseous form. A product, material or container is not considered waste until someone throws it away.

This study uses the definition by UNEP (2002) which defines wastes as substances or objects, which are disposed or are intended to be disposed or are required to be disposed by the provisions of national law. This definition is also in congruence with what Mugambwa and Kizito (2009); and Mukisa (2009) use that wastes refer to items, materials or substances which individuals consider useless at a given time and place. Usually, the definition of waste depends on types or categories and characteristics of waste under consideration. Some of the dominant types of waste include: municipal waste, solid waste, hazardous waste and electronic waste.

## **2.2 Solid Waste**

Solid waste is non-liquid waste arising from domestic, commercial, industrial, agricultural, mining and construction activities and from public services. Solid waste can also be defined as unwanted material disposed-off by man which can neither flow into streams nor escapes immediately into the atmosphere (Kulkari, 2008).

For the purpose of this study, solid waste are referred to as garbage; they are organic and inorganic waste materials that are normally solid produced by households, commercial, institutional and industrial activities that have lost value in sight of the initial users.

## **2.3 Classification of Solid Waste**

Solid waste can be classified in several ways and most classification of solid waste is based on the source from which it is generated (Hoornweg *et al.*, 2008). Major sources of solid waste include;

- i. Residential and Domestic Waste
- ii. Industrial waste
- iii. Commercial Waste
- iv. Institutional Waste
- v. Construction and Demolition Waste
- vi. Municipal Waste
- vii. Agricultural Waste
- viii. Hazardous Waste

- ix. Mining waste
- x. Electrical and Electronic Waste
- xi. Biodegradable Municipal Waste
- xii. Packaging Waste
- . xiii. End of Life Vehicle and Tyres (ELVs)

## **2.4 Solid Waste Management**

Waste management is the practice of the gradual removal of waste substances or materials in an environment with the ultimate aim of eliminating those substances or materials that have the potential to cause harm to people and the environment. Solid waste management therefore, is the planned systematic administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment and disposal of solid waste.

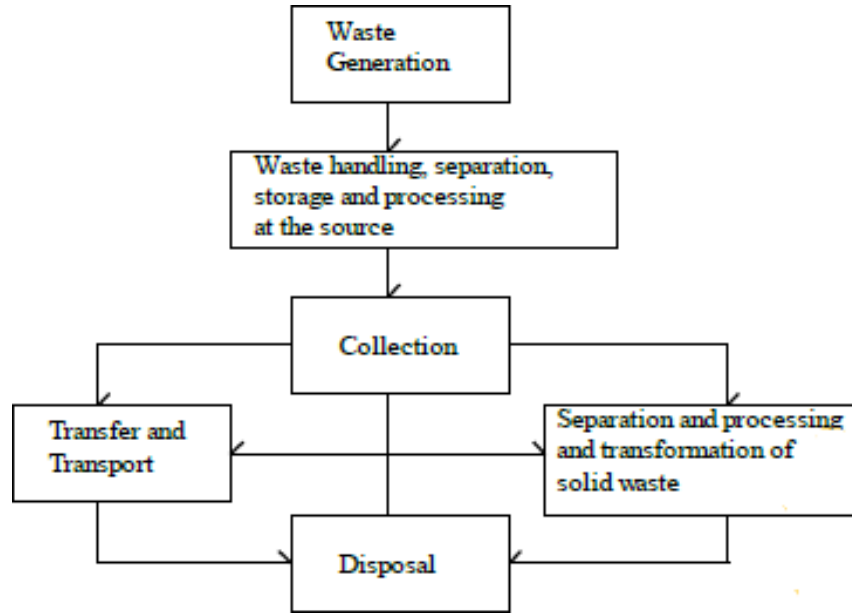


Figure 2.1; Schematic diagram of Solid waste management (Shridhar, 2013).

## **2.5 Objectives of Waste Management**

The objectives of waste management are designed to promote aesthetics, land-use, and health, prevent pollution of air and water, generate income for economic growth; create awareness for proper solid waste management for municipal, corporate, and individual. Solid waste management is a complex process because it involves many technologies and disciplines. These include technologies associated with the generation (source reduction); on-site handling and storage; collection; transfer and transportation; processing and disposal of solid wastes. All of these processes have to be carried out within existing legal, social and environmental guidelines that protect the public health and the environment in a safe, hygienic and economically acceptable manner. In other to achieve these solid waste management must take an integrated approach (Shridhar, 2013).

Rick (2020) describes the primary goal of solid waste management as reducing and eliminating adverse impacts of waste materials on human health and the environment to support economic development and superior quality of life.

## **2.6 Waste Separation**

Segregation or Separation at source refers to the practice of setting aside post-consumer materials and household goods so that they do not enter mixed waste streams. The purposes of waste separation are recycling, reuse, improved waste management such that different processes-composting, recycling or incineration can be applied to different kinds of waste, create incentives, improve the aesthetics of the environment, promote public health etc. The concept was coined in affluent societies during the 1980s in contradistinction to the recovery of resources for recycling from mixed post-consumer waste in plants called materials recovery facilities (MRFs).

Occupational safety can only be maintained if the risks from the materials are defined, is identifiable and the resulting counter measures are taken. By this, the risk of injury and incidents can be minimized in a cost effective way. Recycling can only be carried out if recyclable materials are separated from the hazardous waste (contaminated materials are excluded from any recycling activity and must be treated as mixed hazardous waste). To guarantee a high quality of the recycling materials it must be collected in at source. Mixed waste will decrease the possible income. The separate handling, treatment and disposal of different kinds of hazardous and non-hazardous waste in different ways will drastically reduce costs. Only the different kind of hazardous waste will be treated and disposed off in a costly way instead of the entire waste stream in a hospital. Separation is the key to any effective waste management! Without effective separation system, the complete waste stream must be considered as hazardous (CETH, 2002).

## **2.7 The Principles of Separation**

Guset (2015) described waste separation as the key for managing solid waste. He believed the correct segregation is the clear responsibility of every waste generator (Duty of care Principle) and listed below effective principles in separating wastes.

In case of doubts regarding the waste group, the precautionary principle must be followed. That means if a classification of the waste is unclear or not recognizable; the waste must be classified in the highest risk group.

The segregation should be carried out by the producer and close as possible to the place of generation. That means separation must take place at source e.g. at the ward, at the bedside, operation theatre, laboratory etc. and must be carried out by the person generating the waste e.g. nurse, physician. This is what is called the proximity principle.

The segregation must be applied from the point of generation, during collection, transport, storage and final disposal.

Every place of generation should have the necessary equipment for the types of wastes that are generated at that place like bags, bag holders, containers etc.

Segregation and identification instructions should be placed at each waste collection point.

Segregated waste should not be mixed during transport and storage.

If hazardous and non- hazardous wastes are mixed the entire mixture must be considered and treated as hazardous waste.

Correct segregation will only be achieved through a rigorous training of all waste generators.

## **2.8 The Planning of Separation**

For the planning of the separation, some necessary information and facts are needed to ensure a proper waste management in the health care facilities:

Kinds of waste generated in each department (because departments generate different kinds of waste) so as to be sure of which kinds of bags/containers to be used for the separation (depending on the waste hazard, treatment and disposal)

The place where the different kinds of waste are generated: Who generates the different kinds of waste so as to fix the segregation points as near as possible to the point of generation.

How many of the different kinds of waste and how much are generated. This will help to calculate the needed size and quantity of bags and containers to ensure proper supply of bags/containers.

If peak times of generation exist so as to ensure the supply of bags and container during the peak times.

The quality of the separation system will depend on the quality of the separation concept and quality of the implementation of the concept (WASTE, 2005).

## **2.9 Color Coding of the Separated Waste**

Color coding means the combination of different waste groups with similar hazards or characteristics in one main group and to identify that main group in a fast and easy way by a fixed color. The different waste groups have different colors for the containers and bags for their identification according to the hazards and are applied throughout the complete disposal chain (segregation, collection, storage, transport and disposal):

Warning colors for hazardous waste (Red, yellow, orange)

Positive colors for recycling (Blue, green etc.)

Neutral colors for normal waste (Black etc.)

The color coding makes the process understandable even for low-skilled workers with language and reading problems (Shridhar and Coker, 2009).

## **2.10 The Packaging of the Separated Waste**

Different kinds of waste need different packaging due to the different risks created by the waste. The chemical characteristic of the waste must be obtained. Some chemical solutions can dissolve plastic bags and must be collected in metal containers or glass bottles. The packaging of infectious waste should be done with good quality or other strong materials.

The use of bags with closable bag holder or bins with lid is recommended. The containers for hazardous waste must be puncture proof and sealable. For the identification of the risks, the

United Nations packaging symbols should be used (WASTE, 2005).

## **2.11 The Labeling of the Segregated Waste**

The labeling of the waste is absolutely necessary, for the identifying, monitoring, controlling and record keeping of the different waste groups along the entire waste stream. At least all yellow and red waste bags or containers should be labelled with the basic information on their content and on the waste producer. The labels should be clearly, legibly and durably marked with the following information:

Name of the producer (if applicable) department

Waste classification, date of production

Special remarks

Waste volume-waste destination

(WASTE, 2005).

## **2.12 Planning of Separation Points**

After mapping out the premises into different sections in case of large premises, each section should have its separation point installed. For example in research laboratories, nearly all kinds of hazardous waste and non-hazardous waste will be generated regularly. For this, separation points must contain possibilities to collect nearly all waste groups. (Waste streams of a research laboratory) —Separation point is the point where waste generators can place the different kinds of separated waste in different waste bags. For each regularly generated waste

group, a different receptacle can be found. The choice of the kind of waste that will be collected will depend on the processes carried out in the specific section. Depending on the size of the section, one or more separation points must be installed. In every section, separation and identification instructions should be available to the generators to help them decide how the waste must be separated. Additionally, above the separation point, an easy to understand short instruction should be put (WHO, 1999).

## **2.13 Definition of a Household**

The concept of a —household‖ differs among countries and even among researchers within a country. In order to maintain consistency the definition created by the United Nations (UN) and documented in their report United Nations: Principles and Recommendations for Population and Housing Census was adopted. A household is defined as: -Either as a single person household, wherein one person makes provision for his or her own food or other essentials for living without combining with any other person to form part of multi-person household or a multi-person household is defined as a group of two or more persons living together who make common provision for food or other essentials for living. The persons in the group may pool their incomes and have related or unrelated persons or a combination of persons both related and unrelated (United Nations, 1959, p. 74).

### **2.13.1 Practice of Household Waste Separation**

1. Keep separate containers or bags of different colors for dry and wet waste in the kitchen.
2. Keep two bags for wet waste collection and one bag for dry waste collection.

3. Keep plastic from the kitchen clean and dry and drop into the dry waste bin. Keep glass /plastic containers rinsed of food matter.
4. Send wet waste out of the home daily. Store and send dry waste out of the home, once a week.
5. Keep a paper bag for throwing the sanitary waste

## **2.13.2 Characterization of Waste for Separation at the Household**

### **2.13.2.1 Dry Waste**

Anything that can be kept for a period of two or three weeks without decomposing is known as dry waste. Make sure that plastic sachets of milk, curds, oil are cleaned of all their contents and dried before being put in the dry waste bag to prevent odor. Clean dry waste will not attract any vermin. Store such waste in a bag in the utility area after cleaning and drying till it is picked up. Examples of dry waste include paper, plastics, metal, glass, rubber, fabric, leather, wood etc. (Shridhar et al., 1985).

### **2.13.2.2 Wet Waste**

Wet waste consists of kitchen waste which including vegetable and fruit peels and pieces, tea leaves bags, coffee grounds, eggshells, bones and entrails, fish scales as well as cooked food. These could be used for home composting in daily dump spots or in aerated containers. Where this is not feasible, such is collected daily or once in every three days to prevent odor nuisance (Shridhar and Coker, 2009).

## **2.14 Health Impacts of Improper Handling of Solid Waste**

Modernization and progress has its share of disadvantages and one of the main aspects of concern is pollution of the earth – be it land, air or water. With increase in the global population and rising demand for food and services, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further thrown into landfills and dumps. However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dumpsites. If at this stage the management and disposal is improperly done, it can have serious impacts on health the surrounding environment. Waste that is not properly managed, especially excreta and other liquid and solid waste from households and the community, are a serious health hazard and lead to the spread of infectious diseases. Unattended waste lying around attracts flies, rats and other creatures that in turn spread disease. Normally it is the wet waste that decomposes and releases a bad odor. This leads to unhygienic conditions and thereby a rise in the health problems. Plastic waste is another cause for ill health. Thus excessive solid waste that is generated should be controlled by taking certain preventive measures. The groups at risk from the unscientific disposal of solid waste include the population in areas where there is no proper waste disposal method, especially the pre-school children; waste workers and workers in facilities producing toxic and infectious material. Other high-risk groups include population living close to a waste dump and those whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases risk of injury and infection (Hoornweg *et al.*, 2008).

### **2.14.1 Organic Domestic Waste**

Food residuals in many areas are left to decompose in the environment, attracting flies, cockroaches, rodents and other vectors of public health importance. Apart from being an unsightly, they create foul odor due to their gradual decomposition. This poses a serious threat, since they ferment; creating conditions favorable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable (Yuwono and Lammers, 2004)

### **2.14.2 Exposure to Hazardous Waste**

This can affect human health; children being more vulnerable to these pollutants. In fact, direct exposure can lead to diseases through chemical exposure as the release of chemical waste into the environment leads to chemical poisoning. There is a connection between health and hazardous waste (Hoornweg *et al.*, 2008).

### **2.14.3 Waste from Agriculture and Industries**

They can also cause serious health risks. Other than this, co-disposal of industrial hazardous waste with municipal waste can expose people to chemical and radioactive hazards. Uncollected solid waste can also obstruct storm water runoff resulting in the forming of stagnant water bodies that become the breeding ground for disease. Waste dumped near a water source also causes contamination of the water body or the ground water source. The direct dumping of untreated waste in rivers, seas and lakes results in the accumulation of toxic substances in the

food chain through the plants and animals that feed on it directly or indirectly (Hoornweg *et al.*, 2008).

#### **2.14.4 Disposal of Hospital and other Medical Waste**

These require special attention since they can create major health hazards. Waste generated from hospitals, health care centers, medical laboratories, and research centers such as discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed off with the regular non-infectious waste (UNEP-IETC, 1996).

#### **2.14.5 Waste Treatment and Disposal Sites**

These sites can also create health hazards for the neighborhood. Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types of insects and rodents that spread disease. Ideally these sites should be located at a safe distance from all human settlement. Landfill sites should be well lined and walled to ensure that there is no leakage into the nearby ground water sources (UNEP-IETC, 1996).

#### **2.14.6 Recycling**

Waste recycling too carries health risks if proper precautions are not taken. Workers working with waste containing chemical and metals may experience toxic exposure. Disposal of health-care wastes require special attention since it can create major health hazards, such as Hepatitis B and C, through wounds caused by discarded syringes. Rag pickers and others, who

are involved in scavenging in the waste dumps for items that can be recycled may sustain injuries and come into direct contact with these infectious items (UNEP, 1996).

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Research Design**

This study was an exploratory and descriptive design. It was aimed at documenting a knowledge, attitude and existing practices of solid waste separation in Bonny community. The research involves collecting information directly from personnel involved in the management of solid wastes in Bonny and examining records to assess the practice. The government and non-government agencies involved in the management of solid wastes in Bonny were visited to gather information and the internet or records from previous studies are also utilized to corroborate findings.

#### **3.2 Area of Study**

The study area is Bonny community in Bonny Island, Bonny Local Government Area (L.G.A) of Rivers State. Bonny L.G.A covers the whole of Bonny Island and mainland area and is located about 40 kilometers to the south-eastern part of Port Harcourt, which is the state capital.

Bonny Island is located on the outer southern section of the Niger Delta complex. Bonny Island is mostly surrounded by the Atlantic Ocean. It's a trapezoid shaped landmass with the following co-ordinates: Northwestward Latitude 4°33'N and Longitude 7°08'E: North eastward Latitude 4°30'N and Longitude 7°20'E: Southwestward Latitude 4°22'N and Longitude 7°20'E; Southwestward Latitude 4°22'N and Longitude 7°08'E. Bonny L.G.A comprises of Bonny Island and the outlying mainland areas around it (Joint Industries Companies, 2002).

The 1991 National Population Commission (NPC) however, adopted a linear extrapolation model at 2.83% growth rate and estimated the population of Bonny to be 140, 753 by 2021. This was further reviewed by a consultant contracted for a household demographic analysis for the NLNG's environmental impact assessment who indicated that a 5% average annual growth rate of population is more realistic for the Bonny urban area than the 2.83% applied by the National Population Commission (Opuenebo, 2004).

The main population Centre on Bonny Island is Bonny Town some 5 km from the NLNG plant site. Based on another estimate (1991 Census), Bonny Town, New Finima and Bonny Local Government Area (LGA) as a whole had populations of 22,989, 5,590 and 76,124 people, respectively. Bonny Town alone accounted for about 30% of the LGA's population, while Finima contributed about 7.3% (NLNG, 2008).

**Figure 3.1** presents a map of Rivers State, showing Bonny LGA and map of Bonny LGA.

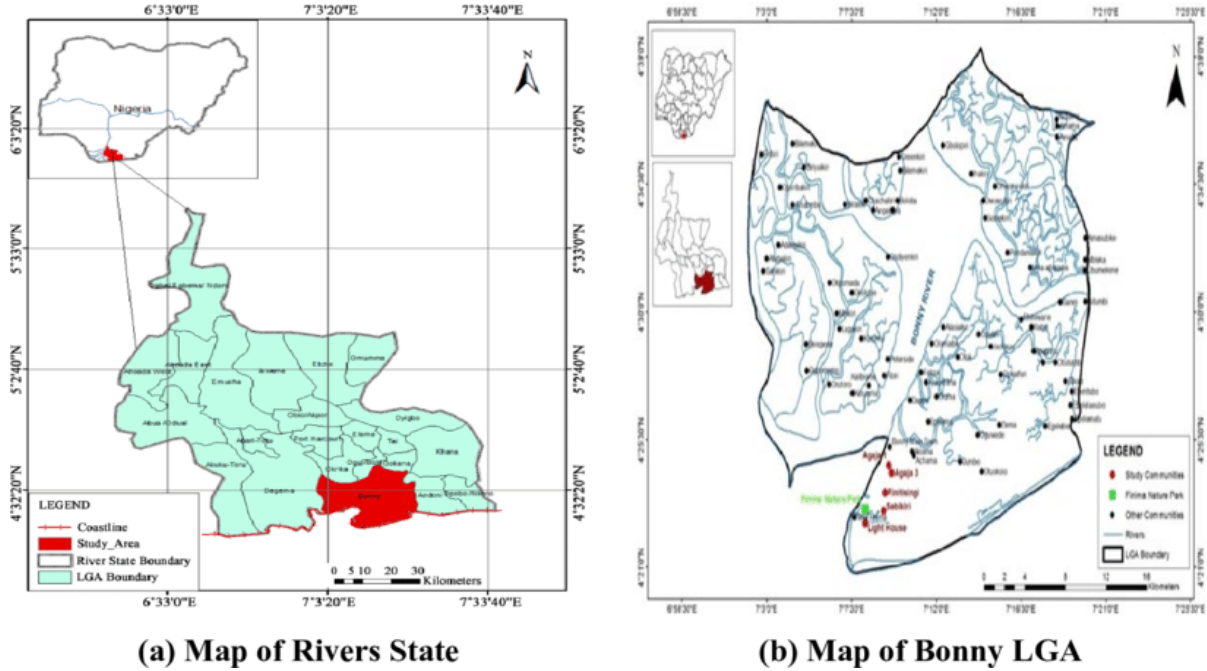


Figure 3.1: Map of Rivers State, showing Bonny LGA and map of Bonny LGA

### **3.3 Population of Study**

According to documented record of Bonny Utility Company (BUC), it currently supplies power to 15,236 households in Bonny community. So, the study area comprises of an estimated 15,236 households. Participants were selected based on mutual consent.

Bonny is estimated to have a population of about 140,753. This was a projection by National Population Commission (NPC) based on 2006 Population Census figure. NPC used linear extrapolation to arrive at this figure for 2021 assuming an arithmetic growth progression rate of 2.83%.

### **3.4 Instrument of Data Collection**

Quantitative method was adopted in the research and data was collected using a carefully existing documented record with Bonny Local Government and Greener Bonny. The personnel involved were also interviewed for clarity on the records. Some residents of Bonny community were equally interviewed to further get facts to complements the information gotten from the personnels involved in the management of solid waste in Bonny.

### **3.5 Validation of Instrument**

To enhance the face and content validity of the instrument, experts in the field of Environmental Health, Safety and Engineering in the department of Industrial Safety and Environmental Engineering Technology were consulted for their opinion and appraisal. Necessary amendments were made to the methodology and reviewed by my Research

Supervisor. The content of all information collected was preserved in English Language. This ensures that the instrument maintains its originality.

### **3.6 Reliability of the Instrument**

In order to determine its reliability, the researcher presented the data obtained to experts and interviewed its custodian for accuracy.

According to most researchers Inter-Rater/Observer involves the use of human expert as a part measurement procedure, to assess the consistency and invariability of data.

Information gathered were verified and rated by experts and confirmed reliable. It's also agrees with similar trends in rural to urban communities in developing nations. The secondary data largely utilized in conjunction with field observation and experts submission is therefore a very reliable source.

### **3.7 Method of Data Collection**

The study involved the evaluation of physical separation in the management of solid wastes in Bonny community. This requires information on whether physical separation is carried out and how. Wastes can be separated from source or post-collection on site. Information on types of wastes generated and assessment for confirmation that they are separated is also necessary. Records generally relating to solid management practices in the community are then collected.

Some of the records are available with the local government wastes management agency, Greener Bonny. The office is visited to collect records of the types of wastes generated and their volumes to check if they separated and differently recorded. The waste collection points,

disposal and management are also collected from this agency. The personnel working with the local government waste organization are also interviewed for further clarity on the records.

Dumping sites and collection points are also visited to verify the records and confirm the practice. In summary, secondary data source from the local government agency in charge of waste management are collected and evaluated to conclude the findings of the research.

### **3.8 Method of Data Analysis**

The information available were collected and evaluated. The type of wastes generated are collected and physically verified. The information on waste separated are also analysed using Microsoft Excel Data Analysis Tool to check the quantity of each of the types of wastes generated predict the volume that will be generated in the future.

The quantity of wastes recycled or reused is also calculated and what they are used for examined. The Microsoft Excel Data Pack for Tool Analysis was also used to estimate the volume of wastes generated daily, weekly, monthly, and by the end of the year.

Wastes generally increase with increase population. With the project figure of population growth available as provided by National Population Commission (NPC), the volume of waste was calculated and that makes it very easy to plan ahead of time for it management.

The solid wastes management processes in Bonny are analysed and recommendation for improvement suggested.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSIONS**

This chapter highlights the knowledge and attitude of Bonny residents towards solid waste segregation at the source of generation (household).

The record was validated by experts interview and field observation exercise carried out to confirm waste segregation practice in the management of solid wastes in the community. Results were analyzed to highlight knowledge, attitude (perception) and practice of physical separation which majorly assessed the role of residents, waste management authorities and need for government intervention in household training on waste management.

#### **4.1 Composition of Solid wastes generated in Bonny**

Municipal solid waste (MSW) is generated from households, offices, hotels, shops, schools and other institutions in Bonny. This majorly comprises of food waste, paper, plastic, rags, metal and glass. Other inclusion in the collected wastes is demolition and construction debris, small quantities of hazardous waste, such as electric light bulbs, batteries, automotive parts and discarded medicines and chemicals.

These wastes can further be regrouped by sources as follows:

**Residential:** these are generated from single and multifamily dwellings. Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g. bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes that are generated at home fall under this category.

**Industrial:** Light and heavy manufacturing, fabrication, construction sites, power and chemical plants are grouped as industrial wastes. Bonny host Nigeria LNG and this makes Industrial wastes a key component of the solid wastes generated. Construction activities, welding and

fabrication also happen a lot in Bonny. Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes are therefore present in reasonable quantity on the Island.

Commercial and Institution: Commercial stores, hotels, restaurants, markets, office buildings, etc. contributes to the wastes generated in Bonny likewise Institutions like Schools, hospitals, prisons and government centres. Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes all come from this source.

Construction and demolition: Wood, steel, concrete, dirt, etc are all wastes from this source. New construction sites, road repair, renovation sites, demolition of buildings generate this waste.

Municipal Services: Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants exist in Bonny and associate waste like street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational area, sludge.

Process wastes: The presence of Nigeria LNG facilitates the generation of this type of wastes. Industrial process wastes, scrap materials, off specification products, slag, tailings are all from this source.

Agriculture: Crops, orchards, vineyards, dairies, feedlots, farms in a low scale are practiced on the Island while markets are also established to trade the products. Spoiled food wastes, agricultural wastes, hazardous wastes (e.g. pesticides) are wastes resulting from these activities.

In summary, all the above listed types of wastes are generated in Bonny with papers, pure water sachet, plastic bags, plastic bottle, agricultural wastes and construction wastes the most.

The wastes are however not separated due to the lack of will power by the Government and proper orientation on the part of the residents.

Shridhar and Coker (2009) reported that awareness on solid waste segregation can only come through persistent and carefully designed enlightenment programs by well trained professionals in solid waste management.

## **4.2 Solid wastes collection practices in Bonny Community**

According to our findings about the methods of waste management in the whole of Bonny, the following results were discovered:

Bonny community has lots of various dumpsites in which an estimated 40% of the dumpsites are places where the local government has placed waste bins for the purpose of collecting the waste while 60% of the dumpsites are places not accredited by the local government for disposal purpose but have been turned into a dumpsite by the residence of the community mostly due to the insufficient waste bins. This act of disposing in an unapproved disposal area can be assumed to be supported by the local government as the government continuously packs the waste dumped in open sites without putting up any control measures henceforth making the presence of open dumpsites in the community in abundance.

More than 20 open dumpsites exist in the community and waste collected is evacuated regularly by the Government waste management authority.

The wastes are neither sorted nor treated; rather they are transported to a very large open ground around Coconut estate where it is allowed to dry and burnt. They are also used as landfill and for land reclamation. Construction wastes such as boulders and irons are however reused for suitable construction purposes. Agricultural wastes like periwinkle shells and other types are also used as substitutes for granites for local ground flooring and to prevent erosion.

Some of the locations where the waste collection bins (Receptacles) and open dumpsites can be found are:

**Waste Receptacle:**

1. Behind Copers lodge
2. Front of Police station, Bonny
3. Bonny National Grammar School, Opposite Berger Road Junction

**Open Dumpsites:**

4. Big market
5. Akiama market
6. Agaja Market
7. Berger Road
8. Waterside, around Ama-Hausa
9. Opposite Assembly junction
10. Inside Macauley
11. Navy Base road, side of the bridge
12. King Jaja road
13. Opposite Finima Girls road
14. Cemedian junction
15. Along Cathedral church,
16. Inside Sandfill by Gigi hotel
17. Bar beach hotel, towards Beach before big slaughter
18. Opposite bar beach hotel linked to cable road
19. Inside Bonny Park by beach side.
20. Inside Beach, Roundabout



Figure 4.1 – Dumpsite at Assemblies Junction



Figure 4.2: Waste Receptacle behind Corpers Lodge, Ukpo Avenue



Figure 4.3: Dumpsite 1 along Berger road



Figure 4.4: Dumpsite 2 along Berger road



Figure 4.5: Dumpsite in front of Bonny National Grammar School opposite Berger Road



Figure 4.6: Dumpsite opposite Bonny Police Station



Figure 4.7: Dumpsite along King Jaja Road



Figure 4.8: Large Dumping Ground at Coconut Estate

### **4.3 Who is responsible for waste management in Bonny Island**

Generally, the residents of Bonny community have 3 options to deal with their wastes. They can either collect the wastes and burn or dump in assigned sites by local government with or without waste bins. Some dump sites have further been created by the residents due to ineffective waste policy in the island. The third option is to pay subscription to the local government to get waste bins who also evacuates it when full.

The Bonny Local Government directly supervises the management of solid wastes on the Island. This is handled by Greener Bonny, an agency of the Local Government saddled with the responsibility of evacuating the wastes from all dumpsites and private waste bins to the collection point where it's burnt.

Greener Bonny maintains the waste disposal by packing the refuse 4 times in a week but still the rate of disposal is too high. Between intervals of just two to three days, lots of waste would have been deposited at the disposal sites and mostly on the ground even in case of sites where waste bins have been placed.

Improperly managed waste exudes offensive odor. Thus people regard waste as filth that should never be meddled with. Hammed (2011) submits that in Nigeria and other developing countries, waste separation at the household or source of generation is looked at as a filthy exercise. Most individuals want to remove waste from their sights as soon and as cheap as possible. Hammed (2011) finds out that the current practice is that the municipal waste management Authority collects heterogeneous waste and disposes them into insanitary landfills without proper leachate control, which is not a sustainable or environment-friendly practice. ICPE India (2011) also reports that

segregation of recyclable wastes at source is invariably not seriously practiced by households and establishments who rather dispose waste on the streets or in the municipal bins unsegregated because that is the normal practice overtime.

#### **4.4 Volume of waste generated in Bonny**

There is no record available to track the volume of waste generated in the community. An estimated value can however be computed from the information available. It takes about 3 days for a 1,100 litre waste bin (Fig. 4.10) to full meaning 2 of such will have to be emptied in a week.

1,100 litre waste bin are commonly found in local government designated waste collection points while smaller sizes such as in Fig. 9 can be found at home, schools and in some office locations.

There are about 25 open dumpsites in Bonny. Table 4.1 below gives an estimate the volume of wastes generated weekly from a combination of sources like open dump site, schools, homes, offices and other sources. An estimated total of about 84,200 litres of wastes is generated weekly in Bonny community.

Public schools generally don't have commercial sizes waste bins but have a dumpsite where they gather their wastes and burn. Private schools, religious institutions, offices and some houses pay government to evacuate their waste weekly and they are given waste bins.

Table 4.2 further summarizes the volume of wastes in the community into daily, weekly, monthly, and provides an annual estimate for year 2021.

Table 4.1: Volume of waste generated weekly in Bonny Community

<b>Source</b>	<b>Waste bin size (litre)</b>	<b>Quantity (1,100 litre x 2)</b>	<b>Weekly Total Waste (litres)</b>
Open Dump ground	1,100	50	55,000
Public Schools	1,100	10	11000
Homes, Private Schools and Offices	360	20	7200
Others (emptied in water bodies and burnt at home)	1100	10	11000
<b>TOTAL</b>			<b>84,200</b>

The table above shows that approximately about 84,000 litres of wastes is generated weekly in Bonny.

Table 4.2: Summary of volume of waste generated daily, weekly, monthly and yearly in Bonny

<b>Frequency</b>	<b>Volume of waste (litres)</b>
Daily	12,000
Weekly	84,200
Monthly	360,000
Yearly	4,380,000,000



Figure 4.9: 120 litre, 240 litre and 360 litre commercial wheelie waste bins  
Credit: AdsAfrica (2020)



Figure 4.10: 1,110 litre commercial wheelie waste bins  
Credit: Yaoota (2017)

#### **4.5 Evaluation of physical waste separation and solid waste management in Bonny**

The management of solid waste in Bonny is too poor and wastes generally are not physically separated either from source or on site. Most people don't have idea on the proper ways in which solid waste can be separated and managed. The remaining few people who have knowledge on how waste can be managed don't really practice it due to the lack of equipment/infrastructure in the community.

According to our findings, the inability of proper waste management can also be said to be fault of the government. Bonny at large don't have a proper waste management system except the one which is been managed by the Bonny community itself even though the agents just pack up the waste from the various dumpsites and dispose them in an open ground (isolated area). This is not going to be sustainable considering the volume currently generated and predicted population growth rate of the community.

As earlier stated, the 1991 National Population Commission (NPC) adopted a linear extrapolation model at 2.83% growth rate and estimated the population of Bonny to be 140, 753 by 2021.

This was further reviewed by a consultant contracted for a household demographic analysis for the NLNG's environmental impact assessment who indicated that a 5% average annual growth rate of population is more realistic for the Bonny urban area than the 2.83% applied by the National Population Commission (NPC). Details of the population projections for the local government area up to year 2051 is given in table 4.3 using both the NPC's linear extrapolation model and the EIA consultant's application of the exponential growth model. Waste generally increases with increased growth rate and this means by 2051 the daily waste generated would have been 17,510 litres.

Table 4.3: Projected Population of Bonny Local Government Area, 2001-2051

<b>Years</b> <b>(Base Year, 1991</b> <b>Population = 76,124)</b>	<b>Assumed Average Annual Growth Rates (%)</b>	
	<b>2.83</b>	<b>5.0</b>
2001	97,667 <b>(100,628)</b>	114,186 <b>(123,998)</b>
2011	119,210 <b>(133,020)</b>	152,248 <b>(201,980)</b>
2021	140,753 <b>(175,840)</b>	190,310 <b>(329,004)</b>
2031	162,296 <b>(232,442)</b>	228,372 <b>(535,912)</b>
2041	183,840 <b>(307,265)</b>	266,434 <b>(872,944)</b>
2051	205,383 <b>(406,174)</b>	304,496 <b>(1,421,934)</b>

**Note:** Figures derived from the exponential growth model are given in parentheses

Source: Ecosphere, 2003

Table 4.4: Projected Daily waste volume generated in Bonny community, 2021-2051

<b>Year</b>	<b>Estimated Population</b>	<b>Estimated vol of waste (litres)</b>
2021	140,753	12,000
2031	162,296	13,837
2041	183,840	15,673
2051	205,383	17,510

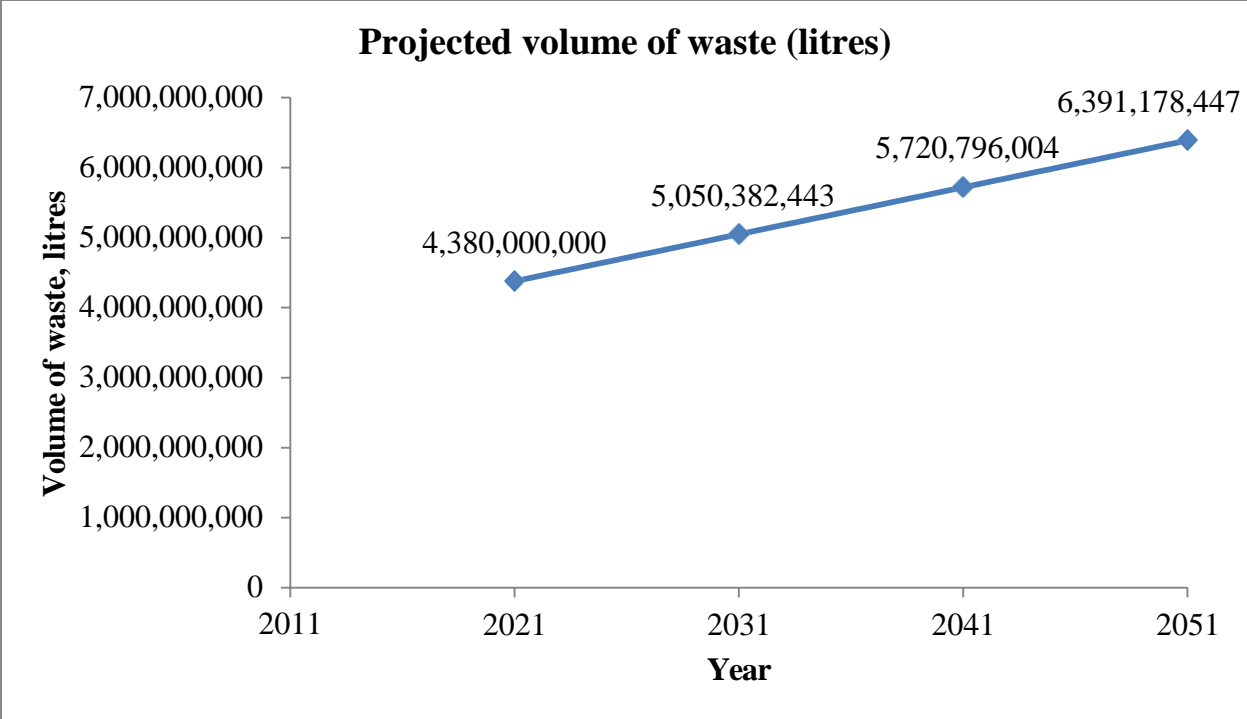


Figure 4.11: Projected waste volume generated in Bonny community, 2021-2051

## **4.6 Effect of improper physical separation in solid waste management system in Bonny**

Knowledge of waste separation and its benefit is expected to motivate people and promote the culture. Majority of households know the benefits of waste separation because few valuables such as cans of drink and infant formulas, plastic water bottles and whole bottles are set aside for reuse and in most cases for sale to scavengers. This monetary gain could be due to their little knowledge and observation of what happens mostly around them. Despite this knowledge, residents of Bonny community don't separate their wastes.

Waste can be managed by reducing, recycling, reusing and recovering it. One approach that makes this easy is physical separation or sorting. A properly sorted waste programme helps the environment and save the business money. This helps reduce the cost of managing waste and burning or disposing of useful wastes (green waste disposal) to the landfill.

Wastes generated in Bonny are not sorted therefore recyclable wastes such as paper, plastic and glass from landfill and compostable waste are all burnt. Recycling is therefore not practiced at all and this is equivalent to resources waste. Effective segregation of wastes means that less waste goes to landfill which makes it cheaper and better for people and the environment. Lack of separation also accumulates wastes and make it bulky thereby becoming more difficult to handle.

Public health is another concern that necessitates waste separation. Some wastes are hazardous and must be separated from the non-hazardous ones. Hazardous waste requires special handling, and hazardous waste in non-hazardous containers can cause serious problems. In particular, hazardous wastes can cause long term health problems.

There are different types of wastes, taking differing lengths of time to break down and decompose naturally, sadly due to the tightly compact piles at landfills, this timescale is increased further due

to the lack of oxygen helping the items decay. Improper recycled wastes results into sending unnecessary items to landfill which takes endless amount of years to decompose as below:

- Plastic bottles: 70-450 years
- Tin can: around 50 years
- Leather shoes: 25-40 years
- Nylon clothes: 30-40 years
- Glass bottles: 1,000,000 years
- Fishing line: 600 years.
- Glass bottle: 1-2 million years
- Aluminum can: 200 years

#### **4.7 Recommendation for Improvement in waste management in Bonny**

##### **Island**

WHO (1999) and Cookey (2005) report that successful implementation of waste segregation can only be achieved by proper training of personnel of several institutions on what healthcare waste is, its classification, purpose of segregation and the use of each segregated waste.

The following are some of the steps that the local government can adopt to encourage physical waste separation and promote solid waste management.

1. Create awareness
2. Implement policies for waste reduction in the region – Pay as you throw policies
3. Reward and Incentive schemes to promote physical separation from source
4. Encourage company and startups to go into recycling business. It is important to encourage public-private partnership in fight against poor waste management
5. Provide adequate facilities and resources to achieve waste separation, recycling and reductions – this include waste bins to collect all types of wastes and adequate collection points.

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 CONCLUSION**

Results of this study show that a lot waste separation is not practiced in Bonny community, a reflection of lack of awareness and poor attitude to the practise. It also shows that Government and Waste management authorities are not doing enough to promote a healthy management of solid wastes generated, hence the call for strategic intervention.

Waste segregation at source is a practicable and sustainable approach for a more effective solid waste management in the country. However, there is need for collaboration of all stakeholders involved especially in the area of advocacy, public enlightenment, creation of buy-back recycling centers, community participation and public-private partnership arrangement. The findings of this study will help improve the planning, development, implementation and evaluation of solid waste management in the Community, Local Government Areas, States and Nigeria at large.

#### **5.2 RECOMMENDATIONS**

It is therefore recommended in very strong terms that

1. Increased community based public awareness programs be undertaken.
2. Provision of bags by government as motivational incentive for waste segregation at the source.
3. Government should establish buy-back recycling centers.

4. Before any policy on Solid Waste Management should be adopted, research on baseline information of the present situation of solid waste generation and practice should be obtained.
5. Encourage solid waste separation or segregation from the source of generation.
6. Encourage community participation and public-private partnership.
7. Encourage house-based waste composting.
8. Provide adequate legislation and enforcement.

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