Chapter One

1.0 Introduction

1.1 Background to the Study

Globally, millions of tons of municipal solid waste are generated every day. Waste management is drawing increasing attention, as citizens observe that too much garbage is lying uncollected in the streets, causing inconvenience and environmental pollution, and being a risk for public health[1]. According to a UN report, quite a large number of urban dwellers live in "life-threatening" conditions of poverty and environmental degradation, and the number is supposed to swell significantly by 2025.[2]

Generation of wastes is a daily affair. The challenge of waste disposal has become one of the most serious environmental problems facing many cities in Nigeria. Many urban areas of Nigeria lack effective waste management systems, which have resorted to the haphazard dumping, burning or burying of solid wastes.[3] The challenge facing the global community today is how to develop a waste disposal system that is environmentally friendly.[4]

Waste management is the collection, transport, processing and monitoring of waste materials. The management of wastes is aimed at reducing the harmful health and environmental impacts of solid, liquid and gaseous wastes through different techniques.[5] Waste management practices in developing nations are influenced by customs, beliefs and level of education of the people and are partly the responsibility of local government authorities. Disposal of waste in a landfill involves burying the waste or burning it and this remains a common practice in most developing countries. Landfills are often established in abandoned quarry sites, mining sites, borrow-pits or erosion sites. This ancient, poorly designed and managed landfills can create a number of

adverse environmental impacts such as generation of leachate (Plate 2), odour problems, eroding of surface vegetation and attraction of rodents.[6] There has been an increasing rise in environmental pollution globally as a result of man's activities (domestic, industrial and agricultural), which includes: institutional wastes, street sweepings, commercial wastes, abandoned vehicles, as well as construction and demolition debris. The majority of substances composing municipal solid waste include paper, vegetable matter, plastics, metals, textiles, rubber and glass.[7]

The practice of open dumpsites as a method of waste disposal in many developing countries like Nigeria is far from standard recommendation. The conversion of burrow-pits used for road construction, erosion sites and river channels into dumpsites in most parts of the country, especially in the southern coastal region, with shallow groundwater table and largely unconfined, highly porous and permeable aquifer system is of great concern to environmentalists and hydrogeologists as health safety of any community depends on its environmental sanitation level.[8] The use of unlined pit-latrine and soak-away pits in areas with shallow groundwater system is disturbing and increases the vulnerability of the aquifer system to contamination. In most developing countries, there are still millions of people today that lack adequate hygienic and acceptable domestic waste disposal and treatment methods.[9] This situation calls for urgent and practical solutions, not only from environmental and health authorities but also from the individuals concerned. However, due to economic reasons and lack of information on sanitary health protection, improvements are not forthcoming and the situations remain unchanged, hence the need for a paradigm shift in the way and manner wastes are generated and managed.[10]

Proper waste management and efficient system of solid and fluid disposal techniques are lacking in most developing countries. Waste disposal techniques have created subtle and yet serious

environmental pollution and ecological deterioration in many developing countries such as Nigeria. The manner in which municipal and industrial wastes generated are disposed in most urban areas in Nigeria is worrisome. The use of inadequate disposal system and lack of consideration of the topography, geology and hydrogeology are the causes of pollution arising from waste disposal in many developing countries.[8]

In Nigeria, open-dump is the most available option for waste disposal in the state capitals as sanitary landfill is rare and unpopular.[11] Complex geochemical processes control the enrichment of heavy metals in groundwater.[12] The chemistry of groundwater depends not only on natural factors such as the lithology of the aquifer, the quality of recharge waters and the types of interaction between water and aquifer, but also on human activities, which can alter these fragile groundwater system, either by polluting it or by changing the hydrological cycle.[13]

The application of conventional refuse and sewage treatment systems in use in industrialized nations may not be realistic for developing countries due to their high cost of construction and maintenance. Hence, the need to develop a practical home-based waste disposal and treatment system that could be easily integrated into the climatic, geological and socio-cultural conditions existing in these nations is the focus of the paper.[14] This method of waste disposal is environmentally friendly, as well as relatively low system capital and operating cost. It has a simple design that is a function of the local geology and available materials and when adopted and practiced will certainly protect the groundwater from contamination.

Municipal wastes and their disposal mechanisms are a great concern in developing countries across the world, as poverty, over-population and rural-urban drift due to urbanization in addition to non-enforcement of existing sanitary laws on offenders as well as poor-funding by

governments of these countries are responsible for the inefficient management of wastes.[4] Domestic and industrial wastes contain a number of harmful microorganisms and trace elements and their presence in groundwater can result in an outbreak of water-borne diseases such as typhoid, diarrhea, hepatitis and gastro-intestinal infections.[8] Most of these diseases are unfortunately still rampant in most developing countries today and are known to be the causes of many deaths, especially within the vulnerable group (children and women). Poor waste management in these countries favours the outbreaks of water-borne diseases. Therefore, improvement on existing waste disposal methods (open dumps) and introduction of new techniques that quarantee high level of health safety as well as groundwater protection as advocated in this research should be encouraged by concerned stakeholders.[15]

In most cities in developing countries, it is common to see huge heaps of domestic and allied wastes such as garbage, plant leaves, damaged agricultural produce, spoiled food materials, pieces of paper, polythene bags, old cloths, wood, abandoned metals, vehicle scraps, used tires, plastics, glass, dust, damaged electronics, industrial wastes, animal wastes, hospital wastes, sanitary pads, pampers, construction materials and demolition debris resulting from over-population, urbanization and industrialization.[1] When these wastes are improperly disposed, which is usually the case in major cities in Nigeria, they constitute threats to air, land, water and man. During decomposition, it produces bad smell and serves as feeding ground for pests that spread diseases, blockage to drainage channels and creating a myriad of health-related and environmental problems. Leachates from the decomposition of these wastes at dumpsites are potential sources of soil and water pollution.[16]

Addressing the waste management challenges in Nigeria requires a comprehensive approach that includes improving infrastructure, enhancing policy enforcement, raising public awareness, and

supporting the informal sector.[17] Investment in modern waste processing and recycling facilities, coupled with effective waste collection services, can significantly improve the efficiency and sustainability of the waste management system. Strengthening policy enforcement and increasing public awareness and participation are also crucial for achieving long-term success. By adopting an integrated approach to waste management, Nigeria can protect public health, preserve the environment, and support economic development, ultimately creating a cleaner, healthier, and more sustainable future for its citizens.[18]

1.2 Statement of the Problem

In Nigeria, effective waste management is a critical issue that significantly impacts public health, environmental sustainability, and urban development. The country faces considerable challenges in this area, primarily due to rapid urbanization, population growth, and industrialization, which have led to a surge in waste generation that outstrips the capacity of existing waste management systems.

A significant problem lies in the inefficiency of waste collection services. Many areas, particularly rural regions and informal settlements, do not receive regular and efficient waste collection. This gap results in the accumulation of waste in public spaces, creating health risks and contributing to environmental pollution. The lack of infrastructure and logistical support further exacerbates this issue, making waste collection sporadic and unreliable.

Another major concern is the inadequacy of waste processing and recycling facilities. Nigeria has only a limited number of such facilities, leading to most waste being disposed of in landfills or open dumpsites without proper treatment. This practice results in severe environmental consequences, including soil and water contamination and the release of greenhouse gases.

Poorly managed landfills and dumpsites, which do not comply with environmental standards, pose additional risks by spreading diseases and contaminating nearby water bodies.

The enforcement of waste management policies and regulations is another critical issue. Despite the existence of several policies aimed at regulating waste management, their enforcement is often weak due to a lack of political will, insufficient funding, and corruption. This inadequate enforcement leads to ongoing poor waste management practices and a lack of accountability among waste management authorities.

Public awareness and participation in waste management practices are generally low in Nigeria. Many citizens are not well-informed about proper waste disposal methods, and community involvement in waste management initiatives is limited. This lack of awareness and engagement further complicates efforts to promote recycling and responsible disposal practices, making it difficult to achieve significant improvements in waste management. Additionally, the informal sector plays a significant role in waste management, especially in recycling activities. However, workers in this sector often operate without proper regulation, support, or safety measures. This situation not only poses health risks to these workers but also results in inefficiencies and missed opportunities for improving the overall waste management system.

1.3 Justification of the Study

The justification for studying waste management practices in Nigeria stems from the urgent need to address the multifaceted challenges associated with inadequate waste disposal systems. This study is crucial for several reasons, each highlighting the importance of a comprehensive examination and intervention to improve public health, environmental sustainability, economic development, policy enforcement, community engagement, and support for the informal sector.

First and foremost, effective waste management is essential for protecting public health. Inadequate waste disposal practices in Nigeria have led to significant health risks, including the spread of diseases such as cholera, malaria, and dysentery, which are transmitted by pests and rodents attracted to accumulated waste. Moreover, the improper handling of hazardous waste can result in the release of toxic substances, posing severe health threats to the population. By assessing current waste management practices, this study aims to identify critical gaps and propose solutions to mitigate these health hazards, thereby safeguarding public health.

Environmental sustainability is another compelling reason for this study. Nigeria's existing waste management practices often result in environmental degradation, including soil and water contamination, air pollution, and greenhouse gas emissions from poorly managed landfills and open dumpsites. These environmental issues have far-reaching impacts on natural ecosystems and biodiversity. This study seeks to highlight the environmental consequences of inadequate waste management and recommend sustainable practices that can help protect natural resources, reduce pollution, and promote ecological balance.

From an economic perspective, effective waste management is vital for fostering economic growth and development.[19] Proper waste management systems can create numerous job opportunities in waste collection, recycling, and processing industries. Additionally, well-managed waste systems enhance the cleanliness and aesthetic appeal of urban areas, making them more attractive for tourism and investment. By identifying efficient waste management strategies, this study aims to unlock economic opportunities, drive development, and contribute to Nigeria's overall economic prosperity.

The study is also justified by the need to enhance policy frameworks and their implementation. Despite having several waste management policies, Nigeria often faces challenges in their

enforcement due to lack of political will, insufficient funding, and corruption. This study will critically assess the effectiveness of current policies and provide insights into how they can be better implemented and enforced. Strengthening policy frameworks is essential for establishing a robust and reliable waste management system that can address existing challenges and prevent future issues.

Low public awareness and participation in waste management practices further complicate the situation in Nigeria.[20] Many citizens are not well-informed about proper waste disposal methods, and community involvement in waste management initiatives is limited. This lack of awareness and engagement hinders efforts to promote recycling and responsible waste disposal. By examining the level of public awareness and the role of community involvement, this study can recommend strategies to increase public engagement and foster a culture of responsible waste management.

The informal sector plays a significant role in waste management in Nigeria, particularly in recycling activities. However, workers in this sector often operate without proper regulation, support, or safety measures, exposing them to health risks and resulting in inefficiencies.[21] This study will explore the contributions and challenges of the informal sector, providing recommendations for integrating and supporting these workers within the formal waste management system. Such integration can enhance overall efficiency, safety, and sustainability.

Lastly, Nigeria's rapid urbanization and population growth have led to increased waste generation, putting immense pressure on existing waste management systems. Addressing the implications of these demographic trends is crucial for developing scalable solutions that can effectively manage the growing waste and ensure sustainable urban development.

1.4 Aim and Objectives of the Study

The research aims is to examine and assess solid waste management practices in the Ibadan south east local government, Ibadan, Oyo state; it also studies the classes of waste generated, how are generated waste disposed and treated in the locality, it explores the opposing factor of effective and sustainable solid waste management in the area and at the end proposes suitable and possible measures to address the challenges and problems.

The Objectives are to:

i. Describe and explain the current waste disposal practices in Ibadan south east LGA
ii. Assess the waste management system and the level of awareness in Ibadan south east LGA.
iii. Explore the challenges of waste disposal practices and provided solution to prevent the complications which arose from poor waste management in Ibadan south east LGA.

1.5 Research Questions

1. What are the current waste disposal practices in Ibadan south east LGA?
2. What are the rates of waste management system situation, level of awareness and how frequent are solid waste collected and disposed in Ibadan south east LGA?
3. What are the challenges of waste disposal practices in Ibadan south east LGA?

1.6 Significance of the Study

This study is of great importance to waste management stakeholders as it outlines the challenges facing household waste management and the impact of these challenges on residents in peri-urban areas. This study is of great importance to governments as it outlines the challenges faced

by households in addressing waste management issues. This will help develop policy options that improve participation in household waste management options.

This study complements existing knowledge and is therefore of great importance to researchers. The recommendations of this study suggest research gaps that require further study and thus provide a basis for further research in the future. This study provides baseline data on waste management practices and the current state of Ibadan southeast Local government's household waste management practices. Additionally, it serves as a starting point for further research and may serve as a document for future use.

1.7 Scope of the Study

The study was conducted in Ibadan south east, Ibadan, Oyo state. The research focused on 365 respondents in Ibadan south east in order to assess waste management situation, the types and sources of solid waste generated, the level of awareness, practices and challenge of people toward solid waste management in Ibadan southeast.

1.8 Limitation of the Study

The major limiting factor during the questionnaire survey, not all were able to cooperate, some residents refused to attend to me perhaps due to unstable security situation in state people are skeptical about any information as they believe data collected might be processed for another purposes.

1.9 Operational Definition of Terms

Household Waste – Household waste is single-use material that occurs in households. This waste includes non-hazardous waste and hazardous waste. Harmless waste includes leftovers,

paper, bottles, etc. that can be recycled or composted. Examples of hazardous waste include batteries and household cleaning products. It is important to handle hazardous waste in a safe manner and dispose of it properly to avoid harm.

Household Waste Management - includes all necessary measures and plans for the correct disposal of household waste

Waste - Waste (or **wastes**) is material that is no longer needed or usable. Waste is material that is disposed of after primary use or is worthless, defective and useless. By- products, on the other hand, are co-products of relatively low economic value. Waste can become a by- product, a common product, or a resource through inventions that increase the value of waste beyond zero.

Municipal Waste - wastes generated from houses, streets and public places, shops, offices and hospitals

Practice - something that is usually or regularly done as a habit, tradition, or convention. The act of doing something regularly or repeatedly.

Endnotes

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Chapter Two

Literature Review

This chapter reviews the strategies and processes of Solid Waste Management. This covers waste handling practices such as generation, storage, sorting, collection, transportation and disposal of waste. This chapter further reviews literature on solid waste management which revolves around developed and developing countries with particular reference to Nigeria.

2.1 Conceptual Review

2.1.1 Definition and Characterization of Waste

Waste is a human concept: it is seen by people in different ways. Scholars have defined it in diverse ways. The World Health Organisation (WHO) refers to waste as something which the owner no longer wants at a given time and space and has no current or perceived market value. It is also recognized as something which is no longer useful to the owner or fails to fulfil its purpose. It is postulating that waste are unwanted or undesired materials left over after the completion of a process. Waste is also defines waste as "any solid, liquid or gaseous substance or materials which being a scrap or being super flows, refuse or reject, is disposed off or required to be disposed as unwanted".[1] The above definitions emphasized that waste is basically unwanted material by the owner. However, waste is seen to be in diverse forms or phases (solid, liquid and gas).

The sources of solid waste include residential, commercial, institutional, and industrial activities. Certain types of wastes that cause immediate danger to exposed individuals or environments are classified as hazardous; these are discussed in the article hazardous-waste management. All nonhazardous solid waste from a community that requires collection and transport to a

processing or disposal site is called refuse or municipal solid waste (MSW). Refuse includes garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. Garbage is highly putrescible or decomposable, whereas rubbish is not. Trash is rubbish that includes bulky items such as old refrigerators, couches, or large tree stumps. Trash requires special collection and handling.

Construction and demolition (C&D) waste (or debris) is a significant component of total solid waste quantities (about 20 percent in the United States), although it is not considered to be part of the MSW stream. However, because C&D waste is inert and nonhazardous, it is usually disposed of in municipal sanitary landfills.

Another type of solid waste, perhaps the fastest-growing component in many developed countries, is electronic waste, or e-waste, which includes discarded computer equipment, televisions, telephones, and a variety of other electronic devices. Concern over this type of waste is escalating. Lead, mercury, and cadmium are among the materials of concern in electronic devices, and governmental policies may be required to regulate their recycling and disposal.

Solid-waste characteristics vary considerably among communities and nations. American refuse is usually lighter, for example, than European or Japanese refuse. In the United States paper and paperboard products make up close to 40 percent of the total weight of MSW; food waste accounts for less than 10 percent. The rest is a mixture of yard trimmings, wood, glass, metal, plastic, leather, cloth, and other miscellaneous materials. In a loose or uncompacted state, MSW of this type weighs approximately 120 kg per cubic metre (200 pounds per cubic yard). These figures vary with geographic location, economic conditions, season of the year, and many other

factors. Waste characteristics from each community must be studied carefully before any treatment or disposal facility is designed and built.

In this research the attention will be on the solid waste than the liquid and the gaseous waste. For this paper, we classify waste into industrial waste, electronic waste, municipal solid waste (MSW), and medical waste.

Industrial Waste

There are many types of materials with different levels of environmental toxicity that constitute industrial waste. Materials of this type typically include metals, textiles, food processing by-products, straw, solvents, sludge, plastics, ceramics, glass, abrasives and leather, paper, etc. The lack of an organized and modernized database on industrial waste makes accurate estimation of production rates impossible.[2] Production rates vary from country to country and from one stage of development to another[3]. They are used as inexpensive adsorbents to clean water contaminated with metals. Most industrial waste needs to be treated to increase absorption capacity. Industrial waste such as sludge, slag, fly ash and red mud have been used to treat wastewater by removing toxic chemicals. They are competitive alternatives to effective adsorbents due to their accessibility, efficiency They are often generated as waste or by-products of industrial processes and low cost[4].

Electronic Waste

Consumer electronics, computers and home appliances such as cell phones, air conditioners, refrigerators, gas stoves and washing machines are all part of the ever-expanding e-waste[5]. . Most people consider them e-waste. This waste contains a variety of harmful compounds (brominated flame retardants (BFRs), heavy metals) as well as valuable materials such as metals

and plastics[6]. Two important global problems have emerged due to e-waste: the power sector cannot continue due to lack of mineral resources and the potential risk to human health and related environmental hazards to the informal recycling process[7].

Municipal Waste

Household waste is part of municipal solid waste, but it is not the only waste; Industrial and commercial waste are also included[8]. Around the world, the volume of MSW generated has increased significantly. Globally, about two billion tons of MSW are generated. Currently, 85% of this waste is collected and 15% is recycled[9]. A country's socioeconomic status is determined by its MSW composition[10]. In general, high-income countries are the largest producers of MSW with large amounts of plastic, paper and other inorganic waste. At the same time, waste streams from low- and middle-income countries contain higher proportions of organic matter[11]. Developed countries around the world often carry out proper municipal waste treatment using advanced technologies such as sanitary landfills, thermal and biological treatment of specific types of waste. These processes require large investments and technical expertise to operate; however, they aim to negate the negative effects of urban waste. In most developing countries, a significant proportion of MSW is burned in the open or dumped in landfills with or without sequential gas and leachate treatment techniques[12]. Current environmental challenges such as global climate change, ozone layer depletion, public health risks and damage to ecosystems are caused by inappropriate waste disposal through open burning, dumping Indiscriminate waste and unsanitary landfills[13]. Furthermore, decision-making in MSW management requires a comprehensive assessment to minimize the risks associated with negative impacts.[14]

Medical Waste

Waste from agriculture, industry, construction and healthcare also has a significant negative impact on the environment and must be managed appropriately[15]. More specifically, the provision of health services frequently leads to the generation of specific forms of waste. These factors can pose threats to human health and the environment. The majority of MW comes from hospitals and other healthcare facilities. Storing MW at a medical facility or transporting this potentially hazardous waste to a treatment facility is very risky. The transportation of these dangerous goods poses public health risks as well as workplace risks associated with the storage and transportation of these products[16]. Typically, 85% of the waste generated by medical facilities is classified as general waste. However, the remaining 15% is highly contagious or toxic wastes[17]. The potential environmental and public health risks associated with solid waste, including its high potential for disease outbreaks, make their collection and treatment important. This remains a major concern, especially in healthcare facilities in developing countries where economic and social constraints and inadequately trained staff are responsible for handling hazardous substances. this waste. Due to the infectious nature and foul odor of waste, inappropriate behavior and improper waste management and disposal techniques pose a significant threat to public health and cause environmental pollution. Current medical waste treatment methods are not standardized in medical facilities. But the difficulty lies in all hospitals and at all stages of waste management[18].

2.1.2 Source and Composition of Solid Waste

In urban areas, there are several places that waste especially solid ones are generated. In a study conducted in Cape Town, it was indicated that most waste generated in the city is from places

such as household, market, school, hospital, industries and work place. Also, as people gather at a point for a function, they tend to generate waste. These functions include: meetings, parties funerals and so on. Solid waste consists of different materials: there are some that can be burnt, recycled and others that cannot. It is argued that solid waste compose of combustible and non-combustible material. The combustible are materials that can burn easily; these include paper, plastics, wood, textiles and disposable diapers. Whiles non- combustible is the opposite, materials that are difficult to burn, for example, glass, metals, bones and aluminium. Also solid waste can be classified as biodegradable (those that can be recycled) and non- biodegradable (those that cannot be recycled).

2.1.3 Waste Management Practices

Waste management practice focuses on people participating in waste management activities such as waste disposal, separation of waste, recycling etc. Proper waste management practice is essential for quality of life. This will avoid dangers associated with improper waste management like flood, diseases etc.

According to a study, Nigeria witnessed flood disaster as a result of improper disposal of refuse leading to destruction of several houses, loss of lives and destruction of properties. This is a result of the negative waste management practice by Nigeria residents. The department of health in South African emphasised that most of the major consequences of inadequate waste collection and disposal system among urban poor communities in developing countries poses threat of diseases outbreak. For instance, diseases such as malaria and cholera are the commonest diseases suffered in Zambia, Nigeria, Kenya and Zimbabwe. It was further argued that in Zambia 767 cases of cholera and 2938 cases of malaria were recorded at Gokwe growth point in 1999. This

situation can also be found in Ghana. People get infected due to improper waste management practices.

Studies have posited that instead of waste being perceived as a problem, it could be converted into a positive tool for improvement in people‟s lives. For example, a study observed in Kampala that households recycled waste from metal into charcoal stoves and convert straws into bags and mats. Another study also observed in Egypt a large scale of innovative and efficient waste recovery, reuse and recycling operation is run by Zabbalen, a group of over 50,000 people involved in the business of waste collection and processes. He added that 80% of all collected plastics, metals and other component of waste stream are recovered and recycled. This is a sign of good practice that will prevent diseases and bring about economic growth.

Empirical findings found in literature have portrayed people‟s practice on waste management. For instance, a study conducted in some markets in Kumasi such as Adum, Kajetia, Roman hill and Central Market revealed that people‟s negative practice to waste management is due to some factors inhibiting proper waste management such as inadequate dustbins and lack of education on waste management given to market women. He added that, the few waste containers in the market centres are farther away from the sellers. This makes residents dispose off waste around their surroundings. However, there is the need for adequate dustbins, law enforcement and education to help minimize this problem. Understanding behaviour is critical to minimising municipal solid waste but there are significant barriers such as lack of knowledge among the general public as well as social norms that adversely affect waste practice. However there is the need for government to ensure that the public receive education on proper waste management practices.

Another study argued that residents in Sta. Rosa City, Luguna exhibited favourable practice on waste management. It was found that majority (65%) of the respondents segregate, recycle and reuse their waste. Recycling and reuse of waste help reduce the quantity of waste sent to the landfill sites. However, studies in Luguna showed that in Calamba, there is recycling of waste but most of the respondents do not segregate their waste. Residents‟ actions towards waste management practice indicate that there is inadequate knowledge on recycling.

Some common waste management practices include:

Open Air Burning

Among the various waste treatment methods, open burning is a popular treatment method used by many businesses and individuals. It is the act of burning waste and is done in open environments, usually on the ground and behind buildings. Kerosene is often added to aid combustion when higher temperatures are required. Waste includes recyclable materials, for example cardboard, paper, polyethylene and plastic; These materials simply burn without using kerosene because they are flammable material[19]. Due to the reduced volume of waste, this method is adopted by many urban centers and thus prolongs the life of landfills. The release of gases such as halohydrides, nitrogen oxides and carbon oxides during this process has a significant impact on the environment. Therefore, they contribute to global climate change, ozone layer depletion and acid rain. Additionally, the reaction of sunlight with carbon monoxide, a greenhouse gas, creates harmful ozone layer[20]. . In addition to harmful effects on humans and the environment, respiratory diseases such as asthma can be exacerbated by emissions from this activity. Additionally, a group of toxic chemicals produced by this method can stick to plants or

settle into waterways. This, in turn, affects the end users of these water bodies or plants, which are considered a simple and cost-effective means of waste disposal[21].

Landfilling

The storage of waste on or over an area of land is considered a landfill. The goal of this measure is to avoid interaction between waste and the surrounding environment, mainly surface water. It is the primary waste treatment method used in urban areas and continues to be an important technology for municipal solid waste management. A large portion of MSW collected worldwide is disposed of in landfills. This practice is an inexpensive method of waste disposal and is available in most communities[22]. However, it does pollute the environment to a large extent[23]. It is a common practice in developing nations of the world such as Nigeria, this practice is at a low position on disposal method hierarchy in comparison to other waste disposal practices such as composting, landfilling, incineration, and it accounts for over 50% of MSW both in high and low-income nations except few Europeans nations. Residuals from other waste disposal practices end up in landfills[24]. Therefore, it is an essential part of solid waste management gear towards the conservation of resources and ensuring the protection of the environment and health. Though developed nations have achieved the latter while developing countries like Nigeria are still contending with health and environmental protection arises from poor solid waste management[25]. There are specific negative environmental impacts of poorly managed landfills, including pests and dissolved pollutants that have the potential to leach into groundwater, thereby polluting the water[26].

Composting

Composting is a controlled technique that improves the aerobic decomposition of organic waste, producing a moistened product that can be recycled primarily for agricultural purposes. This

practice is one of the most essential tools for waste management. Recently, it has gradually been used as a remedial measure to remove biodegradable pollutants from soils and control the availability of heavy metals in plant decontamination strategies. This practice helps optimize resource recovery from waste, which can also increase soil fertility and promote its use in bioremediation of contaminated soils.[27] Compost is never fertilizer. It is best used to improve the structure of the oil. However, higher quality fertilizer can be achieved by adding sufficient nitrogen, phosphorus and potassium. This practice can be performed in both aerobic and anaerobic states. For most composting systems operating under aerobic conditions, due to the lower energy/unit weight of organic material separated, this is necessary. However, the compost formation time is long; Odor problems remain due to exposed materials and the lower temperature of the composting organisms.[28] Fertilizer is produced; This waste management practice is a good soil amendment, ideal for Nigerian soils that produce good crops. This can serve as a locally produced supplement to inorganic fertilizers to ensure agricultural sustainability and address the challenge of food insecurity in Nigeria as well as in other countries. other in the world[29]. Effective use of this method will improve crop yields well, bring profits and promote conservation of natural resources. It is environmentally acceptable compared to other waste disposal methods[30].

Composting offers a method of processing and recycling both garbage and sewage sludge in one operation. As more stringent environmental rules and siting constraints limit the use of solid-waste incineration and landfill options, the application of composting is likely to increase. The steps involved in the process include sorting and separating, size reduction, and digestion of the refuse.

Sorting and Shredding

The decomposable materials in refuse are isolated from glass, metal, and other inorganic items through sorting and separating operations. These are carried out mechanically, using differences in such physical characteristics of the refuse as size, density, and magnetic properties. Shredding or pulverizing reduces the size of the waste articles, resulting in a uniform mass of material. It is accomplished with hammer mills and rotary shredders.

Digesting and Processing

Pulverized waste is ready for composting either by the open windrow method or in an enclosed mechanical facility. Windrows are long, low mounds of refuse. They are turned or mixed every few days to provide air for the microbes digesting the organics. Depending on moisture conditions, it may take five to eight weeks for complete digestion of the waste. Because of the metabolic action of aerobic bacteria, temperatures in an active compost pile reach about 65 °C (150 °F), killing pathogenic organisms that may be in the waste material.

Open windrow composting requires relatively large land areas. Enclosed mechanical composting facilities can reduce land requirements by about 85 percent. Mechanical composting systems employ one or more closed tanks or digesters equipped with rotating vanes that mix and aerate the shredded waste. Complete digestion of the waste takes about one week.

Digested compost must be processed before it can be used as a mulch or soil conditioner. Processing includes drying, screening, and granulating or pelletizing. These steps improve the market value of the compost, which is the most serious constraint to the success of composting as a waste management option. Agricultural demand for digested compost is usually low because of the high cost of transporting it and because of competition with inorganic chemical fertilizers.

Incineration

High-temperature controlled combustion (from 9,000 to 12,000 degrees Celsius) produces gas and ash during combustion. During this procedure, the waste is burned. This is a volume reduction strategy that when applied correctly can reduce waste volume by up to 90%. Although this method reduces the amount of waste that must be incinerated, it does not replace landfilling. Completely incinerate hazardous materials. Although this practice is widely practiced in underdeveloped countries like Nigeria, it has been criticized for wasting energy, raw materials and other natural resources needed for production. At high temperatures, waste production is determined by combustion. Although this method can remove harmful microorganisms or toxins, it still requires the waste, after being reduced and reused, to be thrown into a landfill. Concerns about incineration arise from the fact that it poses a number of operational difficulties, including deterioration of air quality, toxicity, heavy metal leaching, and disposal of the ash produced. The cost of waste management through incineration is estimated to be 7 times the cost of landfilling[31]. Proposals have been made to reduce pollution by integrating scrubbers and exhaust gas cleaning systems inside the incinerators[32].

Incineration has become a good alternative because landfills are expensive and the space needed is limited. This approach has comparative advantages over waste and composting. It is more efficient and effective in waste management due to its relatively small space, reducing waste and producing electricity. However, this approach has problems such as inappropriate locations, excessive production of fly ash and lack of environmental impact assessment. Therefore, ensuring the safety of this activity for public health and the environment is necessary[33].

Incineration is a very effective method of reducing the volume and weight of solid waste, though it is a source of greenhouse gas emissions. In modern incinerators the waste is burned inside a

properly designed furnace under very carefully controlled conditions. The combustible portion of the waste combines with oxygen, releasing mostly carbon dioxide, water vapour, and heat. Incineration can reduce the volume of uncompacted waste by more than 90 percent, leaving an inert residue of ash, glass, metal, and other solid materials called bottom ash. The gaseous by-products of incomplete combustion, along with finely divided particulate material called fly ash, are carried along in the incinerator airstream. Fly ash includes cinders, dust, and soot. In order to remove fly ash and gaseous by-products before they are exhausted into the atmosphere, modern incinerators must be equipped with extensive emission control devices. Such devices include fabric baghouse filters, acid gas scrubbers, and electrostatic precipitators. Bottom ash and fly ash are usually combined and disposed of in a landfill. If the ash is found to contain toxic metals, it must be managed as a hazardous waste.

Municipal solid-waste incinerators are designed to receive and burn a continuous supply of refuse. A deep refuse storage pit, or tipping area, provides enough space for about one day of waste storage. The refuse is lifted from the pit by a crane equipped with a bucket or grapple device. It is then deposited into a hopper and chute above the furnace and released onto a charging grate or stoker. The grate shakes and moves waste through the furnace, allowing air to circulate around the burning material. Modern incinerators are usually built with a rectangular furnace, although rotary kiln furnaces and vertical circular furnaces are available. Furnaces are constructed of refractory bricks that can withstand the high combustion temperatures.

Combustion in a furnace occurs in two stages: primary and secondary. In primary combustion, moisture is driven off, and the waste is ignited and volatilized. In secondary combustion, the remaining unburned gases and particulates are oxidized, eliminating odours and reducing the

amount of fly ash in the exhaust. When the refuse is very moist, auxiliary gas or fuel oil is sometimes burned to start the primary combustion.

In order to provide enough oxygen for both primary and secondary combustion, air must be thoroughly mixed with the burning refuse. Air is supplied from openings beneath the grates or is admitted to the area above. The relative amounts of this underfire air and overfire air must be determined by the plant operator to achieve good combustion efficiency. A continuous flow of air can be maintained by a natural draft in a tall chimney or by mechanical forced-draft fans.

Energy Recovery

The energy value of refuse can be as much as one-third that of coal, depending on the paper content, and the heat given off during incineration can be recovered by the use of a refractory-lined furnace coupled to a boiler. Boilers convert the heat of combustion into steam or hot water, thus allowing the energy content of the refuse to be recycled. Incinerators that recycle heat energy in this way are called waste-to-energy plants. Instead of a separate furnace and boiler, a water-tube wall furnace may also be used for energy recovery. Such a furnace is lined with vertical steel tubes spaced closely enough to form continuous sections of wall. The walls are insulated on the outside in order to reduce heat loss. Water circulating through the tubes absorbs heat to produce steam, and it also helps to control combustion temperatures without the need for excessive air, thus lowering air pollution control costs.

Waste-to-energy plants operate as either mass burn or refuse-derived fuel systems. A mass burn system uses all the refuse, without prior treatment or preparation. A refuse-derived fuel system separates combustible wastes from noncombustibles such as glass and metal before burning. If a turbine is installed at the plant, both steam and electricity can be produced in a process called cogeneration.

Waste-to-energy systems are more expensive to build and operate than plain incinerators because of the need for special equipment and controls, highly skilled technical personnel, and auxiliary fuel systems. On the other hand, the sale of generated steam or electricity offsets much of the extra cost, and recovery of heat energy from refuse is a viable solid-waste management option from both an engineering and an economic point of view. About 80 percent of municipal refuse incinerators in the United States are waste-to-energy facilities.

Sanitary Landfill

Land disposal is the most common management strategy for municipal solid waste. Refuse can be safely deposited in a sanitary landfill, a disposal site that is carefully selected, designed, constructed, and operated to protect the environment and public health. One of the most important factors relating to landfilling is that the buried waste never comes in contact with surface water or groundwater. Engineering design requirements include a minimum distance between the bottom of the landfill and the seasonally high groundwater table. Most new landfills are required to have an impermeable liner or barrier at the bottom, as well as a system of groundwater-monitoring wells. Completed landfill sections must be capped with an impermeable cover to keep precipitation or surface runoff away from the buried waste. Bottom and cap liners may be made of flexible plastic membranes, layers of clay soil, or a combination of both.

Constructing the Landfill

The basic element of a sanitary landfill is the refuse cell. This is a confined portion of the site in which refuse is spread and compacted in thin layers. Several layers may be compacted on top of one another to a maximum depth of about 3 metres (10 feet). The compacted refuse occupies about one-quarter of its original loose volume. At the end of each day's operation, the refuse is covered with a layer of soil to eliminate windblown litter, odours, and insect or rodent problems.

One refuse cell thus contains the daily volume of compacted refuse and soil cover. Several adjacent refuse cells make up a lift, and eventually a landfill may comprise two or more lifts stacked one on top of the other. The final cap for a completed landfill may also be covered with a layer of topsoil that can support vegetative growth.

Daily cover soil may be available on-site, or it may be hauled in and stockpiled from off-site sources. Various types of heavy machinery, such as crawler tractors or rubber-tired dozers, are used to spread and compact the refuse and soil. Heavy steel-wheeled compactors may also be employed to achieve high-density compaction of the refuse.

The area and depth of a new landfill are carefully staked out, and the base is prepared for construction of any required liner and leachate-collection system. Where a plastic liner is used, at least 30 cm (12 inches) of sand is carefully spread over it to provide protection from landfill vehicles. At sites where excavations can be made below grade, the trench method of construction may be followed. Where this is not feasible because of topography or groundwater conditions, the area method may be practiced, resulting in a mound or hill rising above the original ground. Since no ground is excavated in the area method, soil usually must be hauled to the site from some other location. Variations of the area method may be employed where a landfill site is located on sloping ground, in a valley, or in a ravine. The completed landfill eventually blends in with the landscape.

2.1.4 Sustainable Roadmap for Solid Waste Management

Many solid wastes Authorities in Nigeria such as Abuja Environmental Protection Board, Anambra State Waste Management Authority (ASWAMA), Lagos State Waste Management Agency (LAWMA), Oyo State Solid Waste Management, Kaduna State Environmental Protection Authority, Rivers State Environmental Sanitation Authority, Kano State Refuse

Management and Sanitation Board employ the TSWMS as the first line of approach in the management process. To this effect, the waste management process and strategy have been tagged poor, due to the continued emergence of illegal dumps, blocked drainages, and deteriorated environment and public health that is as a result of poor management[33]. Even with the challenges attached to the TSWMS, when other strategies are employed, they could be faced with larger issues if not applied right. The constraints and benefit of each strategy are highlighted in the table below;

Table 1: Some Constraint and Benefit of Each Waste Management Strategy in Nigeria

S/N	Solid Waste Management Strategy	Constraint	Benefit
1.	Traditional Waste Management Strategy A. Generation/Characterisation B. Collection, C. Transportation And Disposal	Heavy Reliance On Government Policies and Authorities For Implementation, Segregation of Waste is Nearly Impossible, No Coordination of The Different Steps Since They Are Most Times not Exclusive, Limited Public and Environmental Awareness, Corruption e.t.c	Reasonably Cheap. No Technical Know-How Is Required.
2.	Waste Minimisation Strategy A. Waste Prevention B. Waste Reduction C. Waste Reuse D. Waste Recycle/Recovery	A. Nil B. Nil C. Nil D. Expensive, Technical Knowhow Is Required, Corruption, Reliance On The Government.	A. Cheap, No Technical Know-How Is Required. B. No Technical Know-How Is Required. C. No Technical Know-How Is Required. D. Provides An Alternate Source Of Revenue And Resource While Safeguarding The Environment.
3.	Technological Strategy A. Application Of GPS B. Application Of GIS C. Application Of Remote Sensing	Technical Know-How Is Required, Expensive, Hardware And Software Are Limited	Easy And Cheap Source Of Data Collection Tool Especially When Covering A Large Area And Population, Saves Time And Energy.

Source: Compile by the Author, 2023

Notwithstanding all the constraints listed above, all three strategies can be employed at different stages of the management process for optimal benefit to the waste management process in Nigeria as can be seen in Fig 2. 1 below.

Fig 2. 1: Showing a Road Map to a Sustainable Integrated Solid Waste Management Strategy. Source:[33]

The Fig 2. 1 above synchronized all waste management strategies, that, in one way or another, is employed by the Waste Authorities in Nigeria. Drawing from the rich benefits of the WMS to both the environment and the public, the researcher developed a Roadmap strategy starting from Waste prevention to Waste reduction and then to Waste reuse phase within the WMS process.[34] This goes a long way to reducing the volume of waste that would have occurred if this Road map is to be dutifully followed. Drawing from the TSWMS, the researcher introduces Wastes segregation which will be carried out at the point of Waste generation. This will enable a systematic waste collection process for all segregated waste to the Waste transportation phase (TSWMS) through an optimized route system that would apply GIS and Remote sensing technology (TcS), to the waste recycle plant or recovery plant (WMS) for all waste that can be recycled to a resource. [35] The bye products or waste that cannot be recovered are then disposed of after applying multi criteria analysis (TcS) such as distance to river, airport, major roads, advance road, slope, soil type future urban expansion to determine a suitable waste disposal site (TSWMS) for sustainable waste management. [36]

Heavy reliance on government policies and Waste Authorities can be remedied when the public is inculcated into every phase of the solid waste management process. Public education as well as awareness campaigns should be promoted in Nigeria. [37] If every citizen is conscious of the implications his/her waste has on the environment and public health there would be a huge reduction in the volume of waste generated. Education and enlightenment programs are key here and it would facilitate the development of technical know-how on the conversion of waste to resources thereby enlightening more people to embrace new technological strategy skills on areas in the management of waste. While embracing all the benefits of these strategies, the government still have a role to play in establishing a public partnership in the various phases of

solid waste management to limit the over-dependence exerted on them for waste management and increase efficiency in the management process, implementing and enforcing SWM policies as well as developing efficient avenues for the acquisition of subsidized technologies that are needed in the waste management process. [38]

However, Solid Waste Management (SWM) strategies commonly adopted by different state waste management Authorities in Nigeria with a view to developing a sustainable roadmap for the management of solid waste in Nigeria. It assessed the Traditional Solid Waste Management Strategy (TSWMS), Waste Minimization Strategy (WMS) as well as the Technological Strategy (TcS) employed, laying focus on their challenges and benefits. [39] The study observed, that waste management across various parts of Nigeria is poor, interwoven with several challenges at all phases of the management process with little benefits recorded on alternative SWM strategy. [40] Although most Waste Authorities rely heavily on the TSWMS, WMS and the TcS showed a better and promising alternative strategy when inculcated into the already existing strategy. This however, can be achieved with a strong public participatory role at all phases of the management process. Based on this finding, a roadmap for the actualization of a sustainable integrated solid waste management strategy framework was recommended for adaptation and adoption by the Nigerian SWM Authorities and Agencies.[41]

2.1.5 Ethical Issues and Legal Frameworks on Waste Management Practices

Nigeria is one of the largest waste producers in sub-Saharan Africa with a population of more than 200 million people.[42] Despite policies and regulations, waste management practices in the country are increasingly worrying. More than 32 million tons of solid wastes are generated each year, one-third of which is collected. Indiscriminate disposal has led to blockages in pipes and

clogging of water bodies.[43] Improper collection and treatment of waste is gradually leading to an environmental disaster, as the country currently does not have enough budget resources to implement an integrated waste management system in all states[44]. In most developing countries like Nigeria, laws, policies, statutes and regulations on waste management are underdeveloped and even those that do exist are poorly implemented. In general, laws related to waste management are largely well-developed and clearly presented. The poor state of the country's waste management system reflects the country's laws and policies[45]. There are some gaps in government policy on waste management, although the public is encouraged to participate in monthly clean-ups. However, the government has not provided disposal sites to reward people's efforts. In some states in the country, it is reported that there are no specific laws related to waste management and some people believe that this is because the institutional, legal and administrative framework for waste management is lacking. bad. Most government policies lack an implementation strategy. Furthermore, a review of the legal aspects of waste management has been proposed by others with a view to achieving the goals set for sustainable waste management. Furthermore, a comprehensive management approach has been proposed that includes waste prevention, reuse, recovery, recycling, composting and energy production. Although there are some good policies in place, proper implementation remains a big challenge; For example, a full environmental impact assessment must be submitted during project planning before approval. However, this essential regulation is often overlooked. Several authors have criticized the implementation and enforcement of environmental laws in Nigeria[46]. Environmental law enforcement is still a matter of concern; monitoring and managing the implementation of environmental laws has achieved very little success. Some of the challenges in law enforcement in Nigeria have socio-political and economic nuances. Furthermore, to

achieve sustainable waste management, appropriate policy and planning, in addition to enforcement of waste management laws, must be implemented[47].

2.1.6 Waste Characteristics in Nigeria

The characteristics of waste in Nigeria exhibit some distinct characteristics influenced by various factors such as rapid urbanization, population growth and industrial activities. The following paragraphs provide an overview of the characteristics of waste in Nigeria.

An important characteristic of waste in Nigeria is the high rate of waste generation. This is likely due to the rapid urbanization and population growth the country has experienced in recent years. As urban areas expand and more people live there, the amount of waste generated will increase significantly[48].

The waste composition in Nigeria is diverse and typically includes organic waste, plastic, paper, glass, metal, textiles and other miscellaneous materials. Municipal solid waste in Nigeria mainly consists of these materials, of which organic waste often constitutes a significant portion[49].

The informal waste sector plays a vital role in waste management in Nigeria. This sector includes garbage collectors and scavengers involved in waste collection and recycling activities. However, the informal waste sector often operates with limited resources and without appropriate equipment and infrastructure, which can lead to ineffective waste management practices[50].

Open dumping is a common waste disposal method in Nigeria, especially in low-income areas. This activity involves the indiscriminate disposal of waste in open areas, leading to environmental pollution, land degradation and the potential risk of disease spread[51].

Another characteristic of waste in Nigeria is the lack of proper waste segregation measures. Waste segregation is crucial for effective waste management, as it allows for recycling and proper disposal. However, in Nigeria, there is often a lack of awareness and infrastructure regarding waste segregation, leading to mixed waste streams and hindering recycling efforts[52].

The issue of electronic waste, also known as e-waste, is also a growing concern in Nigeria. With the increasing use of electronic devices, improper handling and disposal of e-waste can lead to environmental pollution and health hazards due to the presence of toxic substances. such as lead, mercury and cadmium[53].

2.1.7 Waste Management

Waste management is defined in diverse ways by authors. Waste management is the process of promoting waste reuse, reducing, recycling, waste prevention and composting of waste to reduce negative impacts on the environment. Another author also argued that waste management is all about waste reduction and recycling. Some other author also defined waste management as the administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment and disposal of waste. Consequently, a study proposed a comprehensive definition of solid waste management. According to them, solid waste management is that discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes.

They continue to argue that if solid waste management is to be accomplished in an efficient and orderly manner, the fundamental aspects and relationships involved must be identified and

understood clearly.[54] Hence, solid waste management incorporates the following: source separation, storage, collection, transportation and disposal of solid waste in an environmentally sustainable manner. The above definition given by these scholars, indicate that when waste is generated, it goes through some process before it is finally disposed off.

A study further explained that when waste is generated, it is first stored in either dustbins or skips. It is then collected and finally disposed off at landfill sites. Waste can be transferred from small collection equipment like tricycles and wheel barrows to bigger trucks for final disposal. The process of waste management will not be explained into detailed in this chapter because the researcher intends to look at the knowledge, attitude and practice of market women but not the technical men who deal directly with the disposal of the waste at the final landfill site.

Waste management is a comprehensive concept that includes all activities, practices and strategies aimed at effectively handling, destroying and disposing of waste materials[54]. The primary goal of waste management is to minimize the negative environmental and health impacts associated with waste while maximizing resource recovery and promoting sustainable practices.

The waste management process includes several key elements that work together to ensure proper waste management:

Waste Generation:

Waste generation refers to the process by which waste is generated from a variety of sources, including residential, commercial, industrial and institutional sectors. This is the first stage of the waste management cycle and involves the generation of different types of waste, such as solid waste, liquid waste, hazardous waste and non-hazardous waste. Waste arises from human activities, consumption patterns and production processes. It includes a variety of materials and substances that are discarded or rendered useless. Examples of waste generated include

household garbage, packaging materials, construction debris, industrial byproducts, wastewater, and chemical residues. The amount and composition of waste generated varies depending on factors such as population size, economic activities, lifestyle and waste management practices in a particular region or country. Urbanization, industrialization and rapid population growth often lead to increased rates of waste generation. Good waste management begins with identifying and classifying waste based on its characteristics, composition and potential impact on the environment and health. The waste is then classified to facilitate the subsequent waste management process. Segregation involves separating recyclable waste, organic waste, hazardous waste and other waste streams for appropriate treatment and disposal methods.[24] Waste production poses a significant environmental challenge as it can contribute to pollution, resource depletion and adverse effects on ecosystems and human health. Therefore, waste prevention and minimization strategies are important to minimize the amount of waste generated.

Waste Collection

Waste collection is an essential part of the waste management process, which includes the collection and treatment of waste from various sources such as households, businesses and public spaces. It plays a vital role in maintaining cleanliness, hygiene and environmental sustainability. Waste collection systems rely on appropriate infrastructure, including bins, containers or designated collection points. These infrastructure elements are strategically placed to ensure easy access and efficient waste collection. Different methods are used to collect waste, depending on the type of waste and available infrastructure. Common methods include kerbside collection, where waste is collected directly from households or businesses, and container collection, where waste is collected in centralized containers located at specific spots in residential or commercial

areas. Establishing a regular collection schedule is essential to ensure timely waste disposal and prevent buildup. Timelines are determined based on factors such as population density, waste generation rates and local regulations. In some waste collection systems, waste sorting and sorting takes place during the collection process. This involves separating recyclables, organic waste and residual waste to facilitate further processes processing or recycling[55].

Waste Transportation:

Waste transportation is an important aspect of the waste management process, involving the movement of collected waste from collection points to designated facilities for further management[56]. It plays a vital role in ensuring timely and safe transportation of waste while minimizing impact on the environment. An efficient waste transportation system is important for many reasons. Firstly, it is necessary to treat waste promptly to avoid its accumulation, which can lead to health hazards, environmental pollution and aesthetic problems. By maintaining cleanliness and hygiene, waste transportation contributes to a healthier living environment[57].

Second, proper waste transportation helps minimize the environmental impact associated with waste management activities. It reduces emissions from waste collection vehicles, reduces fuel consumption and reduces traffic congestion, thereby minimizing air pollution and reducing carbon emissions. Implementing sustainable waste transport practices, such as using cleaner fuel sources or optimizing routes to minimize travel distances, can further improve environmental sustainability[58].

In addition, an efficient waste transportation system helps prevent illegal dumping and littering. By ensuring that waste is transported to designated facilities, the risk of illegal waste disposal in unauthorized locations, which can be harmful to the environment and public health, is reduced[59].

Waste transportation infrastructure, such as secure waste transfer stations or landfill sites with proper containment measures, contributes to preventing accidental spills or releases during transportation[60].

Safety measures are a critical consideration in waste transportation. Adhering to proper handling techniques, utilizing appropriate vehicles, and complying with relevant regulations and guidelines ensure the protection of waste handlers, transportation personnel, and the general public. Training programs, safety protocols, and inspections play a vital role in minimizing occupational risks and ensuring safe transportation practices[61].

Waste transportation commonly utilizes specialized vehicles such as garbage trucks or waste transport containers. These vehicles are designed to safely transport different types of waste, including solid waste, liquid waste, hazardous waste and recyclable materials[62]. . Choosing the right vehicle depends on factors such as the volume and type of waste, distance and local infrastructure.

Optimizing waste transport routes through efficient routing and logistics is essential to minimize travel distances, optimize fuel consumption and reduce overall costs. Advanced technology and data analytics can be used to increase operational efficiency and improve waste transportation. Route optimization algorithms, real-time monitoring systems and geographic information system (GIS) integration contribute to the planning and execution of efficient waste transportation[63].

Waste Treatment and Disposal:

Waste treatment and disposal is an integral part of a waste management system that effectively manages and minimizes the environmental impact of waste. The waste treatment process uses a variety of techniques to change the characteristics of the waste, minimize its volume, and reduce potential damage to the environment and public health.

A common waste disposal method is incineration, which uses high temperatures to burn the waste and reduce its volume. Combustion can also produce energy in the form of heat or electricity. Composting is another widely used treatment process, especially for organic waste. This involves the natural decomposition of organic matter into nutrient-rich compost, which can be used as a soil amendment for agricultural and landscaping purposes[64].

Anaerobic digestion is a biological treatment process that decomposes organic waste in the absence of oxygen, creating biogas and digestion. Biogas, which mainly consists of methane, can be used as a renewable energy source, while decomposed waste can be used as fertilizer. Mechanical and biological processing (MBT) combines mechanical sorting techniques with biological treatment processes to separate recyclables from the mixed waste stream, thereby maximizing resource recovery[66].

When waste cannot be effectively treated or recycled, appropriate disposal methods will be used. Landfilling is one of the most common disposal methods worldwide. This involves the controlled disposal of waste in landfills designed to minimize environmental impacts such as groundwater pollution and emissions[67]. Deep well injection is used to dispose of certain hazardous or toxic wastes by injecting them into deep underground wells, thereby isolating them from the environment. Waste-to-energy facilities use advanced technologies to convert waste into energy, such as electricity or heat. These facilities can help reduce waste volumes while harnessing their energy content for productive use. Additionally, specialized treatment facilities are available to handle specific types of waste, such as hazardous or medical waste, ensuring their safe and proper disposal[68].

Integrated waste management approaches emphasize waste reduction, recycling, and sustainable treatment practices as key strategies to minimize the amount of waste requiring final disposal[69].

By adopting a comprehensive waste management approach that incorporates these principles, societies can optimize resource utilization, minimize environmental pollution, and promote a circular economy.

The following Treatment and Disposal of Hazardous Waste are;

Current Conditions

Hazardous waste management is variable in Nigeria, management of organic wastes from the oil sector and organic chemicals sector has in the past been fairly good, and in some cases still is. However, several in-house facilities for treatment and/or disposal of organic wastes have been allowed to fall into disrepair and have become unusable due to economic difficulties. The situation regarding inorganic wastes is worse, in that a significant proportion of in-house treatment systems have been allowed to fall into disrepair and have become derelict.

In addition, enterprises in Nigeria; are often failing to identify some hazardous wastes (either deliberately, because of unwillingness to pay for proper management or lack of available options for proper management, or unwittingly), secondly, some non-hazardous wastes are being incorrectly categorised as hazardous wastes.

Some hazardous wastes are however being identified and segregated and many of these are being "stored" pending later management. The term "storage" implies a future intention to do something with the material stored, but in Nigeria the term storage is used interchangeably with the term "disposal". Most "stores" are in reality waste dumps.

Issues

Not all hazardous waste generation can be avoided, similarly it is not practicable to reuse, recover, recycle or utilise all unavoidable hazardous wastes. There will always be a need for environmentally sound hazardous waste treatment and disposal.

Wastes, wastewaters, emissions and hazardous wastes are all inter-related. Treatment of hazardous wastes is principally aimed at reducing the hazardous nature of the waste in order to facilitate simpler final disposal. For example, toxic heavy metals may be precipitated as water insoluble hydroxides, the resultant sludge being dewatered and stabilized to give a non-toxic, non-hazardous, solid material for landfill and an effluent for wastewater treatment. Equally, wastewater treatment generally results in a hazardous sludge for treatment and disposal. Figure 2 is a general schematic illustrating industrial waste management activities and their inter-relationships.

As indicated above, where facilities exist, they are often poorly maintained and many have fallen into disuse. It is important to ensure that adequate facilities are developed to manage hazardous wastes currently being generated and likely to be generated in the future. This will require a combination of upgrading existing facilities and development of new facilities. Various national approaches to achieve this objective are discussed in the next section.

Whatever method is used to secure the development of necessary infrastructure, it is important that coherent plans should be produced, and that these are properly integrated with other inter-related plans such as the plans for municipal and solid waste management.

The waste management hierarchy generally takes precedence over the proximity hierarchy (e.g. it is better to recycle waste at a national facility than dispose of it locally).

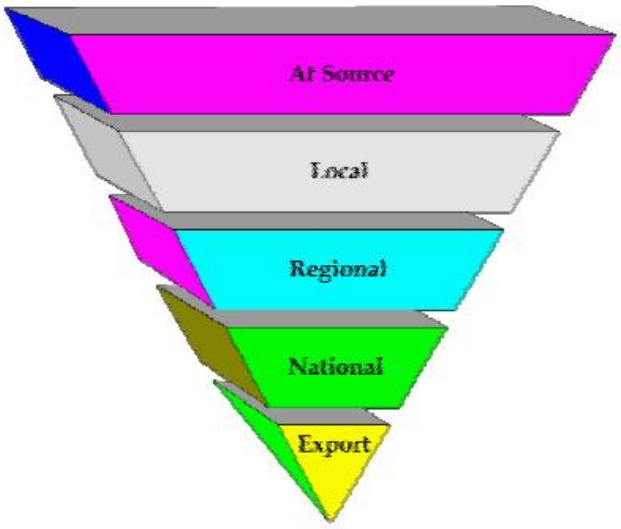

Figure 2. 3 – Proximity Hierarchy. Source: [70]

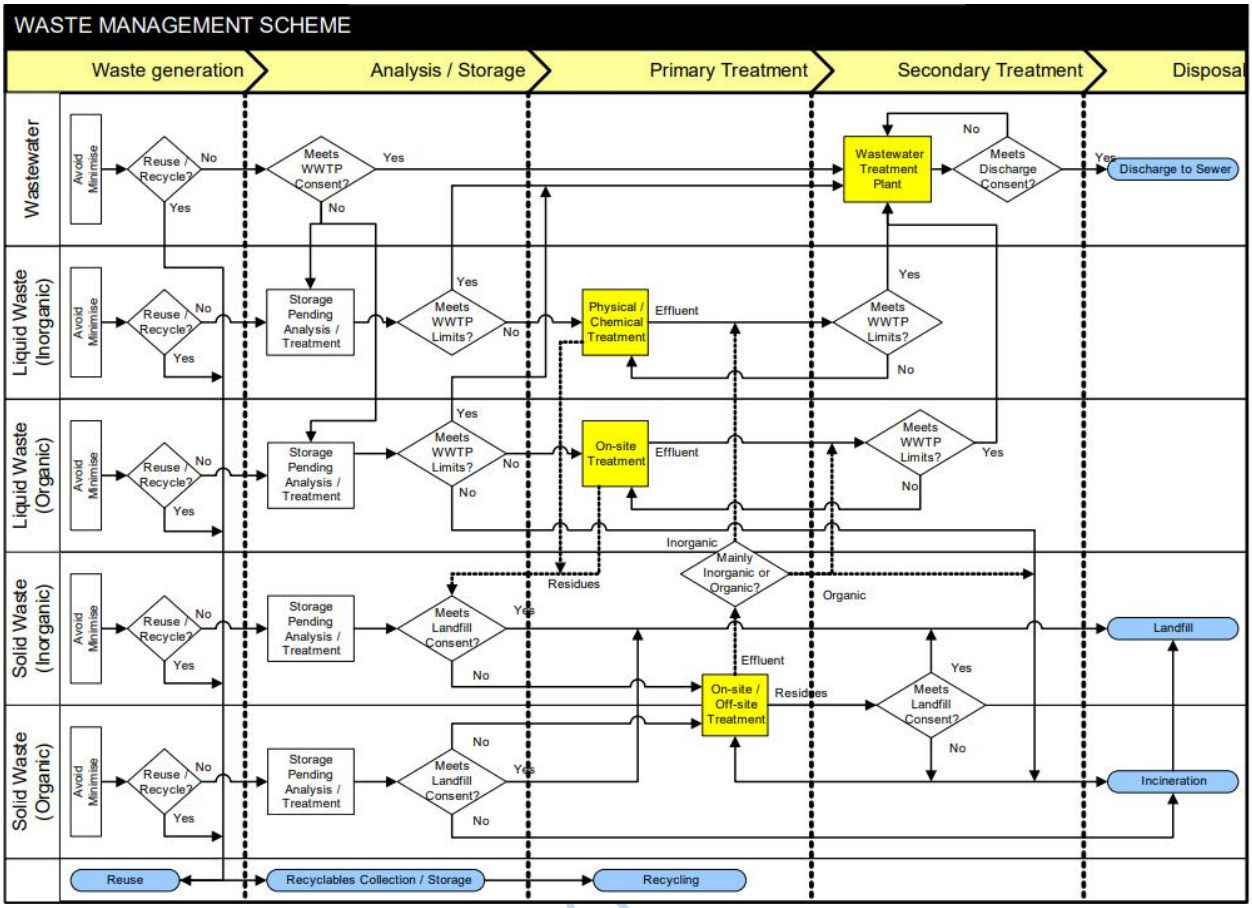

Figure 2.4: Schematic of Industrial Waste Management. Source: [71]

Monitoring and Regulation:

Monitoring and regulation are an integral part of the waste management system, ensuring environmental standards are met, tracking progress and protecting public health and the environment. environment[70]. Effective monitoring and regulation facilitate decision making, policy development and continuous improvement of waste management practices. Monitoring includes the collection and analysis of data on the production, processing, disposal and environmental impact of waste[71]. For example, waste composition analysis provides information about the type and quantity of waste generated, thereby guiding waste management strategies. Waste flow tracking helps monitor transportation routes, treatment facilities used and final disposal locations, helping to identify gaps and ensure assurance. Environmental monitoring is important to assess the impact of waste management activities on ecosystems, air quality, water resources and soil. It includes measuring parameters such as air emissions, landfill leachate, groundwater quality and soil pollution. Waste management regulation involves the development and enforcement of laws, policies and standards. Sorting and classifying waste are essential aspects of regulation, determining appropriate treatment and disposal methods. Licenses and permits ensure that waste management facilities comply with operational requirements, environmental protection measures and reporting obligations[72].

Waste management regulations often aim to promote waste reduction, recycling and resource recovery. They can set waste sorting goals, encourage recycling programs and set standards for waste-to-energy projects. Enforcement measures play an important role in waste management, ensuring compliance through inspections, audits and penalties. Sanctions for non-compliance may include fines, facility closure or legal action. Oversight and regulation work closely together to promote responsible waste management practices, measure performance and drive continuous

improvement of waste management systems. Implementing sustainable waste management practices is essential to achieving a circular economy, in which resources are conserved, waste is minimized, and materials are continually reused, recycled or Reuse. This requires collaboration between government agencies, industries, communities and individuals to promote waste minimization, source separation and responsible waste management practices.

Identification and Assessment of Existing Facilities

Interim Storage of Hazardous Waste

Wastes may be stored at the point of generation, pending transfer to longer term storage, landfill or for further management (reuse, recovery, recycling, treatment or disposal). This "interim" storage is often under very poor conditions with very poor containment of wastes.

Waste Treatment and Disposal at Source

In common with many countries with transitional economies, many of Nigeria's industries have old, outdated, inefficient processes and equipment. This is particularly true of waste treatment and disposal systems where these exist.

Many factories have in the past have had physical/chemical treatment systems and incineration systems which, due to economic pressures, have been allowed to fall into disrepair and have become inoperative as a result. Similarly, due to the general decline some factories have opted not to use their existing treatment facilities and also discharge wastes untreated or are stockpiling the wastes. Whilst this is a fairly general problem there are some examples of good practice too.

It is not uncommon for enterprises to compensate for lack of adequate wastewater treatment to rely on massive dilution of hazardous wastes to meet discharge consent concentrations.

Waste "Storage"

ICIM have estimated that approximately 500,000 tons of hazardous industrial wastes were accumulated and stored within various companies by the end of 2000. In theory this is temporary storage pending utilisation, recovery, recycling, treatment or final disposal/landfill. However, it is noted that such "temporary" storage clearly lasts more than two years in some cases, essentially changing the local storage area into an unprotected landfill, located on companies' sites.

The most commonly used storage methods are: bulk storage, storage in metallic containers and storage in basins/settling tanks. Storage conditions are often very poor and containment often poor - some metal containers observed holding wastes have almost completely rusted away.

Waste Collection and Transportation

Waste collection agents appear to be generally private companies and are essentially local enterprises rather than national organizations. Most of the existing collectors in Nigeria are municipal waste collection and transportation contractors and these largely only collect municipal wastes. Some of these collectors also collect refuse-type wastes from commercial and industrial sources, park wastes and construction and demolition wastes. These contractors claim not to collect any hazardous wastes.

There are waste recycling organizations that collect wastes from generators, some of these collect hazardous wastes, most notably waste oils, car batteries and, to a lesser extent, solvents.

There are a very small number of hazardous waste management contractors in Nigeria. Those that do exist generally offer waste collection but their transportation capacity is generally small. No dedicated haulage contractors have been identified who collect hazardous wastes.

The remainder of hazardous waste transported is transported by the waste generators themselves. However, more than 80% of hazardous waste is deposited or stored and this generally happens at or close to the place of waste generation requiring minimal transportation.

2.1.8 Impacts of Waste Management

Literature indicates that waste management in Nigeria is poor, resulting from irregular waste collection and indiscriminate disposal of waste. It was observed that waste is one of the three major environmental problems affecting Nigeria, the others being flooding and desertification[73]. The way in which waste is managed can have a profound impact on the environment, public health and quality of life. The impacts of waste on public health and the environment are discussed in detail in the following sections.

Impact on Public Health

Studies have been carried out across Nigeria to investigate the impact of waste on public health[74]. Poor household waste disposal practices and inadequate solid waste management facilities in Nigeria have led many households and cities to dispose of their waste indiscriminately, thereby posing a threat to human health. health of urban residents. According to Modebe, this is worrying because it encourages the growth of house flies, parasites, mosquitoes, rats and other pests that contribute to the spread of infectious diseases. It includes information on how the disease spreads and details of studies documenting its impact in Nigeria. Several studies have highlighted the negative effects of poor waste management on children and adults, as well as the decline of flora[75]. It is recognized that improper management of medical waste is a major concern in LEDC, especially in Nigeria[76]. Most hospitals in Nigeria use the services of public solid waste management companies for the collection and final disposal of medical waste in official government landfills. This implies that medical waste is disposed of along with other waste

streams. Many researchers point out that improper handling and disposal of medical waste endangers the health of medical staff and other members of the community. People exposed to medical waste are at high risk of contracting diseases such as meningitis, tuberculosis, Lassa fever, Ebola, hepatitis and HIV/AIDS. Burning waste outdoors can cause air pollution and health risks for people directly exposed to the smoke. There have been reports of the release of many toxic gases into the environment due to burning of outdated foam and electronic waste[77]. Outdoor burning especially affects people with sensitive respiratory systems. Smoke emitted during waste burning has a significant impact on the human respiratory systems. Smoke released during the burning of waste has a significant impact on human respiratory systems[78]. It has been stated that some of the contaminants in smoke include dioxins, furans, arsenic, mercury, polychlorinated biphenyls (PCBs), lead, carbon monoxide, nitrogen dioxide, sulfur carbon dioxide, and hydrochloric acid. Some contaminants may also remain in the ash. Toxic gases such as nitrogen oxides and sulfur dioxide, released into the atmosphere during waste burning, have been observed to accumulate and then fall as acid rain. Several types of human cancers and birth defects have been linked to burning municipal solids. For example, burning tires is known to release dioxins and benzene derivatives that have been linked to reproductive harm and cancer in humans. Additionally, there have been reports that exposure to secondhand smoke can cause headaches, nausea, skin rashes, and worsen respiratory problems.

Dioxin is a "dirty" environmental pollutant - a group of dangerous chemicals called persistent organic pollutants (POPs), which are harmful to human health and the environment[79]. Polychlorinated dibenzo-para-dioxin and dibenzofuran (PCDD/PCDF) are POPs. Open waste burning has been identified as the largest source of unintentional POP generation in LEDCs. It is thought that significant amounts of POPs may also be generated during the incineration of e-

waste for metal recovery. E-waste contains precious metals including copper (Cu), platinum group metals (PGM), as well as potential environmental contaminants including lead (Pb), antimony (Sb), mercury (Hg), cadmium (C), nickel (Ni). , polybrominated diphenyl ethers (PBDEs) and polychlorinated biphenyls (PCBs). Burning electronic waste produces dioxins, furans, polycyclic aromatic hydrocarbons (PAH), polyhalogen aromatic hydrocarbons (PHAH) and hydrogen chloride chemicals that pollute the environment. Exposure to dioxins and furans has been linked to certain types of cancer, liver problems, and impaired immune system, endocrine system, heart attacks, and reproductive function. Dioxins and furans produced from open waste burning can be deposited on edible plants and animals and can persist in the food chain until they are present in meat and dairy products. humans consume. More than 90% of the dioxins and furans that humans absorb come from the diet, mainly meat and dairy products, fish and seafood. dust, drinking water and food. Cases of illness caused by burning solid waste and emissions from landfills have been recorded. There is also a link between waste burning and the incidence of respiratory diseases in adults and children in Nigeria. Smoke from waste burning has harmful effects on the health of city residents due to inhalation of airborne particles containing carbon monoxide, nitrogen dioxide and sulfur dioxide, even more seriously in natural households. Burn your waste. It has been clarified that biomass smoke is a significant risk factor for chronic obstructive pulmonary disease (COPD). Wood is an important cooking fuel in Nigeria and cases of COPD from such exposure have been reported.

Impact on the Environment

Improper handling, storage and disposal of waste is a major cause of air, soil, groundwater and surface water pollution[80]. Globally, the most serious environmental problem regarding solid waste is greenhouse gas emissions. Greenhouse gases and their effects on the environment have

recently attracted the attention of researchers and environmentalists due to their significant impact on global warming[81]. Dumping organic waste outdoors releases methane, a potent greenhouse gas. Soil pollution is the result of dumping waste into open spaces or landfills. The growth and development of urban centres, coupled with poor waste management, has worsened land pollution in Nigeria. Landfills lead to soil contamination with metals and heavy elements. Chemical elements released from the soil landfills of Kano municipality were observed to contribute to soil pollution in that locality and the same was reported in Karu. Soil contaminated with heavy metals can have adverse effects on human and animal health and soil productivity. Waste containing a variety of metals is transferred to plants through soil water or seeps into groundwater. Elements such as Cd, Cu, Ni, Pb and Zn can change the chemistry of soil and impact the animals and plants that rely on that soil for food. Landfills pollute surface and groundwater and release unwanted biological, chemical and physical wastes into water bodies, causing water pollution. Studies have shown a deterioration in groundwater quality due to leachate generated from landfills. Leachate runoff and infiltration have been described as the most serious source of groundwater pollution resulting from existing solid waste management practices in Lagos, thereby posing potential environmental and public problems. hidden. It is also believed that water pollution from leachate can transmit bacteria and diseases such as typhoid fever, a common problem for LEDC residents, who cannot afford to dig wells deep enough to reach the facilities. freshwater aquifer. Some Nigerians still rely on shallow wells for water supply and a large proportion of them get their household and drinking water from ponds and streams. Therefore, water pollution is a major concern causing the health of about 40 million Nigerians to suffer from diseases such as cholera, dysentery, diarrhea and typhoid fever[82]. The incidence of these diseases is likely to add to the burden of existing inadequate health services in

Nigeria, thereby imposing a heavy economic burden on both the country's ailing health system and the rest of the world. large extremely poor population. The National Environmental Sanitation Policy, formulated by the Union Ministry of Environment in 2005, aims to ensure that good sanitation practices promote sustainable development, public health and good quality of life, but environmental sanitation remains very poor in many surrounding areas[83]. It has been observed that the waste clogging gutters contains biodegradable waste, creates an unpleasant odor, attracts flies and also contains harmful bacteria that cause illness in humans. Studies also show that waste in gutters and waterways contributes to flooding. It linked the floods in Lagos to the blockage of drainage channels due to the dumping of solid waste, and this is happening again in most cities. Purified water bags placed in gutters have caused pipes to become clogged and flooded during heavy rains. The current pollution caused by plastic bags in Nigeria is at an alarming level. Other reported impacts associated with plastic bags include suffocation of animals and water and soil pollution due to the breakdown of plastic in the environment[84].

2.1.9 Household Waste Management Practices

Civilization and globalization affect our lifestyle and daily activities. Nowadays we see more and more disposable products. However, most households do not have measures to classify waste and people need to be aware of solid waste management at home, school and work[85]. It was found that 37% of respondents practiced waste management at home, while in Zambia it was found that 63% had not conducted a survey of 468 households and 59.4% of households know that households separate their waste. Some households segregate waste because they want to process it effectively, while others want to make fertilizer from the sorted waste. Broken bottles are often thrown into the toilet. Sorted waste includes bottles, plastic bags, bananas and potato peels. Plastic bags are often burned. Waste paper is not usually thrown away. Instead, it is used

to make fires and sometimes for cleaning purposes. One study found that while the majority of households stored solid waste indoors, only a minority stored solid waste outside their homes. It turns out that garbage stored in the house is often associated with house flies and house flies. As a result, many children suffer from diarrhea. Many households store trash at home in open bins or plastic bins, making their homes unhygienic. In addition, regular waste is dumped in vacant lots located on the side of the road. In a survey conducted in India, the majority (66.1%) of households preferred to throw garbage outside the house. Only 38.8% of families said the city's vehicles collect solid waste. The most commonly reported waste disposal problem was lack of access to trash cans (84.5%) and city trucks (22.6%) for regular solid waste [86]. Home solid waste collection is limited to low- and middle-income households. As a result, poor people dump their waste into landfills, sewers and waterways[87]. Some residents burn their waste. Indiscriminate disposal, pruning and burning of solid waste pose potential health risks due to environmental pollution. Most rural areas still have serious waste disposal problems[88]. Several solid waste management projects have been implemented, especially in Vhembe district and Thulamela municipality. For example, paper towels are collected at one location and the city government collects them once a week. A small number of people, mostly women, organized and volunteered to look after specific areas. We also collect used nappies at home[89].

2.1.10 Acceptable and Safe Household Waste Disposal Practices

Waste is stored at the place of generation before collection. One of the most important issues related to warehouses is keeping them clean and tidy. Garbage stored at home can attract flies, even if only for a short time. Waste should always be contained in a container with a tight-fitting lid and wrapped in plastic to prevent flies and odors. Waste containers must be protected from direct sunlight. Additionally, trash must be kept away from animals. Additionally, the container

must always be empty and never overflow. Waste containers should always be cleaned with soap and water. Equitable waste collection must be guaranteed for all households under the jurisdiction of the city. In areas where regular waste collection services are impractical due to the distance traveled and costs involved, local authorities should allow more viable alternative waste disposal methods through legislation there. Communities must provide households with an environment where household waste can be recycled. Use only suitable means to collect waste. Every household should have separate containers for biodegradable and non-biodegradable products[90].

Garbage trucks may not be used for any purpose other than garbage collection. For health reasons, these vehicles must always be cleaned and covered with waste. Giving birth less than once a week is unhealthy due to the climatic conditions and hot weather in South Africa. To avoid any health risks, all employees responsible for handling waste must undergo regular health checks. Additionally, you must wear appropriate personal protective clothing/equipment and undergo ongoing training on health and safety issues. The collection of household waste is also expected to create employment opportunities for local community[91].

Between 20 and 80% of solid waste in African cities is disposed of due to inadequate infrastructure, dumped into open spaces, into water bodies and through surface runoff. No person may burn waste except in an approved municipal incinerator. Waste treatment facilities or landfills are often used by rural communities that do not have access to landfills. must be de at termined after consultation with the location as determined by the local health authority[92]The landfill must be at least 20 meters from the kitchen. Additionally, do not install drains that can carry water into your home or surface water because toxins can contaminate the water. Children and pets can pose serious health risks. Do not place it near a landfill as this can be dangerous[93].

The Impact of Poor Waste Management

Illegal dumping is considered one of the most common problems in South Africa. This is because illegal waste dumping affects communities large and small, and this practice negatively impacts the environment and people's health. The problem of waste management seems to be more acute only in developing countries due to poor management frameworks. Furthermore, waste has direct and indirect impacts on human health and ecosystems, including surface and groundwater pollution. It was also noted that methane emissions from waste are estimated to account for 2% of South Africa's greenhouse gas emissions profile. Environmental hygiene plays an important role in disease prevention. For example, it affects the conservation of important natural water sources such as natural environments and water sources. It has been explained above that the production and disposal of waste leads to the loss of our natural resources. Risks associated with unhealthy waste disposal. Do. Their survey found that the majority of respondents had inadequate knowledge and inadequate waste management practices. Inadequate solid waste facilities lead to indiscriminate incineration and burial of solid waste. There is a link between incineration and the incidence of respiratory disease in adults. Improper disposal of solid waste poses serious risks to disposal contractors and people living near the waste. Landfills are home to rodents, insects and other vermin that can transmit diseases such as typhoid fever, dysentery, diarrhea, cholera and yaw disease. Indiscriminate disposal of waste poses a serious threat to the immediate environment because it makes the environment dirty, polluted and threatens people's health. Such improper waste disposal causes serious environmental problems, affects human and animal health, and leads to serious economic and other welfare losses. When people throw waste near their homes, the organisms associated with this waste can act as decomposers. This reduces the quality of the living environment. Therefore, buildings need to be

renovated or maintained more frequently. The quality of the human environment contributes significantly to the quality of the entire family and the quality of life of the individual. If the landfill is located near a residential area, this environment is affected by the organisms that grow in these unclean areas, which are also factors that cause disease outbreaks. Therefore, the purpose of the shelter as a place where people can live and play hygienically is undermined when the stench from nearby landfills is a constant threat. In addition, these wastes can contaminate groundwater sources, affecting the purity of water taken from wells. Therefore, if city residents do not have access to drinking water, it will affect their health. This is a precarious situation, affecting the living environment. Poor sanitation, such as abandoned or non-existent wastewater systems and toilets, fuels the spread of diseases such as cholera and hidden diseases such as diarrhea, causing one to die every 21 seconds. the child died. Poor sanitation mainly affects the rural poor in rapidly growing cities, mainly in Africa and Asia, as well as slum dwellers. But these impacts go far beyond landfills. Instead, waste enters the local environment, creating, dispersing or accumulating waste. If organic waste is not managed properly, its negative effects will persist until it is completely decomposed or stabilized. Uncontrolled or poorly managed intermediates can pollute air, water and soil resources[94]. Achankeng noted that African countries face health and environmental problems arising from municipal solid waste management. Uncollected and illegally dumped waste endangers human and animal health and contributes to environmental degradation. It has been pointed out that different waste treatment methods have different environmental impacts. Burning waste releases carbon dioxide, reduces air quality and contributes significantly to global warming. Landfills contribute to air pollution, soil degradation and groundwater contamination, allowing rodents to breed and increasing the spread of diseases such as cholera, typhoid and malaria. Open landfills have a significant negative impact on the

environment. Several negative impacts have been observed in the area due to open dumping of solid waste. Strong winds blow waste and debris from vacant lots into residential areas and continuously release toxic gases into the atmosphere. Solid waste dumped into landfills is eventually burned, causing serious air pollution. The most obvious environmental damage caused by urban solid waste is the aesthetics, the ugliness of urban waste, the degradation of the urban environment and urban aesthetics. More serious and often overlooked is the transfer of pollution to water and groundwater.

Table below shows the environmental impacts of waste management methods. The methods that have been assessed are burning, controlled tipping and landfills.

Table 2.1: Environmental Impacts of Waste Management Methods

Refuse Disposal Method	Environmental Impacts
Burning	- Co2 emission - Reduce air quality -Contributes to global warming
Controlled Tipping	- No negative impact - Cleaner residential environment
Landfills	- Air pollution - Soil degradation -Contamination of ground water -Constitutes breeding grounds for rodents and other harmful creatures. - Contributes to prevalence of diseases such as; cholera, typhoid, malaria, dysentery, et.c

There are many different approaches that can be taken to solve the problem of household waste management. This includes reducing consumption, separating waste from the source and reducing waste through waste treatment. However, the impact of these methods remains limited until they are integrated into a comprehensive waste management system, given the following recommendations submitted to the Nigerian government in 2012: and individuals can access and maintain a good and healthy environment. To protect the environment from pollution, areas need well-designed landfills. Furthermore, existing health and environmental sanitation laws and regulations need to be reviewed and enforced with stricter measures to make them more effective. More attention needs to be paid to waste management through appropriate funding sources. Local authorities responsible for waste management face greater challenges when it comes to providing quality services. They believe that it is the responsibility of local communities to provide waste disposal services, as stipulated in the South African Constitution. We also found that municipalities face four major waste management challenges. Specifically, financial management, facilities management, labor (employee) management and institutional behavior. Local governments should devote their resources to cleaning campaigns and prevention strategies. This includes providing trash bins and using vacant land that could be used for illegal dumping for projects that benefit the community. Communities are responsible for these projects, which include parks, playgrounds, community gardens, car washes, etc., which also help generate income and jobs. Currently, there is a shortage of highly skilled workforce in the field of waste treatment. Shortages of skilled workers, combined with high workforce mobility in local government, pose new challenges to sustainable waste management. Likewise, improve financing for the waste management sector and provide adequate waste collection and treatment facilities. It makes no sense to train the workforce without improving financing. The city needs

to properly plan waste collection and treatment as well as determine the type and capacity of waste management equipment to purchase.

2.1.11 Knowledge and Awareness of Waste Management

Many people, especially women, are not aware of proper waste disposal and its harmful effects on human health and the environment in daily life. Women play an important role in household work and household waste treatment. In most households, women and girls are responsible for waste disposal and management. Waste disposal has a significant impact on the lives of women, especially in some developing countries and regions. Women are often responsible for collecting household waste and transporting it to city landfills. This may be because women are frequently exposed to waste at home and because they tend to be the most disadvantaged group in many societies. Formal education is one of the factors that influence knowledge. Formal education influences public response to waste management. A study on the environmental benefits of education concluded that formal education has an indirect impact by improving public understanding of waste management practices. It was also emphasized that obtaining a high school diploma has an indirect effect on waste separation. Formal education has a direct and significant impact on the understanding of waste classification and management. Waste management practices were influenced by the education and university training of the 300 students she interviewed[95]In this sample, 54% were classified as having a low level of knowledge and 46% were classified as having an intermediate level of knowledge in waste management. It was concluded that the majority of students do not have enough knowledge about waste management and should improve their knowledge about waste management to protect the environment from waste-related hazards[96]. Good knowledge about waste management can help people protect themselves against infectious diseases such as malaria, diarrhea, typhoid

fever, cholera and hepatitis. Furthermore, knowledge of the consequences of poor waste management and disposal can encourage people to adopt positive waste management measures and promote personal hygiene. Fakere, Fadairo and Oriye added that designing and operating a suitable waste management system requires knowledge of local waste sources and types[97].

2.1.12 Knowledge and Perception on Solid Waste Management

Waste management education is an important and necessary part of waste management. Lack of knowledge leads to inadequate waste management practices. This is evident from a study that shows that the amount of municipal solid waste generated has generally increased significantly due to poor waste management and lack of knowledge. Tenants' lack of knowledge has led to irresponsible waste management. Young and middle-aged people are more likely to have a positive attitude towards modern waste management practices due to their level of knowledge and receptiveness towards adopting new technologies. Because of their high knowledge and attitude towards solid waste, educated people make better decisions about the different types and sources of solid waste generated compared to less educated people. may reduce. Relevant agencies have not made much effort to inform households about waste management. Pollution associated with indiscriminate waste disposal has serious negative impacts on public health and safety. Mamady said most Guineans do not know that poor waste disposal leads to diseases such as cholera, typhoid fever, diarrhea and respiratory infections. Abdel-Naser and Abdel found that solid waste recycling is a major concern for every society. However, the growing awareness of environmental problems among people and authorities has made finding strategies to solve them a difficult task[98].

2.1.13 Challenges of Effective Waste Management in Nigeria

There are a number of waste management techniques and consideration should be given to economic aspects, type of waste generated, land available for disposal, availability of suitable technology, as well as psychological and politics. Countries vary widely in their selection and other key indicators etc[99]. The challenges of effective waste management in Nigeria are synonymous with other developing countries, with poor enforcement of laws and policies, inadequate environmental health awareness programs, Limited infrastructure and expertise. environment, lack of funding for environmental agencies and lack of motivation for recycling initiatives and treatment technologies.

Poor Legislation and Implementation of Policy

The Federal Government of Nigeria promulgated Executive Order No. 58 on 30 December 1988, establishing the Federal Environmental Protection Agency (FEPA), directing and minimizing the indiscriminate handling and dumping of waste. The goal, as it stands, remains unachieved. The weak and ineffective constitutional strength of the national municipal solid waste management policy and its inadequate implementation. Poorly structured policies fail to achieve the SDGs in promoting the 3Rs (reduce, reuse and recycle) of waste management to minimize waste production[100]. Likewise, the policy is not comprehensive enough to support public cooperation and there is no appropriate planning for waste management. In other words, the monthly corrective measures implemented nationwide have not had a significant impact on waste management in most cities

Poor Sensitization Programs on Environmental Sanitation

Awareness of sustainable waste management in the country is low, with waste management agencies making little or no effort to educate the community about the negative impacts of indiscriminate waste disposal and the benefits of not doing so. appropriate measures. Also, by

focusing strictly on the economic price of the product instead of respect for the environment and by drawing the attention of manufacturers to the green delivery shift away from services. There is no public awareness raising. The level of growth following the implementation of the above awareness programs is likely to overshadow the cultural beliefs of some people who view waste as irreplaceable, more valuable and useless than wealth

Limited Infrastructures and Professionals

Lack of appropriate technology is one of the major obstacles to effective waste management in Nigeria. A lack of waste collection equipment and poor maintenance as well as a lack of experts to operate these machines have led to the accumulation of waste in illegal locations. This may be due to a lack of institutions offering specialized courses and training in asset management. Furthermore, the lack of cooperation between local waste management agencies and international solid waste management organizations or agencies further contributes to the shortage of skilled labor, hindering development. Rapid sustainability in waste management[101].

Poor Funding of Environmental Agencies

Lack of funding hinders waste management in Nigeria because achieving sustainable waste management requires continuous financial resources to achieve the desired goal of environmental sustainability, as in developed countries. . Another major obstacle. Poor and inadequate maintenance of machinery and limited staff are evidence of the sector's lack of funding.

Recovering, Recycling, Reuse and Disposal Technique

There are no formal government recycling programs/initiatives or policies to promote the 3Rs of waste management and composting, as seen in developed countries. Legal and illegal dumping falls outside the informal recycling activities of trash collectors, who seek out and pay for recyclable waste in their neighborhoods. This will be an eye-opening opportunity for unprofessional governments to promote people to practice 3R in waste management. There are only two sanitary landfills in the country without proper management techniques. Due to the lack of sanitary landfills, solid waste is often disposed of in sanitary landfills, open dumps, drainage ditches, and local people burn waste uncontrolled. Infection into society by animal transporters and scavengers who go to landfills to collect reusable items thus contributes to the greenhouse effect, as it has become a normal and abnormal thing in society

2.1.14 Factors Influencing Solid Waste Management in Developing Countries

Many factors that affect solid waste management must be considered when designing a solid waste management system. These include waste volume and composition, waste accessibility for collection, awareness and attitudes, institutions and laws.

Waste Quantity and Composition

Household waste in industrialized countries is less dense due to the high proportion of paper, plastic, glass and metal packaging. In many developing countries, waste not only contains large amounts of inert materials such as sand, ash, dust and stones but also contains large amounts of fresh fruit and vegetables, resulting in high water content. These are the factors that make the waste very dense (high weight per unit volume). The result of this high density is that the facilities and systems that work well with low density waste in developed countries are not suitable or reliable when the waste is heavy. Add weight, sand. The combination of corrosion resistance and moisture corrosion can cause equipment to degrade very quickly[103] If the waste

has a high moisture content or consists mainly of inert material, it cannot be burned and is excluded from the treatment process. Recycling or recovery operations typically reduce the amount of flammable paper and plastic contained in the waste before it reaches the processing stage.

Access to Waste for Collection

Many waste sources are only accessible by roads or alleys that are inaccessible to certain modes of transport due to their width, slope, bulk or surface area. This is especially important in unplanned settlements, such as slums and low-income areas, and has a significant impact on selection arrangements[104].

Awareness and Attitudes

Public awareness and attitudes towards waste can influence the entire waste management system. Every step of solid waste management, protest meetings of waste treatment and disposal facilities, everything depends on community awareness and participation. This is also an important point that determines the success or failure of a waste treatment system[105.]

Institution and Legislation

Institutional issues include existing and proposed legislation and its scope. Standards and limitations may limit the technological options that can be considered. Government policies regarding the role of the private sector (formal and informal) must also be taken into account. Union strength and interest can also have a significant impact on what can be done.

2.1.15 Environmental and Health Issues in Developing Countries

In the complex dance of nature and urbanization, waste undergoes a mysterious transformation into its basic constituent parts, a process that often contributes to the creation of local pollution smogs. This dilemma casts its darkest shadow in developing countries, where budgets are insufficient to meet environmental criteria. Rapid urbanization is a harbinger of trouble, because as concrete sprawl becomes increasingly compact, human habitation encroaches on the sacred ground of landfills. In some daring cases, these landfills serve as backdrops for new developments, painting a picture of ecological desperation.

Beneath this unpleasant background, however, an invisible agent takes center stage, methane, a phantom gas released by the decomposition of alchemical waste. This elusive byproduct arises from the mysterious anaerobic respiration of tenacious bacteria, finding their greatest refuge in the heart of high-humidity landfills. When this microbial symphony reaches its peak, methane concentrations can reach a staggering 50% of the entire landfill atmosphere. Sadly, in a world plagued by insatiable material desires, our voracious appetite for resources has given rise to staggering volumes of industrial and household waste. This looming mountain of trash poses a disturbing specter, an existential threat to human health lurking in the shadows[106]. However, the problems associated with improper disposal of municipal solid waste are many. Poor health, accidents, floods and environmental pollution are some of the negative effects of ineffective waste management. For example, a devastating landslide occurred at the Koshe landfill on the outskirts of the capital Addis Ababa, burying dozens of makeshift houses under tons of waste, killing many people and injuring many others. Rescue workers at the landfill reported the death toll had reached 113 and more were expected. Nearly 150 people were present at the scene when the landslide occurred.

2.1.16 Legal Frameworks and Ethical Issues on Waste Management Practices

With more than 200 million people, Nigeria is one of the largest waste producers in sub-Saharan Africa. Despite policies and regulations, household waste management remains a daily concern. More than 32 million tons of solid waste are generated each year, one-third of which is collected. Indiscriminate disposal sometimes clogs drains and clogs water bodies. Due to the current lack of sufficient budget to implement a statewide integrated waste management system, improper collection and disposal of waste is gradually leading to an environmental disaster[107]. In most developing countries like Nigeria, waste management laws, policies, laws and regulations are underdeveloped and even those that do exist are poorly implemented. In general, waste management laws are widely and clearly developed. The poor state of the country's waste management system is a reflection of its laws and policies. Although there are some loopholes in the government's waste management policy, public participation in monthly cleanups is encouraged. However, the government failed to create landfills to pay tribute to the people's efforts. Some states in the country are said to lack clear legislation on waste management, attributing this to weak institutions, legal frameworks and political control. Most current government policies lack an implementation strategy. Furthermore, consideration of the legal aspects of waste management has been proposed towards achieving the goals set for sustainable waste management. In addition, a comprehensive management approach has been proposed, including waste prevention, reuse, recovery, recycling, composting and energy production. Although there are some good guides, getting it right is still a huge challenge. For example, a full environmental impact assessment must be submitted during the project planning process before approval. However, this important rule is often overlooked. Some authors criticize the implementation and enforcement of environmental laws in Nigeria. The enforcement of environmental laws is still a matter of concern, monitoring and enforcement of environmental

laws but there has not been much success. Some of the challenges in law enforcement in Nigeria have socio-political and economic nuances. Furthermore, in addition to enforcing waste management laws, there is a need to implement appropriate policies and plans for sustainable waste management[108].

2.2 Theoretical Review

The Theory of Planned Behavior (TPB) is a well-established psychological framework that has been widely used to understand and predict human behavior across various domains, including environmental actions like waste management. When applied as a theoretical framework for assessing waste management practices, TPB offers a structured approach to analyzing the factors that influence individuals' intentions and behaviors related to waste reduction, recycling, composting, and other sustainable practices.

Core Components of the Theory of Planned Behavior

At the heart of TPB are three primary constructs that shape an individual's intention to perform a specific behavior: attitudes toward the behavior, subjective norms, and perceived behavioral control. These constructs collectively determine the strength of an individual's intention, which is the most immediate precursor to actual behavior.

Attitudes toward the Behavior refer to the degree to which an individual holds a favorable or unfavorable evaluation of the behavior in question. In the context of waste management, this could involve how positively or negatively a person views actions such as recycling or reducing waste. For instance, an individual might develop a positive attitude towards recycling if they believe it significantly contributes to environmental conservation, reduces pollution, and conserves resources. On the other hand, a negative attitude could emerge if the person perceives

recycling as time-consuming or inconvenient. Therefore, attitudes are shaped by the individual's beliefs about the outcomes of the behavior and the value they place on these outcomes.

Subjective Norms involve the perceived social pressure to engage or not engage in a particular behavior. This aspect of TPB emphasizes the role of social influences, including family, friends, and broader societal expectations, in shaping behavior. In waste management, subjective norms might be reflected in whether an individual feels that important people in their life expect them to participate in activities like recycling or composting. If recycling is perceived as a normative behavior within a community or peer group, individuals within that community are more likely to feel compelled to conform to this expectation. Conversely, if waste reduction is not socially encouraged, individuals may lack the motivation to adopt such practices, even if they recognize their benefits.

Perceived Behavioral Control is the individual's perception of their ability to perform the behavior, considering both internal factors (such as skills, knowledge, and confidence) and external factors (such as the availability of resources and opportunities). This construct is particularly relevant to waste management practices, as the ease or difficulty of engaging in behaviors like recycling or composting can vary significantly depending on the context. For example, a person living in an area with well-organized waste collection services and accessible recycling facilities may feel more empowered to participate in recycling than someone without such access. Perceived behavioral control not only influences the intention to engage in the behavior but can also directly impact the likelihood of carrying out the behavior, especially when the behavior is perceived as challenging or complex.

The Relationship between Intention and Behavior

According to TPB, the intention to perform a behavior is the most important predictor of whether the behavior will actually be performed. Intention, in this context, is a motivational construct that captures the effort an individual is willing to invest in performing the behavior. The stronger the intention, the more likely it is that the individual will engage in the behavior. For instance, if a person strongly intends to reduce their waste footprint by recycling, composting, and minimizing single-use plastics, TPB suggests that this intention will likely translate into consistent waste reduction practices. However, the translation of intention into action is not always straightforward, as it can be moderated by perceived behavioral control and other situational factors.

Application of TPB in Waste Management Research

TPB has been extensively applied in waste management research to explore the psychological factors that drive or hinder sustainable waste practices. Researchers often use TPB to examine how attitudes, subjective norms, and perceived behavioral control collectively influence individuals' intentions to engage in behaviors like recycling, composting, or reducing waste.

For example, studies on recycling behavior frequently analyze how positive attitudes towards recycling (such as beliefs in its environmental benefits), strong subjective norms (such as social expectations to recycle), and high perceived behavioral control (such as easy access to recycling bins) contribute to the intention to recycle. Interventions based on TPB might focus on altering these key constructs—by educating the public about the environmental impacts of waste, fostering a community culture of recycling, or improving the accessibility of recycling facilities—to strengthen individuals' intentions and encourage actual recycling behavior.

Similarly, TPB has been used to understand composting behavior, where the intention to compost is shaped by individuals' attitudes toward composting (e.g., seeing it as a way to enrich soil and reduce landfill waste), the influence of subjective norms (e.g., whether composting is common in the community), and perceived behavioral control (e.g., the ease of setting up and maintaining a compost system). By addressing these factors, waste management programs can design more effective strategies to promote composting practices among households.

Strengths and Limitations of TPB in Waste Management

One of the key strengths of TPB as a theoretical framework is its ability to provide a comprehensive understanding of the psychological factors that influence behavior. By considering the roles of attitudes, subjective norms, and perceived behavioral control, TPB offers a nuanced view of how individuals form intentions to engage in waste management behaviors and how these intentions lead to actual behavior. This makes TPB a valuable tool for designing targeted interventions aimed at promoting sustainable waste practices.

However, TPB is not without its limitations. One criticism is that TPB assumes behavior is the result of rational deliberation, which may overlook the influence of habitual or unconscious behaviors that are also significant in waste management practices. For example, waste disposal behaviors might be driven more by habit than by conscious intention, especially when individuals are in a hurry or distracted. Additionally, TPB's focus on intention as the primary predictor of behavior may not fully capture the complexity of behavior change, as there is often an intention-behavior gap where individuals intend to act but fail to do so due to unforeseen barriers or competing priorities.

Moreover, TPB may not adequately account for the influence of broader contextual factors, such as socioeconomic status, cultural norms, or environmental constraints, which can significantly impact waste management behaviors. For instance, individuals in low-income communities may face greater challenges in accessing recycling services, despite having positive attitudes and strong intentions to recycle.

Practical Implications of TPB for Waste Management

Despite its limitations, TPB provides valuable insights that can inform the design of waste management policies and programs. By identifying the key psychological factors that influence waste management behaviors, TPB can guide the development of interventions that are more likely to succeed. For example, public education campaigns that focus on changing attitudes by highlighting the environmental and economic benefits of recycling can foster more positive attitudes and stronger intentions to recycle. Similarly, community-based initiatives that create social norms around sustainable waste practices can enhance subjective norms and encourage wider adoption of these practices.

In addition, policies that improve perceived behavioral control, such as making recycling facilities more accessible or providing clear instructions on waste sorting, can empower individuals to act on their intentions. By addressing the specific barriers identified through TPB, waste management programs can create more supportive environments that facilitate sustainable behaviors.

2.3 Review of Empirical Studies

2.4 Conceptual Framework

The conceptual framework for this study will undertake the waste administration hierarchy model. The waste administration framework premised on “Lansink’s Ladder” was developed in 1981. It serves as the prototype for the present day framework for waste management in many waste related areas such as regulation and numerous projects, initiatives and also strategies. The waste administration hierarchy model is a widely recognized framework that prioritizes waste management practices according to their environmental impact. It serves as an effective conceptual framework for assessing and improving waste management practices in Nigeria. This model typically includes five key levels: prevention, minimization, reuse, recycling, energy recovery, and disposal. Here’s a detailed discussion of each level within the context of Nigeria’s waste management challenges and opportunities

Prevention is the most preferred waste management strategy. It involves reducing waste generation at the source by encouraging sustainable production and consumption patterns. In Nigeria, this can be achieved by implementing policies that promote eco-friendly products and packaging, educating the public on sustainable consumption habits, and encouraging industries to adopt cleaner production techniques. Prevention not only reduces the amount of waste that needs to be managed but also conserves resources and reduces environmental pollution.

Minimization focuses on reducing the amount of waste produced through efficient resource use and waste reduction techniques. In Nigeria, adopting advanced technologies that optimize resource use and minimize waste can significantly contribute to waste minimization. Providing economic incentives for businesses to reduce waste, such as tax breaks or subsidies, can also encourage more sustainable practices. Additionally, educating manufacturers and consumers on

best practices for waste minimization is crucial for achieving long-term reductions in waste generation

Reuse involves using items multiple times before discarding them. It is an effective way to extend the life cycle of products and reduce waste. In Nigeria, establishing community programs that facilitate the donation and resale of used goods can promote reuse. Encouraging businesses to design products that are durable and easy to repair can also contribute to increased reuse. Promoting a culture of reuse among consumers through awareness campaigns and educational programs can further support this waste management strategy.

Recycling involves converting waste materials into new products, thus conserving resources and reducing the need for raw materials. In Nigeria, investing in recycling facilities and systems can enhance recycling rates and reduce the amount of waste sent to landfills. Creating markets for recycled products can make recycling economically viable and encourage more businesses to participate in recycling initiatives.

Energy recovery includes converting non-recyclable waste materials into usable heat, electricity, or fuel through various processes, such as incineration. In Nigeria, adopting technologies for waste-to-energy conversion can help manage non-recyclable waste efficiently. Ensuring that energy recovery processes comply with environmental standards is crucial for minimizing pollution and protecting public health. Assessing the cost-effectiveness of energy recovery projects and securing funding for their implementation can also support the development of this waste management strategy.

Disposal is the least preferred option in the waste management hierarchy. It involves the safe and environmentally sound disposal of waste that cannot be reused, recycled, or recovered for energy.

In Nigeria, improving landfill design and management can minimize environmental impacts and reduce the risk of soil and water contamination. Regularly monitoring landfill sites and enforcing strict regulations on waste disposal are essential for ensuring compliance with environmental standards and protecting public health.

Applying the waste administration hierarchy model in Nigeria presents several challenges and opportunities. Challenges include inadequate infrastructure for waste collection and recycling, insufficient enforcement of existing waste management regulations, low levels of public awareness and participation in sustainable waste practices, and limited funding for waste management projects and technologies. However, there are also significant opportunities for improving waste management practices in Nigeria. Implementing comprehensive waste management policies that align with the waste hierarchy model can provide a clear framework for action. Building and upgrading waste management infrastructure, including recycling plants and waste-to-energy facilities, can enhance the capacity for effective waste management. Launching extensive public awareness campaigns can promote waste prevention, minimization, reuse, and recycling, while encouraging private sector participation through public-private partnerships and investment incentives can provide the necessary resources and expertise.

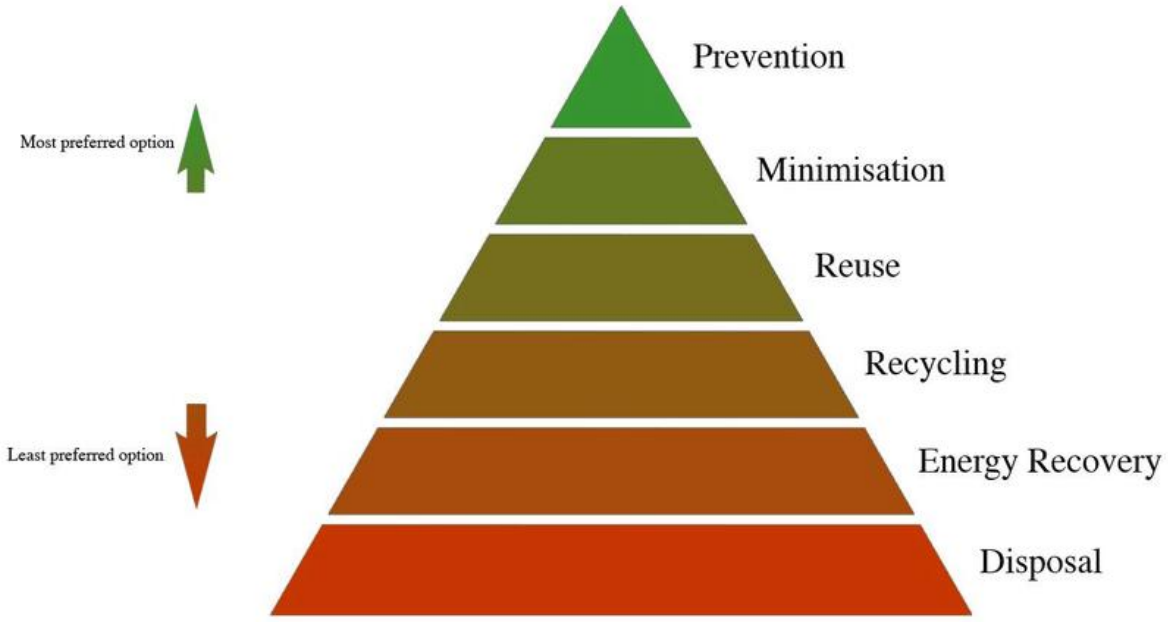

Fig 2.5: Diagram of Waste Administration Hierarchy Model

2.5 Summary of Gaps in Literature Reviewed

The assessment of waste management practices in Nigeria reveals several critical gaps in the existing literature that hinder the development of effective strategies and solutions. Identifying and addressing these gaps is essential for directing future research and policy-making efforts to improve waste management practices in the country.

One of the primary gaps is the limited availability and reliability of data. There is a notable scarcity of reliable, up-to-date quantitative data on waste generation rates, composition, and trends across different regions of Nigeria. This lack of data makes it challenging to develop accurate waste management plans tailored to specific areas. Additionally, there are few in-depth qualitative studies exploring the socio-economic, cultural, and behavioral aspects of waste management. Understanding the human dimensions of waste management is crucial for designing effective interventions

The literatures also exhibit an urban bias, with most studies concentrating on waste management in major cities like Lagos and Abuja. This focus on urban areas neglects the unique challenges faced by rural areas, which often have different waste generation patterns and infrastructural constraints. Consequently, there is a lack of research on tailored waste management strategies for rural communities. Another significant gap is the inadequate examination of the informal sector's involvement in waste management. The informal waste sector plays a vital role in waste collection, recycling, and disposal in Nigeria. However, limited research exists on how to effectively integrate informal sector activities into formal waste management systems. Additionally, studies that quantify the economic contributions of the informal waste sector and explore ways to improve working conditions and efficiency are scarce.

The existing policy and regulatory framework for waste management in Nigeria also requires comprehensive analysis. There is a need for detailed evaluations of current waste management policies, regulations, and their implementation to identify gaps, inconsistencies, and areas for improvement. Comparative studies that evaluate Nigeria's waste management policies against those of other countries with successful waste management systems are limited. Such comparisons could provide valuable insights for policy enhancement.

Technological and infrastructural deficiencies present another gap in the literature. Research on the adoption and adaptation of advanced waste management technologies in Nigeria is limited. This includes technologies for waste processing, recycling, and energy recovery. Detailed assessments of existing waste management infrastructure and identification of infrastructural needs are also lacking. This information is crucial for planning investments and upgrades.

Environmental and health impact studies related to waste management in Nigeria are insufficient. There is a paucity of studies examining the long-term environmental impacts of current waste management practices, including landfill pollution, leachate contamination, and greenhouse gas emissions. Additionally, research on the public health implications of poor waste management practices, particularly in densely populated urban areas and informal settlements, is inadequate.

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Chapter Three

Methodology

3.1 Research Design

A cross-sectional study design was used to carry out the research in Ibadan southeast, Oyo State, Nigeria.

3.2 Description of Study Area

Ibadan Southeast is a local government area domiciled in the city of Ibadan, Oyo state. The headquarters of the LGA are in the Mapo Hall district of Ibadan city and LGA shares bothers

with Ibadan Southwest, Ibadan Northeast, and Oluyole LGAs. Several districts constitute Ibadan Southeast LGA and these include Boluwaji, Ring Road, Challenge, Odinjo, Felele, Molete and Owode. Ibadan South East Local Council Development Area. The estimated population of Ibadan Southeast LGA as of 2022 was 380,800 inhabitants with the most populous ethnic group in the area being the Yoruba. There are 12 wards in Ibadan southeast local government area.

Ibadan southeast is one of the 33 local government areas in Oyo state. It is majorly located in the inner core of the metropolis which has high-density population, is poorly planned with poor access roads and drainage facilities are scantily located within the LGA.

3.2.1 Housing

The study area lacks sufficient modern housing units, especially in the urban areas of the district which has among other things contributed to overcrowding, development of illegal structures conversion of commercial facilities to residential use, streetwise and pressure on social facilities and amenities.

3.2.2 Economic Activities

In the study area, artisanship and trading are dominant in its occupational scene, followed by farming and crafting. Besides, a sizeable proportion of the working force in the district is unemployed reflecting the high poverty level and for that matter their inability to pay for health services offered them.

3.3 Study Population

The targeted population for the study will include household heads in the study location, waste management officials, the Oyo Environmental Agency. These different categories of study participants will be used because of variations in availability, knowledge and experience in waste management, access to waste disposal facilities as well as differences in attitudes to waste handling and disposal practices.

3.4 Sampling and Sampling Technique

A two-stage cluster sampling was used to select the eligible respondents for this research. At stage one, a simple random sampling was used to select 3 wards out of the 12wards in the local government; and a cluster sampling will be used to select the respondents from the selected wards proportionately.

3.4.1 Sample Size

Therefore, the sample size was determined as follows.

$$n=\frac{Z^2PQ}{d^2} \quad [3]$$

Where;

Z= Standard normal deviate at 95% confidence interval which is set at 1.96

P= proportion of population exhibiting a defined quality (P= 1-Q, at maximum variability = 0.5)

Q= 0.5

d= degree of accuracy (at 95% C.I = 0.05)

n = desired sample size

P= 36% = 0.36

Q= 1-P = 1- 0.35

= 0.64

$n = \frac{1.96^2 \times 0.36 \times (1 - 0.36)}{0.05^2}$

$n = \frac{3.842 \times 0.2304}{0.0025}$

$= \frac{0.885}{0.0025}$

= 332

Therefore, Adjusted sample size for null response.

$n = n_0 \times 1/1\text{-}f$

$n = n_0 \times q$

$n = 332 \times 1.1$

n= 365. Thus, a sample size of 365 respondents including households, business owners, and market vendors was randomly selected to participate in the survey questionnaire.

3.5 Description of Research Instrument

The research tool for this study is a self-administered questionnaire distributed to eligible household-level participants on the basis of consent and suitability. The questionnaire was adapted from previous study conducted in Nigeria[3].

The questionnaire comprised five sections:

Section A: Socio-demographic data

Section B: current waste management system and practices

Section C: factors influencing waste management

Section D: the challenges and the limitations.

Section E: level of community participation in waste management practices

3.6 Validity of Research Instrument and Reliability of Survey Tools

The questionnaire for the study was adapted from previous studies. Research includes: Waste Management in Nigeria: A Case Study of the Commercial City of Onitsha

3.7 Method of Data Collection

Data were collected during the administration of questionnaires to participants within the local government. The study objectives were verbally presented and informed consent is obtained from each participant prior to the process. Instructions for collecting data from participants were explained and the survey will be shared.

3.8 Data Analysis

After data collection is complete, the Social Science Statistics Package (SPSS version 22) is used for analysis. Descriptive statistical methods employed include chi-square and Pearson correlation to determine the statistically significant difference or relationship between some background information of the respondents and their knowledge, attitude and practice towards waste management. The results were then presented in charts and tables, showing frequency distributions and percentages. All data were analyzed at 5% level of significance.

3.8.1 Variables

The following are the variables of the study.

- Dependent Variable –Waste Disposal Practice
- Independent Variables – Demographic characteristics (Age, sex, gender, religion, marital status, and place of residence), types of waste generated at home, perception of solid waste management, sociocultural factors.

3.9 Ethical Considerations

Ethical approval conducted for this study was obtained from the Oyo State Ministry of Health. All participants were fully informed of the purpose and design of the study. Informed Consent was obtained from the respondents prior to administration of the questionnaires. Participation was voluntary. Respondents are free to withdraw from the study at any time.

Endnotes

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Result And Discussion of Findings

This chapter contains discussing, analyzing and presenting the results of all the results of all the responses/data received from the questionnaire administered. In all, a total of valid 331 responses were recorded.

4.1 Demographic Analysis

The subjects for the study comprised of households, business owners, traders and hospitals in the study area. The study gathered information on the respondents' personal attributes. These attributes encompassed the age, sex, marital status and educational status, household size and occupational status.

Table 4. 1 Shows Respondents Socio- demographic Characteristics

Three hundred and sixty-five was distributed but 331 were valid on return and were thus analyzed giving a response rate of 90.7%. The mean age of the respondents was 33.48 ± 11.593years. Majority of the respondents 58.9% were females and about 61.0% attained at least the Higher level of education. About 155 (46.8%) were married, while 94 (28.4%) were Professionals. The mean of people that live in the house is 7.50 ± 4.92.

Table 4. 1 Socio- demographic Characteristics

Variable	Frequency (N= 331)	Percent (%)
Age (N=331)		
Mean ± SD	33.48 ± 11.593	
How many people live in the household		
Mean ± SD	7.50 ± 4.92	
Sex		
Male	136	41.1
Female	195	58.9
Educational level		
Primary and less	202	16.3
Secondary	75	22.7
Higher	54	16.3
Marital status		
Single	130	39.3
Married	155	46.8
Once married	46	13.9
Occupational status		
Clerical Job	37	11.2
Sales and services	64	19.3
Skilled	49	14.8
Professional	94	28.4
Unemployed	87	26.3

Source: Researcher's Field Survey 2022

4.2 Presentation of Data

Objective One: To Describe the Current Waste Disposal Practices in Ibadan South East LGA

Table 4.2 reveals that food waste is the most dominant type, with 88.8% of respondents indicating its prevalence. Polythene and sachet water waste closely follow, representing 86.4% of the waste types, indicating a significant issue with disposable packaging. Paper and plastic waste also form a considerable part of the waste stream, with 65.9% and 64.7% of respondents reporting these types, respectively. On the other hand, glass and aluminum waste are less common, with only 16.9% and 3.6% respectively.

The data indicates a substantial increase in waste generation over the years, with 86.4% of respondents acknowledging this trend. This rise is attributed to several factors, including increased consumption (73.1%), higher income levels (67.1%), and a rise in the use of packaged foods (66.4%). Interestingly, only 17.8% attribute the increase to family size, suggesting other factors are more significant in driving waste production.

Waste storage and collection practices vary significantly among households. A majority (50.7%) store waste in closed containers, which is a good practice for preventing environmental contamination and pest infestations. However, a concerning 10.4% do not store waste but dispose of it directly, potentially exacerbating sanitation and environmental issues. The storage duration also varies, with most households storing waste for 0-7 days (55.6%), while a significant portion stores it for 8-15 days (40.2%), and a smaller group for over 16 days (4.2%).

Regarding waste collection, 60.1% of households rely on a waste management agency, while 26% handle it themselves, indicating a gap in waste management services. Among those who manage their waste, various disposal methods are employed. A high proportion (91.3%) dispose

of waste in drainage channels, highlighting a significant environmental and public health concern. Other common methods include disposal in nearby bushes (78.3%), at dump stands (69.6%), and burning (63.0%). Less common practices include burying waste (34.8%), dumping in flowing water (4.3%), recycling/reuse (10.9%), and composting (2.2%). The responsibility for taking waste to disposal sites typically falls on the mother (10.9%) or children (9.7%), with a smaller percentage handled by the father (3.0%) or house girls (2.1%).

Table 4.2 Shows the Current Waste Management System and Practices in the Locality

Variable	Frequency (N= 331)	Percent (%)
Categories of dominant waste in areas		

Food Waste		
Yes	294	88.8
No	37	11.2
Paper White		
Yes	218	65.9
No	113	34.1
Plastic Waste		
Yes	214	64.7
No	117	35.3
Glass Waste		
Yes	56	16.9
No	275	83.1
Textile Waste		
Yes	89	26.9
No	242	73.1
Aluminum Waste		
Yes	12	3.6
No	319	96.4
Polythene/ sachets water waste		
Yes	286	86.4
No	45	13.6
Other waste		
Yes	15	95.5
No	316	4.5
Waste generation has increased over the year		
Yes	286	86.4
No	45	13.6
Increased number of consumptions (n=286)		

Yes	209	73.1
No	77	26.9
Increased Income (n=236)		
Yes	192	67.1
No	94	32.9
Increased in packaged food (n=286)		
Yes	190	66.4
No	96	33.6
Increase in Family Size (n=286)		
Yes	51	17.8
No	235	82.2
How do you store/ collect your waste before disposal		
No storage- direct dispose to the dump	29	10.4
In a closed container	142	50.7
In an open container	43	15.4
In a polythene bad/sack	66	23.6
Number of days you store waste before disposal		
0-7	184	55.6
8-15	133	40.2
16 days and above	14	4.2
Who collected the waste in your house		
Collected by the waste management agency	199	60.1
Collected by household's, contractor	46	13.9
No collection service (done by household head)	86	26.0
If collected by the head of household, where do you empty/ dispose your waste?		
Drainage channels like gutter (n=46)		

Yes	42	91.3
No	4	8.7
Nearby Bush (n=46)		
Yes	36	78.3
No	10	21.7
Dump Stand (n=46)		
Yes	32	69.6
No	14	30.4
Along the road/street (n=46)		
Yes	8	17.4
No	38	82.6
In the stream (n=46)		
Yes	16	34.8
No	30	65.2
Burn it (n=46)		
Yes	29	63.0
No	17	37.0
Bury in the ground (n=46)		
Yes	16	34.8
No	30	65.2
Dump in flowing water (n=46)		
Yes	2	4.3
No	44	95.7
Recycle/Reuse (n=46)		
Yes	5	10.9
No	41	89.1
Compost (n=46)		
Yes	1	2.2
No	45	97.8

Who normally takes the waste to the disposal site		
Father	10	3.0
Mother	36	10.9
Children	32	9.7
House girl	7	2.1

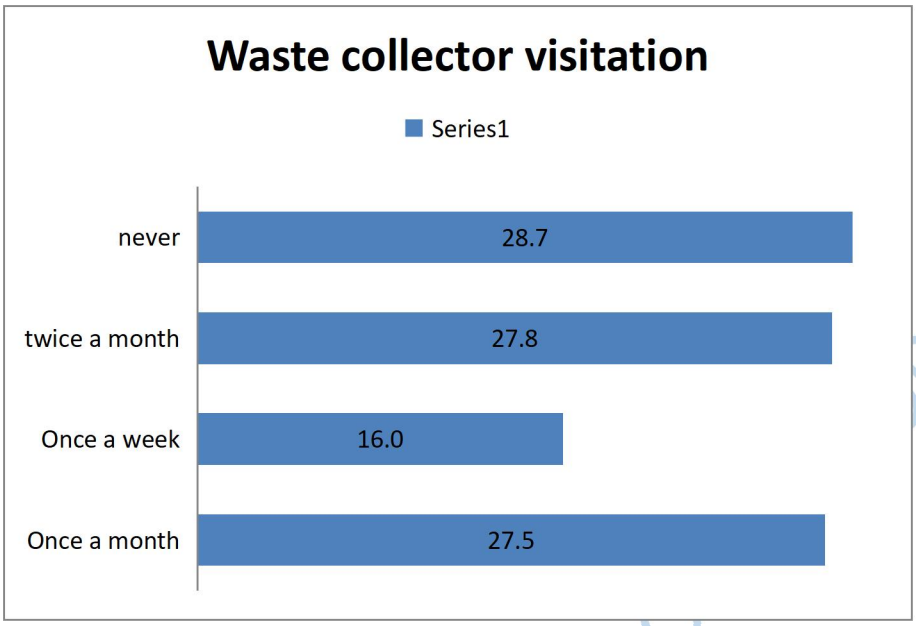
Source: Researcher's Field Survey 2022

In summary, the commonest types of waste generated in Ibadan southeast were food waste, paper waste, plastics, and sachets of water waste (polythene bags). The dominant method of disposal by the household were drainage channels, dump stands and along the streets.

Objective Two: To Assess the Waste Management System in Ibadan South East LGA.

Figure 4.2 below shows waste management visitation in the locality for waste collection and disposal.

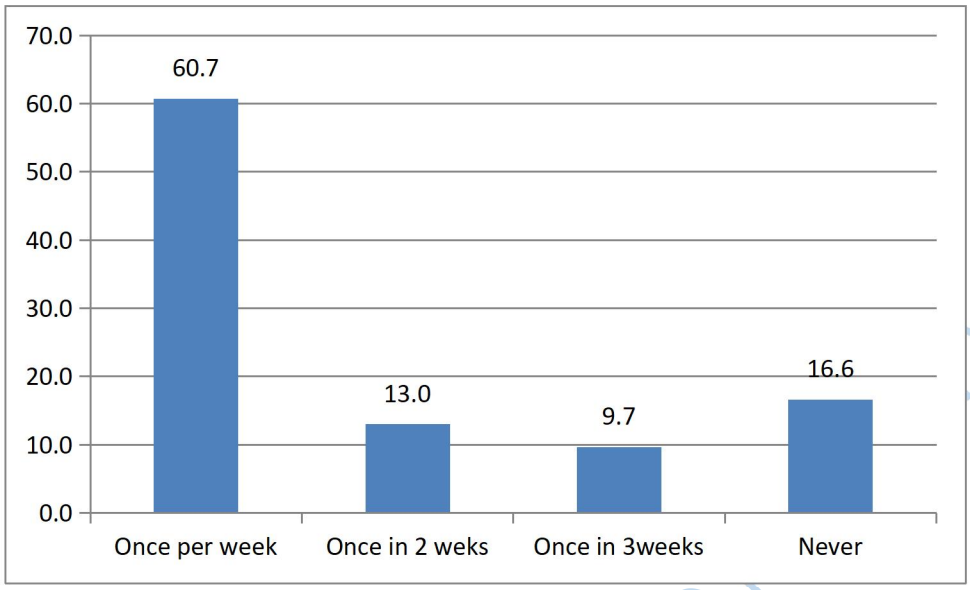
Figure 4.2: waste collector visitation in the locality



Source: Researcher's Field Survey 2022

Figure 4.2 shows waste management visitation in the locality for waste collection and disposal. Majority of the respondents 27.8% revealed that the waste management team has never visit their locality for waste collection and disposal, 27.5% shows that the waste management teams visit them once a month for waste collection and 16.0% shows that the management team visits once per week.

Figure 4.3: Environmental sanitation practices

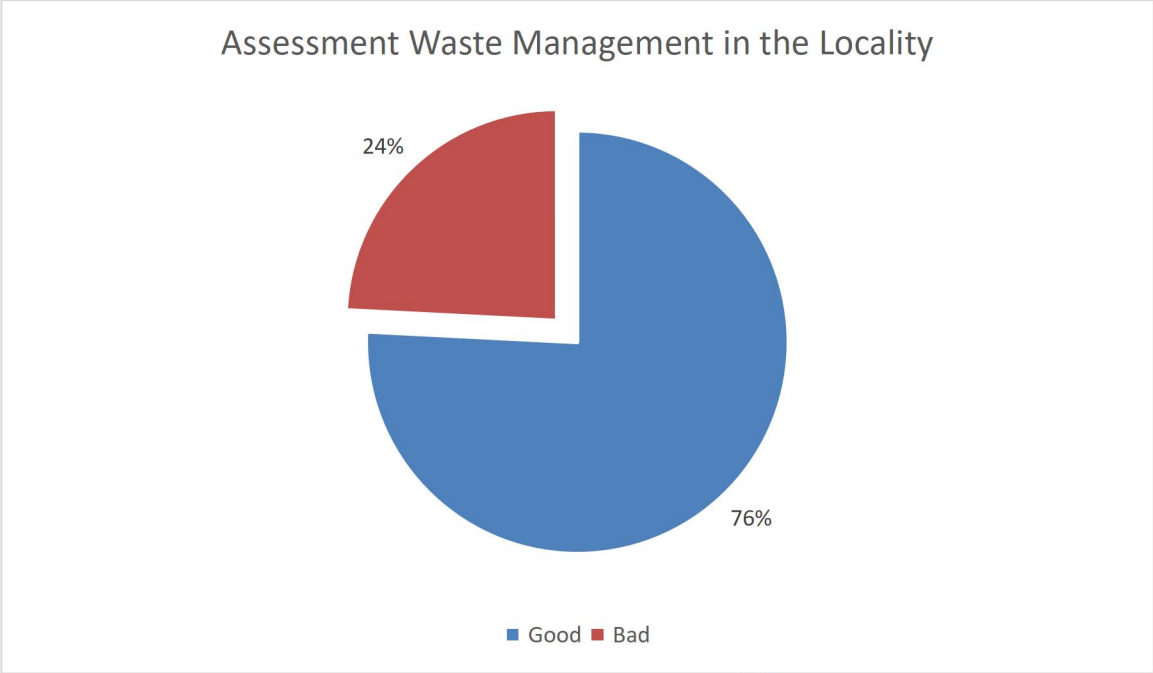


Source: Researcher's Field Survey 2022

Figure 4.3 shows Environmental sanitation practices frequency, from them result majority of the respondents (60.7%) stated that practices of environmental sanitation is conducted once per week,

16.6% of the respondents revealed they never practices environmental sanitation at all, 13.0% of the respondents shows they practice environmental sanitation Once in 2 weeks and 9.7% stated that the practice is carried out once in 3 weeks.

Figure4.4: Assessment Waste Management in the Locality

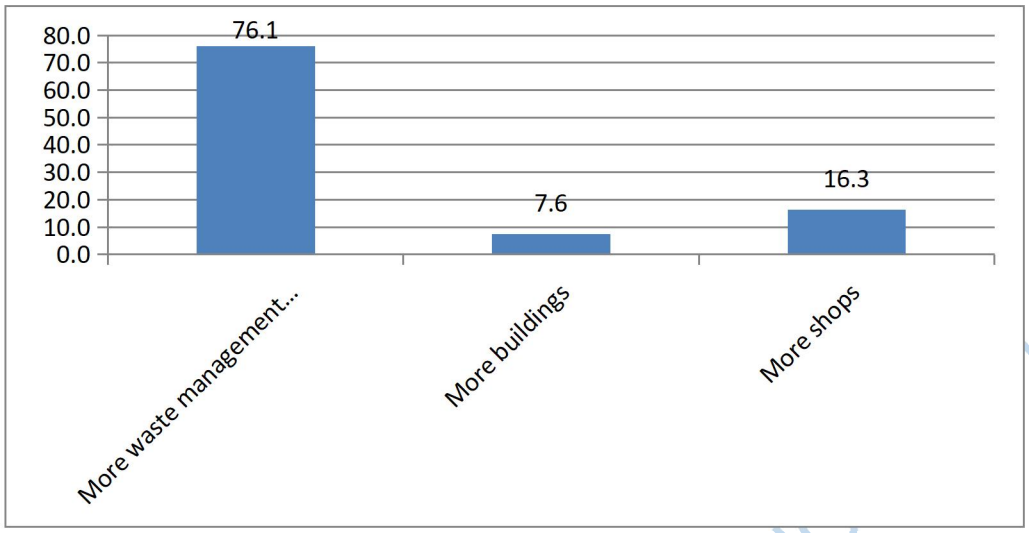


Source: Researcher's Field Survey 2022

From the outcome of the rating of waste management assessment, majority of the respondents 42.0% revealed that the waste system situation is Better while 33.8% revealed that the waste

management situation is Good, 17.2% of the respondents rate the waste situation are Bad and 6.9% shows that the rate of waste management situation are Worst.

Figure 4.5 Public Preferences in Ibadan South East LGA



Source: Researcher's Field Survey 2022

In the above Figures, the willingness of the residents to pay for improved waste management services was also assessed, the chart above shows that the majority of the respondents 76.1%

would prefer to pay to have more and improved waste management systems like dumpsters, bins recycling plants etc., in Ibadan southeast LGA, while 16.3% prefers to pay for more shops, and 7.6% would prefer to pay to have more buildings.

Table 4.3 Attitude of the Respondent Towards Waste Management

The table below shows that 76.7% of the respondents know that some waste could be transformed into wealth, Majority of the respondents 80.4% think it is right to treat/manage waste. About 73.4% of the respondents think that waste management is the sole responsibility of the government, while 76.4% would love to be involved if there are waste management infrastructures in place. The significant effects of poor waste disposal methods, 41.4% of respondents show it caused Air pollution and 32.9% of the respondents stated in their opinion, the problem of waste management is very serious.

Table 4.3 Attitude of the respondent towards waste management

Variable	Frequency (N=331)	Percent (%)
Transformation of waste to wealth		
Yes	254	76.7
No	77	23.3
Necessity of Waste Management/Treatment		
Yes	266	80.4
No	65	19.6
Waste management is the sole responsibility of the government		
Yes	243	73.4
No	88	26.6
Use of waste management infrastructures if in place		
Yes	253	76.4
No	78	23.6
Significant effect of the presence of Municipal solid waste at your locality		
Flood	116	35.0
Air pollution	137	41.4
Disease	32	9.7
None	46	13.9
Severity of the problem of waste management		
Very serious	109	32.9
Somewhat serious	77	23.3
Not serious	75	22.7
Don't know	70	21.1

Source: Researcher's Field Survey 2022

Objectives Three. To Investigate the Challenges of Waste Disposal Practices in Ibadan South East LGA

Table 4.4 This survey revealed that 56.8% of the respondents have no dumpters in their vicinity, 45.3% of the respondents often use the dumpsters occasionally, Majority of the respondents 74.3% revealed that the dumpsters are not enough in their area, 56.2% shows that they are willing to pay to have more dumpsters, Majority of the respondent 71.3% also revealed that there are no recycling programs in their area. The study further revealed that 60.7% of the respondents dump their wastes beside the garbage bins instead of putting it inside the bins due to Overflowing of the bins in the area. Many of the respondents 63.2% stated that they are not involved in any recycling or waste management activity or program due to the lack of such programs in their area.

Table 4.4 Challenges of waste disposal practices

Variable	Frequency (N=331)	Percent (%)
Presence of dumpster/large bins in your vicinity		
Yes	143	43.2
No	188	56.8
Utilization of dumpster/large bins		
Occasionally	82	24.8
Not at all	150	45.3
Often	99	29.9
Adequacy of dumpsters		
Yes	85	25.7
No	246	74.3
Willingness to pay to have more dumpster installed		
Yes	186	56.2
No	145	43.8
Availability of any recycling programs in the locality/area/wards		
Yes	95	28.7
No	236	71.3
Dumping of wastes beside garbage bins instead of putting it inside those		
Yes	117	35.3
No	214	64.7
Main reason for such act		
Difficult to put waste inside the bin due to the waste and litter spread around the bin	13	11.1
Any other reasons	35	29.9
Over Flowing bins	51	43.6
Difficult to put waste inside the bin due to height of the bin	18	15.4
Involvement in any recycling or waste management activity or programs		
Yes	92	27.8
No	239	72.2
Reasons for not involving		
Lack of such programs in your are	155	63.2
I don't know	55	23,0
I don't care	33	13.8

Source: Researcher's Field Survey 2022

As already discussed under Table 4, the dumpsters/containers available in the town are woefully inadequate. And so the waste management team is not able to effectively collect all the waste generated in the town.

Correlations Between Socio-Demographics Factors and Solid Waste Collection Methods

Table 4.5 shows the Correlation of demographics characteristics and waste collection method of the respondents.

From the Observed study, at 95% confidential level shows that there is a significant association between the age and collection the waste in the house of the respondents with a P- value of 0.004. There are also significant associations between collection of waste in the house and other socio demographics characteristics which include Educational status and Occupational status with the P- value 0f 0.009 and 0.027 respectively. The variable of sex, marital status and number of people living in the house has the P- value of 0.235, 0.296, 0.290 respectively, in which are not significant in value.

Consequently, the current findings show that age of a respondent is significant to the waste disposal methods and management with the P- value of 0.004. which makes the education status of the respondent significant to the waste disposal methods with the P value 0.009. Unlike the work done by Garang Manyok John on assessment of solid waste practices in Bor Town, south sudan which showed that at 95% confidence level there was no significant difference between education levels of the respondents and solid waste disposal methods/ management, this implies that the level of education does not increase or reduce the levels of waste disposal methods.

Furthermore, this result is in line with the findings of work done in Owerri, Nigeria by Adogu, P.O.U et all 2015 on Assessment of waste management practices among residents of Owerri, Imo state Nigeria which indicate the respondent level of education is significant to the waste disposal methods. Also, Findings done by Birma 2016 on Assessment of household solid waste management shows that educational levels have influence on waste management. The higher the level of education one attained, the more conscious one is toward proper waste disposal/ management.

Table 4.5 Correlations Between Socio-Demographics Factors and Solid Waste Collection Methods

Variable	Collected by Waste Management Agency (%)	Done by Owner (%)	Frequency (N=331)	P-Value	Chi Square
Age					
18-30	58.0	40.7	177	0.005	10.804
31-40	25.7	27.9	87		
>41	16.3	31.4	67		
Sex					
Male	39.2	46.5	136	0.235	1.412
Female	60.8	53.5	195		
Educational Status					
Primary or less	65.7	47.7	202	0.009	9.485
Secondary	20.8	27.9	75		
Higher	13.5	24.4	54		
Marital Status					
Single	41.6	32.6	130	0.296	2.436
Married	44.5	53.5	155		
Once married	13.9	14.0	46		
Occupational Status					
Professional	31.4	19.8	94	0.027	10.979
Clerical Job	12.2	8.1	37		
Sales and	20.4	16.3	64		
Services	13.5	18.6	49		
Skilled	22.4	37.2	87		
Unemployed					

Number of People in the House					
1-10	83.3	77.9	271	0.290	2.476
11-20	14.3	20.9	53		
>21	2.4	1.2	7		

Source: Researcher's Field Survey 2022

4.3 Discussion of Findings

This study focuses on Assessment of Waste Management **Practices** in Ibadan southeast LGA, the study aims to describe the current waste disposal practices, assess the waste management system, investigate the challenges of solid waste disposal practices in Ibadan south east LGA.

4.3.1 Socio Demographic Variables

In this study, 3365 questionnaires was distributed but 331 were valid on return and were thus analyzed giving a high response rate, this is similar to the response rate of a study Practice, pattern and challenges of solid waste management in Onitsha Metropolis, Nigeria[1].The majority of the respondents were aged between 25 – 34 years, the mean age of the respondents is 33.30 with the standard deviation is 11.951, this corresponds with the age range of respondents (25-34years,Mean =33.1%) in the study in Solid waste management in Nigeria: The case study of Onitsha commercial city. A little over half of respondents were females while less than half of the participants were males, which is similar to a study done in Owerri.

This finding also revealed that majority of respondents had Higher Education, Secondary school education was about one-quarter of the study participants, and less than that for participants with primary and no education, this corresponds with the result of the study done in Owerri, which show that more than half of the participants had tertiary education, one-fifth had Secondary education and others had primary or no education, unlike the work done on assessment of solid waste practices in Bor Town, South Sudan which showed that Majority of the respondents had not gone to school and thus lacked formal education and nearly one-fifth of the respondents had tertiary level of education while others had primary and secondary level of education, respectively[4].

4.3.2 The Current Waste Practices

The findings of my study revealed that the major type of waste mostly generated in the respondents' areas, households, shops, or streets was food residue, accounting for nearly one-third of the waste. Other significant categories of waste included polythene and sachet water

waste, which made up about a quarter, and paper waste, which comprised roughly one-sixth. These results align with other studies that have shown food waste as the predominant type, followed by polythene waste and paper waste.[2]

A significant portion of my respondents, around two-fifths, collect their waste in containers with covers, and a majority, more than two-thirds, do not separate their waste before disposal. This is consistent with a study in Owerri Municipal, which found that just over half of the households stored their waste in closed containers outside the house and a majority, nearly nine-tenths, did not sort their waste prior to disposal.[1]

The findings of this study revealed that the majority of residents, approximately three-fifths, dispose of their waste through government agencies, while around one-seventh use private contractors. A similar pattern was observed in a study conducted in Onitsha, where the majority of respondents, roughly two-thirds, used waste management agencies or private contractors for disposal, while about one-quarter did not store their waste, opting instead for direct disposal, which leads to unaccounted waste. This study highlights a general picture of poor waste management practices among the residents of Ibadan South East, with around one-eighth of respondents resorting to burning their waste and a small fraction, approximately one in thirty, dumping it in drainage channels like gutters. These findings align with other studies.

4.3.3 Assessment of Waste Management System

The majority of respondents, representing just over a quarter, reported that the waste management team has never visited their locality for waste collection and disposal. Another quarter indicated that the waste management teams visit them once a month, while a smaller proportion, less than one-fifth, said the team visits once a week. These findings are consistent

with a similar study, which revealed that approximately one-third of households do not have their waste collected at all, about a fifth have their waste collected weekly, and just under one-fifth have it collected monthly.[3].

A majority of Ibadan Southeast residents are aware of the importance of sustainable waste management, with over three-quarters knowing that some waste can be transformed into wealth. Similarly, a large majority, more than four-fifths, understand the importance of treating and managing waste. About three-quarters of respondents believe that waste management is solely the government's responsibility, while a similar proportion would be willing to participate in waste management initiatives if the necessary infrastructure were available. The significant effects of poor waste disposal methods were noted, with over two-fifths of respondents citing air pollution as a concern, and one-third considering the waste management problem very serious. These findings align with a study conducted in Onitsha, where over three-quarters of respondents acknowledged the potential of waste transformation into wealth, more than two-thirds understood the importance of waste treatment, and more than half believed that solid waste management is solely the government's responsibility.[2]

4.3.4 To Investigate the Challenges of Solid Waste Disposal Practices in Ibadan South East LGA

From my findings, the major challenges identified include the lack of dumpsters in some parts of the vicinity, as indicated by over half of the respondents. Nearly half of the respondents use dumpsters only occasionally, and a large majority believe there are not enough dumpsters in their area. Additionally, a significant majority revealed that there are no recycling programs available in their vicinity. The study further uncovered that a majority of respondents dump their waste

beside the garbage bins rather than inside them, attributing this behavior to the bins being often overflowing and the irregular collection patterns by waste management authorities. Moreover, many respondents stated they are not involved in any recycling or waste management activities or programs, largely due to the absence of such initiatives in their area.

This study revealed that the dumpsters and containers available in the town are woefully inadequate, preventing the waste management team from effectively collecting all the waste generated. Improper waste disposal in Ibadan is linked to irregular collection patterns by the waste management authorities. These findings are consistent with many other studies, which also report the non-availability of waste collection centers, potentially explaining the unhealthy disposal habits observed in this study.[5]

Endnotes

[1] Adogu P.O.U, Uwakwe K.A, Egenti N.B, Okwuoha A.P & Nkwocha I.B. *"Assessment of waste management Practices among Residents of Owerri Municipal Imo State Nigeria*". **Journal of Environmental protection** Vol. 6 No. 5, 2015 May

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Chapter Five

Summary, Conclusion, and Recommendation

This chapter presents the summary, conclusion, recommendation, as well as suggestions for further studies. This chapter was discussed using the following outline:

5.1 Summary of Findings

The findings of this study identified suitable solid waste management as a pressing need in Ibadan Southeast. However, the residents' level of awareness, attitudes towards waste

management, waste disposal methods, and available infrastructure contribute immensely to the current state of solid waste management in the Local government.

Although there has been a remarkable improvement in the collection, the level of collection remains lower than that of the generation. However, the indiscriminate disposal of refuse cannot be wholly blamed on the inadequate communal containers in the area. The other culprit is a total lack of education on solid waste management issues. Good solid waste management has much to do with changing behaviours and habits. A person's long-held attitude can only be changed through education.

Unfortunately, majority of the respondents in the study area confirmed that there has not been any form of education to enlighten them on solid waste management and recycling programs. There is no public awareness and enlightenment campaigns as regards to the dangers of poor waste management practices. Therefore, the overall performance assessment of the agencies responsible for solid waste management in Ibadan southeast LGA was not efficient.

The solid waste management practice adopted by the residents of Ibadan southeast is negative although with high environmental awareness. Bad disposal attitude is a common practice which is why many of the residents dispose their waste incessantly by burning, through drainage channels, on the street, flowing river etc.

The study also observed that the residents' attitude is towards adopting better solid waste management practices is hampered by several infrastructural inadequacies, that identified several challenges related solid waste management which included, ignorance of the community about the need for proper waste disposal, lack legislation, Lack of finance, lack of awareness among the public.

Solid Waste Management Practices at the Household Level

Proper handling of waste at households' level constitutes the first step to effective waste management. Therefore, waste handling practices at the household level in Ibadan Southeast is improper. This is as a result of indiscriminate dumping of households waste within the neighborhoods most especially where there are few or no official designated collection points. Therefore, residents of these areas resort to burning in order to reduce the quantity of waste generated, to the use of dumping of waste in open spaces and drainage channels. Furthermore, there is no waste separation at the point of generation within households as all the components of waste are stored together in one receptacle.

5.2 Conclusion

This study underscores the critical need for improved solid waste management in Ibadan Southeast LGA. Despite residents' awareness of the importance of sustainable waste practices and the potential for waste transformation into wealth, the existing waste management system is significantly lacking. Findings reveal that a substantial portion of the population still faces challenges such as inadequate dumpsters, infrequent waste collection, and a lack of recycling programs. These issues contribute to improper waste disposal methods, including the burning of waste and dumping in drainage channels.

The disparity between waste generation and effective collection highlights systemic inefficiencies, exacerbated by the absence of educational initiatives and public awareness campaigns. This lack of education on proper waste management practices and recycling perpetuates poor disposal habits. It is essential to enhance waste management infrastructure, improve collection frequency, and implement comprehensive public education programs. Such

measures will be crucial in fostering better waste management practices and mitigating environmental and public health concerns in Ibadan Southeast LGA.

5.3 Recommendations

Based on the findings of this study, the following strategy options were recommended for efficient and effective management of solid waste in Ibadan southeast LGA.

This will include the following:

1) **Enforce Waste Management Regulations and Adequately Resource Waste Management Agencies**

Strengthening the enforcement of existing waste management regulations is crucial for addressing improper disposal practices in Ibadan Southeast LGA. To achieve this, the local government should implement measures such as fines for illegal dumping and incentives for proper waste management. Regular inspections and enforcement actions will help ensure compliance and deter improper disposal.

Also, it is essential to adequately resource the waste management agencies, such as the Oyo State Waste Management Authority (OYOWMA). This includes providing sufficient funding, personnel, and equipment to enhance their operational efficiency. By ensuring that these agencies are well-equipped and supported, Ibadan Southeast LGA can improve waste management practices and better address the community's waste management needs.

2) **Enhance Waste Management Infrastructure**

The findings indicate a critical need for additional dumpsters and better waste management infrastructure in Ibadan Southeast LGA. The local government should invest in increasing the number and accessibility of waste containers throughout the area. Ensuring these dumpsters are regularly emptied and maintained will help manage waste more effectively and reduce overflow, which currently leads to improper disposal practices.

3) Implement Recycling Programs

With a significant portion of the population indicating a lack of recycling programs, establishing such programs should be a priority. Ibadan Southeast LGA should set up dedicated recycling centres and promote community recycling initiatives. Local businesses and schools can be engaged to support and participate in recycling efforts, helping to create a culture of waste separation and recycling.

4) Regularize Waste Collection Patterns

The irregular waste collection reported in Ibadan Southeast LGA needs to be addressed by establishing a consistent and reliable waste collection schedule. Coordination between the local government and waste management contractors should be improved to ensure timely and efficient waste removal. Publicizing the collection schedule will help residents manage their waste more effectively.

5.4 Contribution to Knowledge

This study provides an understanding of the current waste practices and their management in Ibadan south-east. It also provides strategies to tackle problems such as public awareness,

community participation, payment for waste management, public-private partnership, adequate resourcing of waste management agencies, use of integrated solid waste management model etc.

5.5 Suggestions for Further Research

A qualitative study should be carried out on solid waste management and practices in the study area. Focusing on a higher level of integrated solid waste management options such as reuse, recycling and composting which contribute to economic development effort.

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Informed Consent

Title Of Study: **Assessment Of Waste Management Practices In Ibadan South East Local Government Ibadan, Oyo State**

Principal Investigator

OBISESAN ADENIKE OLUWASEUN

PUBLIC HEALTH DEPARTMENT, LEAD CITY UNIVERSITY

LEAD CITY UNIVERSITY, TOLL GATE, IBADAN,

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Purpose of Study

My name is Obisesan Adenike Oluwaseun, a master of public health student at the Faculty of Public Health, Lead City University, Ibadan. I am conducting a study on assessment of waste management practices in Ibadan south east LGA.

I am interested in understanding the assessment of local waste management practices in Ibadan south east local government, and also to know the waste situation in the local government and how members of the households and the community has been living through the situation. I hereby solicit your support in completing this questionnaire.

Research Procedure

If you agree to be in this study, you will be asked to answer questions about yourself pertaining to the purpose of this study described above. These questions will be asked using a structured questionnaire. The questionnaire will take about 5 to 10 minutes of your time to complete.

Risks and Benefits

There are no known risks if you take part in this study. There are also no incentives but the information you provide would hopefully serve as an important input to intervene in programs that aim at improving children health.

Compensation

Participant will not be compensated for participation in this study. Participation is voluntary.

Confidentiality

All information you provide will be confidential and used for research purpose only. Your name will not be required and will never be used in connection with any information you give. Your response is completely anoynymous.no personal identifying information will be collected. Every effort will be made by the researcher to preserve your confidentiality. Only the research team will have access to the answered questionnaires. Confidentiality and privacy will be maintained.

Contact Information

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page. If you have questions regarding your rights as a research participant, or if problems arise which you do not feel you can discuss with the Primary Investigator, please contact the Supervisor at olowolafe.tubosun@lcu.edu.ng

Voluntary Participation

Your decision to participate in this study is completely voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason.

Withdrawal from the Study/Withdrawal of Authorization

If you decide to participate in this study, you may withdraw from your participation at any point without penalty. Withdrawing from this study will not affect the relationship you have, if any,

with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

Consent

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Appendix

Questionnaire

My name is Obisesan Adenike Oluwaseun; I am a student of lead city University. I am conducting this study as a partial fulfilment for the Award of a Master Degree in public health. This questionnaire was drafted in ASSESSMENT OF WASTE MANAGEMENT PRACTICES IN IBADAN SOUTH EAST LOCAL GOVERNMENT AREA, IBADAN, OYO STATE. Please answer all the questions with honesty. The information you will give is purely academic and it will be treated with a lot of confidentiality. I am requesting you to kindly participate in this study by responding to the following questions.

Section 1: Demographic And Socio – Economic Data

1. SEX: Male [ ] Female [ ]
2. AGE:

3. Education status: None [ ] Primary [ ] Secondary [ ] Higher [ ]
4. Marital status: Single [ ] Married [ ] Divorced [ ] Widowed [ ] Separated [ ]
5. Occupational status: Professional [ ] Clerical Job [ ] Sales and Services [ ] Skilled [ ] Unskilled [ ] Agricultural [ ] House wife [ ] Unemployed [ ]
6. How many people live in your house? ……

SECTION 2: To examine the current waste management system and practices in Ibadan Southeast LGA.

7. What (category) of waste is dominant in your area, in your household/place of work?

i. Food waste ( ):
ii. Paper waste ( ):
iii. Plastic waste ( ):
iv. Glass waste ( )
v. Textile waste
vi. Aluminum(cans)/Metal waste ( ):
vii. Polythene/ Sachets of water waste [ ]:
viii. Hairs and weave-on waste( ) :
ix. Electronic gadgets waste ( ) :
x. Chemicals waste( ):
xi. Blocks/concretes/tiles from construction waste ( ):
xii. Electronics waste[ ]

8. Do you think your waste generation level has increased over the years? Yes [ ] No [ ]

8b. If yes, what could be the cause of this?

Increased number of consumption [ ]
Increased income [ ]
Increase in packaged food [ ]
Increase in Family size [ ]

9. How do you store/collect your waste before disposal?

	No of Days(9b)
In a closed container	
In an open container	

In a polythene bag/sack	
No storage—direct disposal to dump	
Others please specify……	

10. Do you separate your solid waste before disposing? YES [ ] No [ ]

11. Who collects the waste in your house?

i. Collected by the waste management agency [ ]
ii. Collected by owner's contractor [ ]
iii. No collection service (done by owner) [ ]

12. If collected by the owner, where do you empty/dispose your waste?

i. Drainage channels like gutter [ ]
ii. Nearby bush [ ]
iii. Dump stand [ ]
iv. Along the road/Street [ ]
v. In the stream [ ]
vi. Burn it [ ]
vii. Burry in the ground [ ]
viii. Dump in flowing water [ ]
ix. Recycle/ Reuse [ ]
x. Compost [ ]

13. What significant effect has the presence of Municipal Solid Waste (MSW) caused in your locality?

i. Flood [ ]
ii. Air pollution [ ]
iii. Disease [ ]
iv. None [ ]

Section 3: Assessment of waste management and level awareness in the Locality.

14. Do you have dumpsters/ large bins in your vicinity? YES [ ] NO [ ]

15. How often do you use them? Often [ ] Occasionally [ ] Not at all [ ]

16. Are there different dumpsters for different class of wastes? YES [ ] NO [ ]

17. How often do you see the dumpsters overflowing with waste/garbage in your area? Often [ ] Occasionally [ ] Not at all [ ]

18. How often does waste management team visit your locality for waste collection and disposal? Once a week [ ] Once a month [ ] Once in 6 months [ ] Never [ ]

19. Do you think the dumpsters in your area are enough? YES [ ] NO [ ]

20. Would you pay/contribute to have more dumpsters installed? YES [ ] NO [ ]

21. Where are the dumpsters located? Close to houses/shops [ ] Street junctions [ ] In another street [ ]

22. How many waste collection points do you have in your locality?

i. 1 to 2 [ ]
ii. 3 to 4 [ ]
iii. 5 to 6 [ ]
iv. None [ ]

23. Will having the dumpsters close to you make you use them often? Yes [ ] No [ ]

24. How can you rate the waste management situation in your locality?

i. Good [ ]
ii. Better [ ]
iii. Bad [ ]

iv. Worst[ ]

24. How often does environmental sanitation take place in your locality?

i. Never [ ]
ii. Once per weeks [ ]
iii. Once in 2 weeks [ ]
iv. Once in 3 weeks [ ]

25. Would you pay to have more shops or more and improved waste management systems like dumpsters, bins recycling plants etc to be built in Ibadan south East LGA?

i. More shops [ ]
ii. More waste systems [ ]
iii. More buildings [ ]

26. Do people dump their waste beside the garbage bins instead of putting it inside those?

Yes [ ] No [ ]

26b If Yes, What could be the cause?

i. Over flowing bins [ ]
ii. Difficult to put waste inside the bin due to height of the bin [ ]
iii. Difficult to put waste inside the bin due to waste and litter spread around the bin [ ]
iv. Stray animals (dogs, mouse and birds etc.) [ ]
v. Any other reason …….. [ ]

27. Are there any recycling programs in your locality/area/ward? YES [ ] NO [ ]

28. Are you involved in any recycling or waste management activity or program? YES [ ] NO [ ].

28b If NO, why? I don't care [ ] Lack of such programmes in my area [ ] I don't know how [ ]

29. Do you know that some wastes could be transformed to wealth? YES [ ] NO [ ]

30. Do you think it is right to treat/manage waste? YES [ ] NO [ ]

31. Are your parents/friends/relatives/colleagues or neighbours involved in any form of waste treatment? YES [ ] NO [ ]

32. Would you copy them if they are involved into any? YES [ ] NO [ ]

33. Would you be involved if there are waste management infrastructures in place? YES [ ]NO [ ]

34. Do you think that waste management is the sole responsibility of the government? YES [ ] NO [ ]

Section 4: To determine the challenges of waste management in Ibadan south east LGA.

35. Do you have any knowledge on the effects of Municipal Solid Waste (MSW) on public health and environment? Yes [ ] No [ ]

36. In your opinion, how serious is the problem of waste management. Very serious [ ] Somewhat serious [ ] Not serious[ ] Don't know[ ]

37. How far (in metres) is the disposal site from your place of residence? ……
……

38.Who normally takes the waste to the disposal site? (Tick against the person/people responsible) Father [ ] Mother [ ] Children [ ] House girl [ ]

39. Is there any specific use of the waste generated individually or collectively in your locality? Revenue generation [ ] Composting [ ] Biogas [ ] None [ ]

40. Are there any problems that you have been experiencing as a result of the waste disposal system(s) in your area? Yes [ ] No [ ]

41. If yes, What effort has been made by the waste management to control the offensive odour from dumpsites in your locality?

i. Recycling
ii. Provide waste disposal plastic bags.
iii. None

Bio – data

A. Personal Data

Name: Adenike Oluwaseun OBISESAN

Home Address: Block 88,Oke Ibadan Estate Ibadan, Akobo Oyo State

Email Address: obisesannike2015@gmail.com

Phone Number: 08161606841/08107475223

Date of Birth and Place of Birth: September 25th, 1993, Ondo State

Nationality: Nigerian

Marital Status: Single

Sex: Female

B. Educational Backgrounds With Dates:

- **Masters' Degree in Public Health** 2021 - present

Lead City University, Ibadan

- **Bachelor Of Science; Public Health** 2015 - 2019

  (Environmental Health Science Option)

  Lead City University

  (Second Class Honours Upper Division).

- **National Diploma; Nutrition and Dietetics** 2012- 2014

  Rufus Giwa Polytechnic Owo

- **Senior School Certificate**

  Dynamic International College, Oka Akoko 2006 - 2012

- **Primary School Leaving Certificate**

  St. Stephen Primary School Akure, Ondo State. 1998 – 2004

C. Work Experience with Dates

Vocational Training at Princess Adetola Couture (PAC) Academy **2020-2021**

Six (6) month vocational training in fashion designs

- Create garments
- Create designs concepts
- Sketching of designs
- Fabrics selection and trims.

Ogun state primary health care Board Oke-Mosan Abeokuta Ogun State **2020**

(Personal Assistant to the Director)

- Administrative support

- Maintained office systems, including data management and filing
- Organizing and scheduling of meetings, correspondent and note-taking.

Ministry of Environment and water resources, Ibadan Oyo state April,2018 - Sept 2019

- Inspected and controlled elimination of wastes and pollutant by industries, firms and residentials premises.
- Commenced enforcement action through improvement notices, prohibition orders, penalty notices or prosections.
- Monitored compliance of sanctioned premises to sanitary regulations.

Ladalob Royal suites Hotel, Bodija Ibadan Dec 2015 - Jan 2017

Post Held: Hotel General Manager

- Recruiting, training and supervising staff
- Promoting and marketing the business, including developing ways to attract new customers
- Maintaining statistical and financial records
- Managing budgets
- Planning maintenance work, events and room bookings
- Customer service, coordinating departmental tasks and overseeing food and beverage.

Carlton Gate Hotel, Idi-Ape. Ibadan 2015

Post Held: Front desk manager

- Greet and welcome guests as soon as they arrive at the hotel
- Handling queries and complaints via phone, email and general correspondence.
- Screen and transferring incoming phone calls as necessary.
- Ensure the reception area are tidy and presentable.

- Taking and ensuring messages are passed to the appropriate staff member in time
- Managing meeting room availability.

University College Hospital, Ibadan **14th October 2013- 31st January 2014**

Dietetics Department and Medical Out Patient Department

Student Industrial Work Experience Scheme (SIWES)

- Making Nutritional Assessment
- Providing diet plans to patients
- Inspection of the diet of patients that are admitted to the hospital
- Providing counseling to patients regarding diet
- Monitoring progress and making changes in diet plan
- Recommending supplements.

D. Publications

Nil

Dissertations

- Impact Of House To House Inspection On Storm Water Management In Ibadan,Oyo State

E. Membership

Associate member of The Institute of Personality Development & Customer Relationship Management (IPD - CRM)

F. Major Conferences attended with Dates

Nill

G. Additional Skills

- Inspection coordination

- Lecturing
- Enviromental inspections
- Project management
- Field data collection

References:

San. Okunola Ifeoluwa Stephen

Environmental Health Officer/ Lecturer

School of Environmental Health

Lagos State College of Health Technology, Yaba, lagos

Tel: 08028836621

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Signature **Date**

The University Compliance Certification

This is to certify that this thesis by Adenike Oluwaseun OBISESAN with Matric No. LCU/PG/002358 in the Department of Public Health, Faculty of Basic Medical and Applied Sciences, Lead City University, Ibadan is in full compliance with the approved university format.

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Signature **Date**