Chapter One

Introduction

1.1Background to the Study

Waste, in its most basic and simplest definition, is the inevitable by-product of human activity[1]. According to the United Nations Statistics Department (UNSD), *"Waste is any material, other than the primary product (i.e., the product produced for the market), which the producer disposes of for the purposes of its own production, transformation or treatment and of which he/she wants to dispose"*[2]. With the prevalence of waste, the word "waste" has become an easily recognizedand undefined phenomenon[3]. If something is obsolete and no longer useful to its owner, it can be classified as waste[4]. The amount and composition of waste depends on many factors, including consumerbehavior, the economic structure of the location, and the pace of development[5]. Waste is generally divided into liquid waste and solid waste[6]. Waste is aresource, regardless of its form or type of material. However, the focus of this research will be on solid waste.

Waste is any substance or material which requires to be disposed of as being broken, worn out, contaminated or otherwise spoilt and as such lost its usefulness. It could be in liquid or solid form and could be hazardous. These classification ranges from garbage or refuse from homes and other places where human or animal lives exist. On the other hand, solid waste as described by State of Vermont Agency of Natural Resources Department of Environmental Conservation is any tangible and non-free flowing unwanted materials or substance that results from human activities[2]. It is referred to as Municipal Solid Waste where its sources are generated from – commercial, agricultural, and industrial operations. To this end, population growth and economic

development is a major contribution to solid waste generation in urban areas. Thus, Municipal solid waste is usually generated from human settlements, small industries, and commercial activities.

Solid waste generally refers to unused, unwanted, or discarded materials available in solid form, originating from domestic, commercial, industrial, institutional, or local government services, household waste, manufacturing activities.[7] It can be in the form of waste, packaging or glass from ... abandoned cars, discarded electronics, garden waste, etc. Garbage and sewage sludge are also classified as general waste[8].

Today, the increased use and consumption of commodities and natural resources is one of the major challenges caused by urbanization, industrial revolution and technological development[9]. The challenges of the negative impacts of solid waste and strategies to reduce solid waste generation, effective collection, and sustainable use are particularly relevant to rapidly growing urban and commercial cities in developing countries are of great concern to governments and stakeholders in these regions, urbanization is progressing at the same time as the generation of waste per capita[10]. This exposes citizens to environmental and health hazards. Therefore, active waste management is urgently needed.

Solid Waste management *"concerns the management of the generation, storage, collection, transfer, transport, treatment and disposal of solid wastes in accordance with the best principles of health, economics, engineering, conservation, aesthetics and other environmental considerations. defined as "field". It also responds to public attitudes"*[11]. Within that scope, solid waste management includes all administrative, financial, legal, planning and technical functions involved in solving all solid waste problems[12]. Therefore, can be considered a staple of

a healthy life[13]. Waste generation dates back to when humans roamed the earth. The abandonment of nomadic life in later years led to the establishment of lasting communities. Until recently, waste was a low priority for most municipalities, conference rooms, and government agencies responsible for public health and safety[14]. It was not until the 19th century that the idea of systematically collecting and disposing of garbage became part of a general drive to improve public health[15]. In today's cities, solid waste is removed and either disposed of or recycled for later use. All forms of human activity change the environment and result in the generation of waste that can harm animals, plants and ecosystems. However, only careful management is required to limit damage to the environment and conserve scarce resources[16].

Affirming the fact that information and telecom are the fastest growing industries stated that computer sales crossed 7.3 million units in 2007-08 growing by 16 percent. According to him, with an installed base of over 25 million units, the consumer electronics market is growing at 13-15 percent annually. In the developed countries, the average life span of computers is said to have dropped from 6 years in 1997 to 2 years in 2005 while mobile phones are said to have a life span of only 2 years and a maximum of 10-15 years. Kamat puts it most succinctly when he posited that:

> 'It has been estimated that 500 million PCs worldwide reached the end of their life in the decade between 1994 and 2003. This volume of obsolete PCs contains approximately 2,870, 000 tons of plastics, 718,000 tons of lead, 1,363 tons of Cadmium and 287 tons of mercury. In the US, it accounted for 2.63 million tons of waste in 2005 (or 1.1 per cent of the waste stream). Between 1981 and 2005, more than 1 billion PCs have been sold worldwide – 400

> million of those in the US. It accounted for 2.63 million tons of waste in 2005 (or 1.1 per cent of the waste stream), an increase of 7.8 per cent over 2004. Of this volume, 87.5 percent was disposed rather than recycled...

In the UK (Western Europe) in 1998, 6 million tons of WEEE was generated accounting for 4 per cent of the MW stream. Increasing at 3–5 per cent a year, WEEE generation in the UK is estimated to hit 12 million tons by 2010. The volume of waste computers generated in South Korea in 2002 was estimated at 1.2 million and was predicted to double, reaching 2.2 million by 2005. Germany has a yearly electronicscrap waste stream of about 1.8 million whereas in Austria, the total e-scrap amounts to about 85 000 tons per year. It is estimated that approximately 300,000 scrap PCs are generated each year in Taiwan. About 1.6 million obsolete EEE were generated in 2003 in China, with TV accounting for nearly half of the total.... The US e-waste recycling industry is reported to have once declared that about 80 percent of the e-waste they received was exported into Asia, and 90 percent of this went to China.

A fundamental environmental issue in developed and developing countries around the world is how best to identify and manage waste streams[17]. As urbanization increases, solid waste disposal in urban areas in many developing countries poses significant public health and environmental problems. Waste management practices on the African continent, whether urban or rural, are one of the overarching social phenomena that have received considerable attention from researchers. There are no major differences between urban and rural waste management practices in Africa[18]. African waste management practices have been evaluated in relation to sustainability, development, poverty, health and well-being, environmental degradation, conflict, public and

private participation, social relations, and many other concepts. The African waste management chain spans sorting, storage, collection, transport and disposal. These chains in Africa are not sustainable, lead to environmental degradation, are not fully engaged and do not reach the necessary development indicators. Poor waste management is a major risk for disease outbreaks.

In Nigeria, for example, heaps of garbage litter the streets and are not uncommonly dumped into the sewers, vacant lots and water bodies of large cities, often leading to the spread of epidemics[19]. This situation seems to continue unabated, mainly due to factors such as urbanization, population growth, lifestyle improvements and resource scarcity for proper solid waste disposal[20]. In addition, some of the factors affecting solid waste generation in Nigeria are inadequate technology, source separation facilities, strength of waste management policies and enforcement, environmental education and awareness, and individual income situation.

The population of Nigeria is put at 155 million and by any estimation generates huge volume of e-waste. For instance, Lagos, as commercial capital of Nigeria, is arguably one of the largest dumps for e-waste from the developed countries.A survey carried out by the Basel Centre in 2010 showed that at least 500 containers of used computers and other electrical appliances are imported into Nigeria through the Lagos port monthly. In just 2011 the National Environmental Standards and Regulations Enforcement Agency even barred six cargo ships loaded with toxic electronic waste from offloading in the country. The population of Lagos is currently about 18 million. It generates about 9,000 metric tonnes of wastes daily. Similarly, according to the 2006 census, Kano has a population of 9.38 million, Kaduna 6.07 million, Kastina 5.79 million, Abuja 776,298, Aba 839,000 and Ibadan 2,550,593. There is no doubt that the population of these cities has increased far more than the stated figures with a corresponding increase in the volume of waste generated.

Added to this is the fact that although Nigeria became mobile phone compliant a few years ago, by December 2009, Nigeria had about 73 million active mobile subscribers, making it perhaps the fastest growing mobile phone market and e-waste volume in Africa. What can be distilled from the above is that e-waste is a big global challenge whose impact will be seriously felt by the more vulnerable groups in the developing countries but whose potentials to get worse if not properly managed cannot be under-estimated.

It is important to note that Nigeria's population and land mass easily gives it away as a major stake holder in the region of Africa with respect to e-waste. By its natural disposition, goods- both the good, the ugly and the bad, easily come into Lagos through the sea ports. Several containers are of-loaded everyday with assortment of goods, some of which are also carried into the hinterland. Of these imported items Benebo (2011) argues that only about 2 percent are functional requiring no repair, 5 percent useable with minimum repair, another 15-20 percent can be used to repair other items, while the rest at best will qualify as junks to be eventually discarded as wastes. This data is corroborated by that of the Basel Action Network (BAN) which estimated that about 400,000 used computers were being imported into Nigeria every month, out of which 25 – 75 percent were junks. It is remarkable that about 90 percent of what is imported into the country comes from European Union and USA in equal proportion while the remaining 10 percent comes from places like Singapore, Korea, Japan and Malaysia. Worst still, most of them are imported without regard to their functionality, safe disposal guidelines and risk implications.

Dumping of e-waste in any environment including Nigeria has negative health consequences such as leaching toxins into the soil, air and groundwater which later enter into crops, animals and human body systems causing contamination and pollution as indicated below. Medical

experts have warned that exposure to these substances can reduce life expectancy through damage to blood, respiratory and nervous systems, DNA, immune systems, and kidneys. Other impacts include skin disorders, cancer, interference with regulatory hormones and brain development. Indeed, a major sense of urgency has been created by the growing environmental and health disaster resulting from indiscriminate disposal and unsustainable management of e-waste in Nigeria. E-waste affects the environment in a peculiar manner. Unlike most other forms of wastes, most of its impact on the environment is occasioned by poor processing or management of the waste. This is because some of the electronic scrap components contain poisonous chemicals which eventually become toxic such as;

i. Mercury found in fluorescent tubes, mechanical door bell, and thermostats,relays, printed circuit boards switches and flat-screen monitors. This causes respiratory and skin disorders due to bioaccumulation in fishes and also chronic damage to the brain.

ii. Beryllium found in motherboard. The health effect of this is Carcinogenic (lung cancer) Inhalation of fumes and dust. This causes chronic beryllium disease and other skin disease like warts.

iii. Lead available in lead-acid batteries, Cathode Ray Tubes (CRTs) monitor glass, and solder,

iv. Brominates flame retardants found in plastic housing of electronic equipment's and circuit boards. This disrupts endocrine system functions.

v. Cadmium found in corrosion-resistant alloys for marine and aviation environments. This chemical which accumulates in the kidney and liveris toxic, and causes irreversible neural damage to human health.

vi. Plastics found in cabling and computer housing. These contain toxic Poly Vinyl Chloride (PVC). The burning of plastics produce dioxin which causes reproductive and developmental problems, immune system damage and interference with regulatory hormones.

vii. Front panel of CRT's found in Barium and short-term exposure to the substance causes muscle weakness; damage to heart, liver and spleen.

Local governments are obliged to exercise the exclusive constitutional function of waste management. Basically, waste management in Nigeria is the responsibility of the local Environmental Protection Agency, as specified in the 1988 Decree establishing the Federal Environmental Protection Agency (FEPA). Decree 58 of 1988 was amended by FEPA (Amendment) Decree No. 59 of 1992. This law gives FEPA overall responsibility for the protection and development of the environment, the conservation of biodiversity, and the sustainable development of Nigeria's natural resources in general and environmental technology. Among other functions, it includes the initiation of policies related to environmental research and technology (Decree No. 59 1992). This study explores how household members deal with waste and perceive it as opposed to cleanliness and dirtiness, how they perceive space in relation to waste management, how waste management seeks to understand how households interact, as well as how household members organize socially in relation to with public bodies in relation to their waste management practices[21]. Therefore, this study aims to assess local waste management practices in Ibadan south east Oyo state.

Some of these organic compounds and heavy toxic metals, are usually released to the workplace environment, surroundings and even drainage water. Worst still, most of these e-wastes are

handled as a high-risk backyard operation performed using non-efficient and non-environmentally sound technologies (most times with bare hands during processing in the various workshops). It is also common sight to see young boys at refuse dump sites rummaging piles of assorted wastes with bare hands in a bold attempt at a mere exiguous income and apparently oblivious of the attendant health and other implications occasioned by exposure to the toxic hazards.

Although research is not yet conclusive in terms of data on the exact impact of these e- wastes (for instance X quantity of e-waste gives rise to X diseases) on the people who process these wastes and the people who live in environment where these wastes are dumped and or re-cycled, there is clear evidence that the toxic constituents of these e-wastes can lead to several occupational and environmental hazards especially in cases of leaching and unsafe exposure to the substances. As will be expected, the impact will be more severe on the usually vulnerable social groups - women, children and perhaps, migrant labourers directly involved in the processing. Resources are equally lost due to inefficient processes.

From the above analysis it is clear that the environment has been compromised, with loss in valuable revenue, pollution problems, health and safety implications amongst others.

1.2 Statement of the Problem

A study found that the issue of proper disposal of trash was a surprisingly significant one in Nigeria. The rapid daily increase in development and commercial activity in these regions has the greatest impact on the cities of Nigeria, including Ibadan, Onitsha, Lagos, and Kano, amongst others[20]. Even though there have been efforts made to remediate it, a large portion of the garbage that is produced is still not managed in the appropriate manner. The collection of

rubbish without sorting it and its disposal at predetermined locations is the waste management method that is utilized most frequently in Nigeria. Sometimes the selection of landfills is done recklessly. These parts of the community are not serviced by the community administrator or by the authorities of the local government. This has led to rubbish being littered, dumped without consideration, containers and bin and dust bin overflowing in every nook and cranny of major cities and across the country. The acceptance of this fact provides the impetus for the theses, which in turn stimulate research in that particular area. The garbage problem in the local government as well as how members of homes and the community have been coping with the situation is the primary subject of the investigation. The term "waste situation" refers to the process of disposing of waste as well as the benefits of doing so.

1.3Justification of the Study

The current capacity of the available infrastructure is insufficient to deal with the rising amount of waste produced by households as a result of the rapid development of the population. As a direct consequence of this, residents are turning to inefficient methods of garbage disposal, such as throwing trash on the curbs. This is due to the fact that there are not enough integrated waste management plans in peri-urban areas to match the rapid population expansion. This, in turn, makes it easy for home waste management options to become unsustainable. Garbage is allowed to accumulate since the responsible authorities do not perform adequate waste collection, which results in an unpleasant environment in which people must live. Ineffective disposal of garbage leads to blocked drainage systems, which in turn causes flooding during periods of severe precipitation. Regrettably, there is little action made to dispose of the increased amount of household waste brought on by the expanding population. Ibadan South East Municipality is a wonderful illustration of this type of research as a result of all of these factors.

1.4 Aim and Objectives of the Study

The research aims is to examine and assesssolid 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. investigate 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

i. What are the current waste disposal practices in Ibadan south east LGA?

ii. What are the rate of waste management system situation, level of awareness and how frequent are solid waste collected and disposed in Ibadan south east LGA?

iii. 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

Assessment - A determination or approximation of the nature, quality, or ability of something.

Waste Management – Covers the processes and actions required to manage waste, from its creation to its final disposal. This includes the collection, transport, treatment, disposal of waste, and the supervision and regulation of waste management processes and waste-related legal, technical and economic mechanisms.Waste can be solid, liquid, or gaseous, and each type requires different disposal and management methods.Waste management deals with all types of waste, including industrial, biological, domestic, municipal, organic, biomedical, and radioactive waste.

Household Waste – Household waste, also known as household waste or municipal 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

Management - the process of handling or controlling something.

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 Definition

2.1.1 Definition and Characterization of Waste

The understanding of waste definition and classification is becoming essential as current waste management practices become multifaceted with regulations, actions and services are modified to distinguish between different types of waste materials[1]. Therefore, it's important to know the exact makeup of garbage. You can recover, reuse, recondition, or purify waste by employing a separate technique on the same material, but it doesn't make it any less waste. The process of categorizing trash frequently goes beyond the garbage itself. Collection, disposal, recovery, transport, and treatment are only some of the most common ways in which a wide range of categorizations are put into practice[2]. 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 accurateestimation of production rates impossible. Production rates vary from countryto countryand 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 containsa 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 recyclingprocess[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 workplacerisks associated with the storage and transportation of theseproducts[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 Waste Management Practices

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 flammablematerial[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 ozonelayer[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].

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].

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, Corruptione.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	A. Cheap, No Technical Know-How Is Required. B. No Technical Know-How Is Required.

		On The Government.	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: Waste Authorities in Nigeria, 2023

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. 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. 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.

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. 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.

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. 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. 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.

2.1.3 Environmental Pollution Impact

Surface-Water

Not only do sources in urban areas contribute to the contamination of surface water, but sources in industrial areas do as well. On the other hand, it has been determined that industrial sources are the predominant contributors to surface water pollution as a result of the relative polluting

potential, volume, and chemical composition of industrial wastes. The fact that industrial sources are the principal contributors to surface water contamination led to the formation of this conclusion. Consequently, this conclusion was obtained. Because the majority of wastewater, which is used for both domestic and industrial purposes, is ultimately converted into waste water, it is essential to have a comprehensive understanding of the soil and wastewater structure of an area. This is because waste water can be utilized for both domestic and industrial purposes[34]. They came to the conclusion that landfills are a significant contributor to the polluting of surface water and that they represent serious environmental dangers. In comparison to the standards set by the World Health Organization and the United States Environmental Protection Agency, the physicochemical qualities and heavy metal concentrations of the water in the surrounding bodies of water were discovered to be alarmingly high. Because of this, landfills need to be situated a sufficient distance away from bodies of water in order to lessen the likelihood that leachate may get into the water supply. It is essential to do research into the relationship between the pollutant loads caused by landfills and the quality of surface water. Actions taken by humans, such as the disposal of garbage in or near water bodies, are another reason for concern due to the fact that these bodies of water serve as a habitat for aquatic life and are utilized for human reasons. Remedial actions that are capable of being planned and recommended based on an in-depth study of the features of leachate can be utilized to keep the water quality in this region at an acceptable level[35].

Air Pollution

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment.

A substance in the air that can be adverse to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly produced from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone – one of the many secondary pollutants that make up photochemical smog. Some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

The air pollution challenge that results from landfilling and open burning needs to be addressed through a unified approach to reduce these activities. It is necessary to assess the level of pollution emitted from these indiscriminate practices. Potential hazards due to human exposure to contaminants. However, unlike developed countries where air quality monitoring is carried out periodically, environmental researchers in sub-Saharan Africa, in countries such as Nigeria, are obliged to assess the quality air[36]. Environmental protection agencies, city managers will need this information, and residents will create buffer zones for landfills to protect public health and welfare[37] In terms of emissions methods, it has been determined that open burning in many Nigerian cities contributes significantly to pollution levels. However, policymakers need to understand that doing nothing about air pollution is more costly than trying to manage air pollution[38]. Additionally, many options have been proposed to utilize waste in Nigeria, including converting waste into organic fertilizer, reusing and recycling. The country's extreme energy shortage recommends

considering waste-to-energy technology[39]. Gas concentration levels assessed in landfills were found to vary by location and season. In general, gas concentrations measured in landfills are higher than in other areas. Furthermore, in addition to landfill pollution, human exposure to chemicals released from landfill fires, especially CO, CO2, SO2 and NO2, can pose significant risks to human health. people, including landfill employees[40].

Major primary pollutants produced by human activity include:

- **Sulphur oxides (SOx)** - especially sulphur dioxide, a chemical compound with the formula SO2. SO2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulphur compounds, their combustion generates sulfur dioxide. Further oxidation of SO2, usually in the presence of a catalyst such as NO2, forms H2SO4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.

- **Nitrogen oxides (NOx)** - especially nitrogen dioxide are expelled from high temperature combustion, and are also produced naturally during thunderstorms by electric discharge. Can be seen as the brown haze dome above or plume downwind of cities. Nitrogen dioxide is the chemical compound with the formula NO2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor. NO2 is one of the most prominent air pollutants.

- **Carbon monoxide (CO)** - is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.

- **Volatile organic compounds** - VOCs are an important outdoor air pollutant. In this field they are often divided into the separate categories of methane (CH4) and nonmethane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead to leukemia through prolonged exposure. 1, 3-butadiene is another dangerous compound which is often associated with industrial uses.

- **Particulates,** alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulates can be manmade or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols—those made by human activities – currently account for about 10 percent of the

total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.

- **Persistent free radicals**connected to airborne fine particles could cause cardiopulmonary disease.

- Toxic metals, such as lead and mercury, especially their compounds.

- **Chlorofluorocarbons (CFCs)** - harmful to the ozone layer emitted from products currently banned from use.

- **Ammonia (NH3)** - emitted from agricultural processes. Ammonia is a compound with the formula NH3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.

- Odors – such as from garbage, sewage, and industrial processes.

- Radioactive pollutants – produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.

Secondary pollutants include:

- Particulates created from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulphur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

- Ground level ozone (O3) formed from NOx and VOCs. Ozone (O3) is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer. Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel), it is a pollutant, and a constituent of smog.

Causes: Factors Responsible for Air Pollution

Air pollution can result from both human and natural actions. Natural events that pollute the air include forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation of organic compounds and natural radioactivity. Sources of air pollution refer to the various locations, activities or factors which are responsible for the releasing of pollutants into the atmosphere.

Man-made sources mostly related to burning different kinds of fuel.

- "Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices. In developing and poor countries, traditional biomass burning is the major source of air pollutants; traditional biomass includes wood, crop waste and dung.
- "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.
- Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents.
- Waste deposition in landfills, which generate methane. Methane is highly flammable and may form explosive mixtures with air.
- Military, such as nuclear weapons, toxic gases, germ warfare and rocketry.

Natural sources

- Dust from natural sources, usually large areas of land with few or no vegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is

considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.

- Smoke and carbon monoxide from wildfires.
- Vegetation, in some regions, emits environmentally significant amounts of VOCs on warmer days. These VOCs react with primary anthropogenic pollutants – specifically, NOx, SO2, and anthropogenic organic carbon compounds – to produce a seasonal haze of secondary pollutants.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde (H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.

Carbon monoxide (CO) poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors.

Biological sources of air pollution are also found indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in

bedding, carpeting and furniture produce enzymes and micrometre-sized fecal droppings, inhabitants emit methane, mold forms in walls and generates mycotoxins and spores, air conditioning systems can incubate Legionnaires' disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature.

Consequences: Effects of Air Pollution

i. Health Effects

Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, and lung cancer, according to the WHO. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing, asthma and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics.

The most common sources of air pollution include particulates, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and outdoor air pollution have caused approximately 3.3 million deaths worldwide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution. The World Health Organization states that 2.4 million people die each year from

causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution.

The worst short term civilian pollution crisis in India was the 1984 Bhopal Disaster. Leaked industrial vapours from the Union Carbide factory, belonging to Union Carbide, Inc., U.S.A., killed more than 25,000 people outright and injured anywhere from 150,000 to 600,000. The United Kingdom suffered its worst air pollution event when the December 4 Great Smog of 1952 formed over London. In six days more than 4,000 died, and 8,000 more died within the following months. An accidental leak of anthrax spores from a biological warfare laboratory in the former USSR in 1979 near Sverdlovsk is believed to have been the cause of hundreds of civilian deaths.

Around the world, children living in cities with high exposure to air pollutants are at increased risk of developing asthma, pneumonia and other lower respiratory infections. Because children are outdoors more and have higher minute ventilation, they are more susceptible to the dangers of air pollution. Risks of low initial birth weight are also heightened in such cities.

ii. Environmental Effects

Poisonous air pollutants (toxic chemicals in the air) can form acid rain. It can also form dangerous ground level ozone. These destroy trees, crops, farms, animals and continue to make water bodies harmful to humans and animals that live and depend on water.

iii. Economical Effects

The effect of air pollution on the economy may be a derived one. In simple language, the economy thrives when people are healthy, and business that depends on cultivated raw materials

and natural resources are running at full efficiency. Air pollution reduces agricultural crop and commercial forest yields by billions of money each year. This in addition to people staying off work for health reasons can costs the economy greatly.

Control: Measures to reduce Air Pollution

Solution efforts on pollution are always a big problem. This is why prevention interventions are always a better way of controlling air pollution. These prevention methods can either come from government (laws) or by individual actions. In many big cities, monitoring equipment'shave been installed at many points in the city. Authorities read them regularly to check the quality of air.

Government (or community) level prevention

- Governments throughout the world have already taken action against air pollution by introducing green energy. Some governments are investing in wind energy and solar energy, as well as other renewable energy, to minimize burning of fossil fuels, which cause heavy air pollution.
- Governments are also forcing companies to be more responsible with their manufacturing activities, so that even though they still cause pollution, they are a lot controlled.
- Companies are also building more energy efficient cars, which pollute less than before.

Individual Level Prevention

- Encourage your family to use the bus, train or bike when commuting. If we all do this, there will be fewer cars on road and less fumes.

- Use energy (light, water, boiler, kettle and fire woods) wisely. This is because lots of fossil fuels are burned to generate electricity, and so if we can cut down the use, we will also cut down the amount of pollution we create.
- Recycle and re-use things. This will minimize the dependence of producing new things. Remember manufacturing industries create a lot of pollution, so if we can re-use things like shopping plastic bags, clothing, paper and bottles, it can help.

Control devices

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

- **Mechanical collectors** (dust cyclones, multi-cyclones)
- **Electrostatic precipitators:** An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulates such as dust and smoke from the air stream.
- **Bag houses:** Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust).
- **Particulate scrubbers:** Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas

streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

Some Facts and Statistics about Air Pollution

- Air pollution affects kids more than adults due to higher concentrations of polluted air in their systems per body size.
- India is the country with the worst air quality in the world.
- The European Union would save 161 billion Euros a year if deaths caused by air pollution were diminished.
- In large cities, over 80% of fatal pollutants that cause lung damage come from cars, buses, motorcycles and other vehicles on the road.
- According to the World Health Organization, there are as many deaths (1.3 million per year) in the world due to air pollution as there are deaths due to car accidents.
- The average adult breathes 3,000 gallons of air every day.
- The Great Smog of London in 1952 was one of the worst air pollution events in history with over 8,000 deaths.
- The largest cause of air pollution in Europe is road transportation with over 5,000 people dying each year from lung cancer and heart attacks caused by vehicle exhaust fumes.

Therefore, air pollution can be prevented only if individuals and businesses stop using toxic substances that cause air pollution in the first place. This would require the cessation of all fossil fuel-burning processes, from industrial manufacturing to home use of air conditioners. This is an unlikely scenario at this time. However, we have to make rules which set stringent regulations on

industrial and power supply manufacturing and handling. The regulations are to be designed to further reduce harmful emissions into the Earth's atmosphere.

Public-Private Partnership

There are a number of private waste management companies operating in Nigeria and these require essential technical assistance, especially capacity building. One of the key factors in enhancing the success of the private waste sector is the government's ability to maintain, implement and maintain written contracts. They describe the services required and state the penalties and other prohibitions that apply in the event of failure to provide the services. It is essential to establish a system to ensure and encourage private sector sustainability in waste management[41]Several factors harm the productivity and performance of private sector organizations in terms of service quality. Lack of capital has hampered these organizations by poor operators, landfill management, especially during the rainy season, ineffective service monitoring and poor policy implementation. Additionally, these private companies operate above average in high-income areas and below average in middle- and low-income areas, suggesting that service quality varies across regions. domestic income group. The difference in service quality is due to factors: years of operating experience, frequency of vehicle maintenance, number of trips per day[42]. Low revenue due to people's unwillingness to pay for the services provided, poor road network and high operating costs were among the issues raised by private sector companies. But residents' complaints focus on the payment system and the regularity of waste collection. Furthermore, carts need to be refitted for inaccessible areas and owners

may then be forced to work with garbage trucks to solve the problem of arbitrary dumping[43].

2.1.4 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. Despite policies and regulations, waste management practices in the country are increasingly worrying. More than 32 million tons of solid waste are generated each year, one-third of which is collected. Indiscriminate disposal has led to blockages in pipes and clogging of water bodies. 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].

2.1.5 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 limitedresourcesand 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].

2.1.6 Waste Management

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. 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 generationrates 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 furtherprocessesprocessing 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 environmentalsustainability[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 transportationpractices[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.

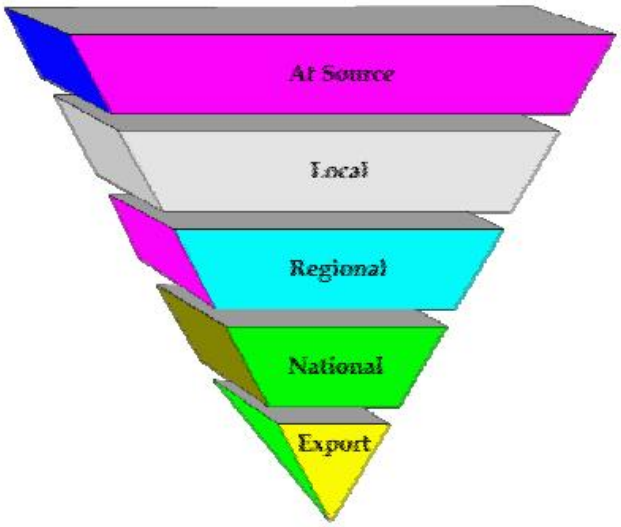
Wastes, wastewaters, emissions and hazardous wastes are all inter-related. Treatment of hazardous wastes is principally aimed at reducing the hazardous nature of the waste in order to facilitate simpler final disposal. For example, toxic heavy metals may be precipitated as water insoluble hydroxides, 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.

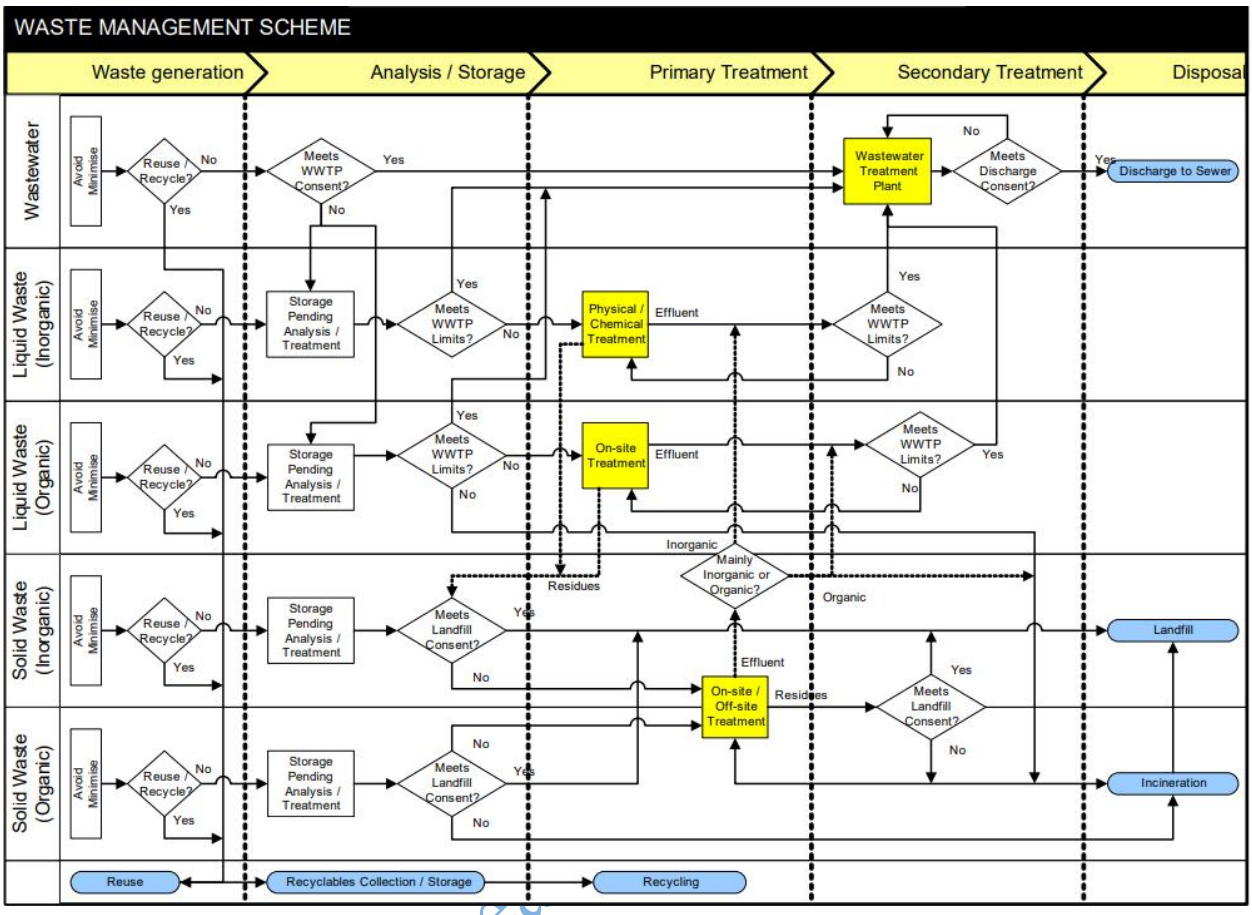
The waste management hierarchy generally takes precedence over the proximity hierarchy (e.g. it is better to recycle waste at a national facility than dispose of it locally).

Figure 2. 3 – Proximity Hierarchy



Source: David Newby Associates

Figure 2.4: Schematic of Industrial Waste Management



Source: David Newby Associates

Monitoring and Regulation:

Monitoring and regulation is 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 facilitates 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 organisations. 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 organisations 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.

2.1.7 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 publichealth[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). , polybrominateddiphenyl 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].

2.1.8 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].

2.1.9 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 their. 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-biodegradableproducts[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 deat 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 bedangerous[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 soilresources[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.

2.1.10 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].

2.1.11 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].

2.1.12 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 become a normal and abnormal thing in society

2.1.13 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.

2.1.14 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 byproductarises 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 trashposes 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 theKoshe 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.

2.1.15 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].

2.4 Conceptual Framework

In this study, it was found that solid waste management is not isolated. The issue for local authorities is that they should "do" and moreover need a comprehensive set of measures that take into account the integration of waste management into the broader environmental management framework. Conceptual issues addressed include the availability of solid waste collection and treatment facilities as well as waste disposal capacity. The organization is responsible for waste collection and management in Ibadan South East as well as educating and sensitizing the public on the effective management of household waste. The conceptual framework shows the relationship between dependent variables such as waste collection and treatment methods and independent variables: level of awareness, type and source of solid waste and socio-economic status (age , educational level and professional level) solid waste management practices. . Furthermore, intervening variables such as lack

of proper budget allocation by the government to facilities may lead to improper disposal of solid waste as the government may not ensure proper public hygiene. The remoteness of collection points can hinder effective solid waste management measures in the state as households cannot afford to send their solid waste to designated disposal sites. , leading to indiscriminate disposal of solid waste around households[109]However, it is believed that strengthening the legal and institutional framework, capacity building and appropriate solid waste management strategies will bring about a number of results such as proper solid waste disposal, improved health standards and environmental pollution protection.

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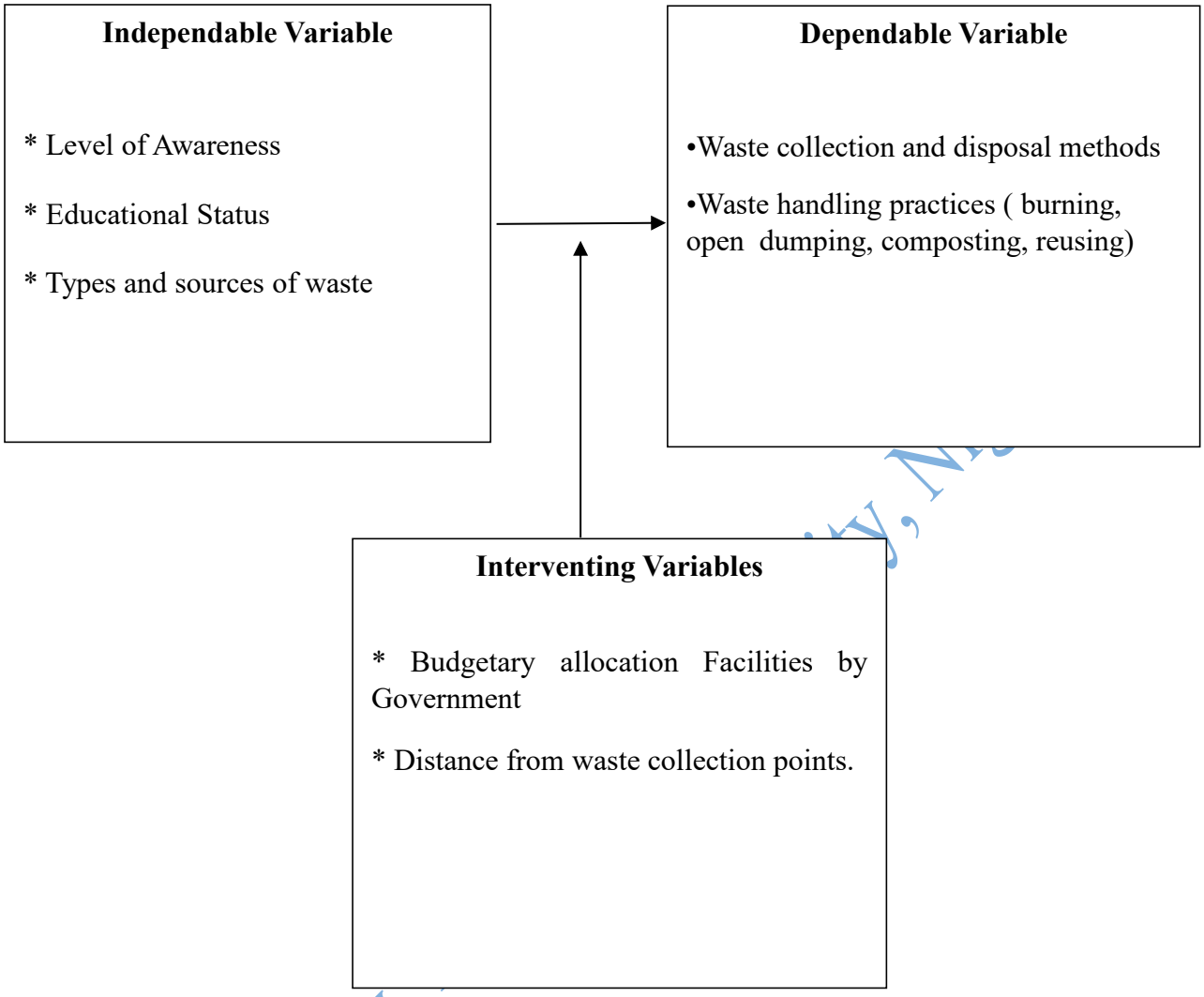

2.5 Summary of Gaps in Literature Reviewed

This chapter describes the conceptual framework, processes and strategies of solid waste management. It also focused on solid waste management which resolves around developed and developing countries with particular reference to Nigeria. This covers best practices and models that promote waste reduction, reuse and recycling activities.

This chapter further examined the household solid waste management in Ibadan south east Local government, Oyo state, Nigeria.

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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 south east, Oyo State, Nigeria.

3.2 Description of study Area

Ibadan south east is a local government area domiciled in the city of Ibadan, Oyo state which is in the southeast geopolitical zone of Nigeria. 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 Aoad, Challenge, Odinjo, Felele, Molete and Owode. Ibadan South East Local Council Development Area. The estimated population of Ibadan southeast LGA as at 2006 was 266,046 inhabitants with most populous ethnics group in the area being the Yoruba[22]. The postal code of the arena is 200. There are 12 wards in Ibadan south east local government area.

Ibadan south-east 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. This figure represents 12.5 of the total population of Ibadan city. Out of the population of the local government 131272 were male (49.22%) while 153460 were female (50.78%)[22].

3.3 Sampling and Sampling Techniques

A two-stage cluster sampling is used to select respondents for this research. At stage one, a simple random sampling will be 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.

Therefore, the sample size was determined as follows.

$$n=\frac{Z^2PQ}{d^2}$$

[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

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

$$n = \frac{3.842 \text{ x } 0.2304}{0.0025}$$

$$= \frac{0.885}{0.0025}$$

= 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.

3.4 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 is based on research relevant to this study, including: Waste Management in Nigeria: A Case Study of the Commercial City of Onitsha

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

3.5 Effectiveness 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

3.6 Data Collection Approach

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

3.7 Data Analysis

After data collection is complete, the Social Science Statistics Package (SPSS version 22) is used for analysis. Descriptive statistics such as frequency tables and percentages is used to show the distribution of the variables across household and neighborhoods: Use modes, means, and percentages to describe the characteristics of the study. It shows the level of generation and volume of waste in relation to population in Ibadan southeast LGA This statistical package contributes to the clarity and easy understanding of raw data. Data were presented using charts, tables, and plates.

3.8 Ethical Considerations

Regulatory approval conducted for this study was obtained from the State government. 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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Chapter Four

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 is 33.30 ±11.951 years. 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 %
Sex		
Male	136	41.1
Female	195	58.9
Educational level		
Primary and less	54	16.3
Secondary	75	22.7
Higher	202	61.0
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

Variable	Mean	Standard deviation
Age	33.30	11.951
How many people live in the house	7.50	4.92

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 shows the current waste management system andpractices, about 40% collect and store their waste in a closed container before disposal, More than 55% of the respondents stored their waste for 0 – 7 days before disposal. Of those that practice self-disposal, about 11.8% of them emptied/ disposed their waste by burning. Also, the result shows that about 67.4% don't separate/segregate solid waste before disposing. Of the total solid waste, food wastes were the largest (28.7%) waste being generated. This is followed by Polythene/sachet water waste 80 (24.2%), paper wastes with 57 (17.2%), Glass waste constitute 55 (16.6%), and others (8.5%) which includes, Hair and weavons, electronic gadgets, blocks and tiles waste are the high

category of waste dominant in the area. Majority of the respondents 142 (50.7%) thinks that the waste generation level has increased over the years due to increased number of consumption and in 127 (38.4%) of the households children were persons that dispose wastes.

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

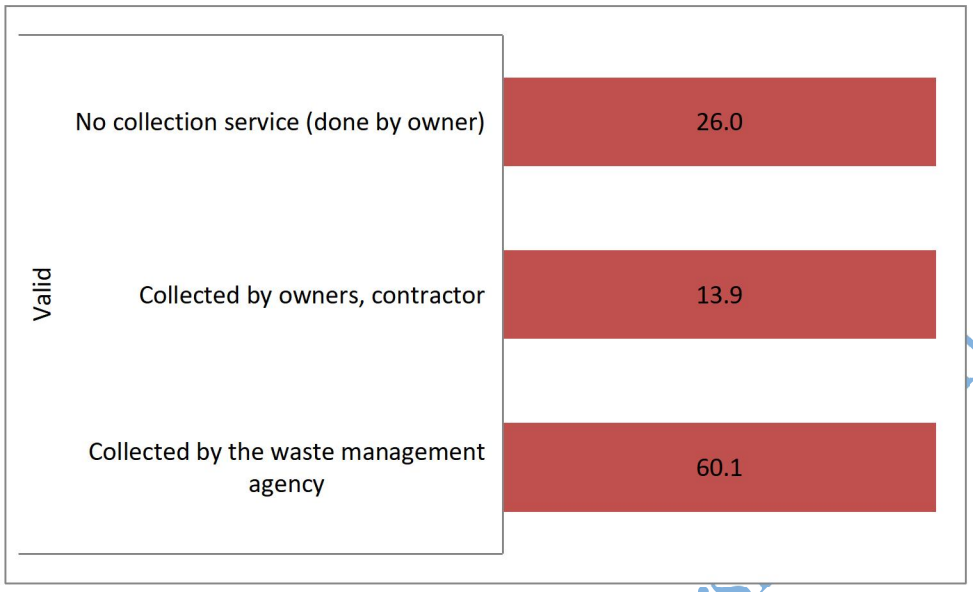
Category of waste dominant in your area	Frequency N=331	Percent %
Food waste	95	28.7
Paper waste	57	17.2
Plastic waste	16	4.8
Glass waste	55	16.6
Polythene/ sachets water waste	80	24.2
Other waste	28	8.5
The causes of waste generation over the years		
Increased income	29	10.4
Increased number of consumption	142	50.7
Increased in packaged food	43	15.4
Increased in Family size	66	23.6
How do you store/ collect your waste before disposal		
No storage- direct dispose to the dump	66	20.3
In a closed container	132	39.8
In an open container	32	9.7

In a polythene bad/sack	101	30.5
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
Do you separate your solid waste before disposing		
Yes	223	64.4
No	108	32.6
Who collected the waste in your house		
Collected by the waste management agency	199	60.1
Collected by owners, contractor	46	13.9
No collection service (done by owner)	86	26.0
If collected by the owner, where do you empty/ dispose your waste?		
Nearby bush	11	3.3
Drainage channels like gutter	13	3.6
Dump Stand	9	2.7
Along the road street	3	.9
In the stream	8	2.4
Burn it	39	11.8
burry it in the ground	3	9
Who normally takes the waste to the disposal site		
Father	10	3.0
Mother	36	10.9
Children	32	9.7
Housegirl	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, sachets of water waste (polythene bags), glass waste. The dominant method of disposal by the household was in open spaces burning.

Figure 4.1: Ways of storing/ collecting waste in Ibadan southeast



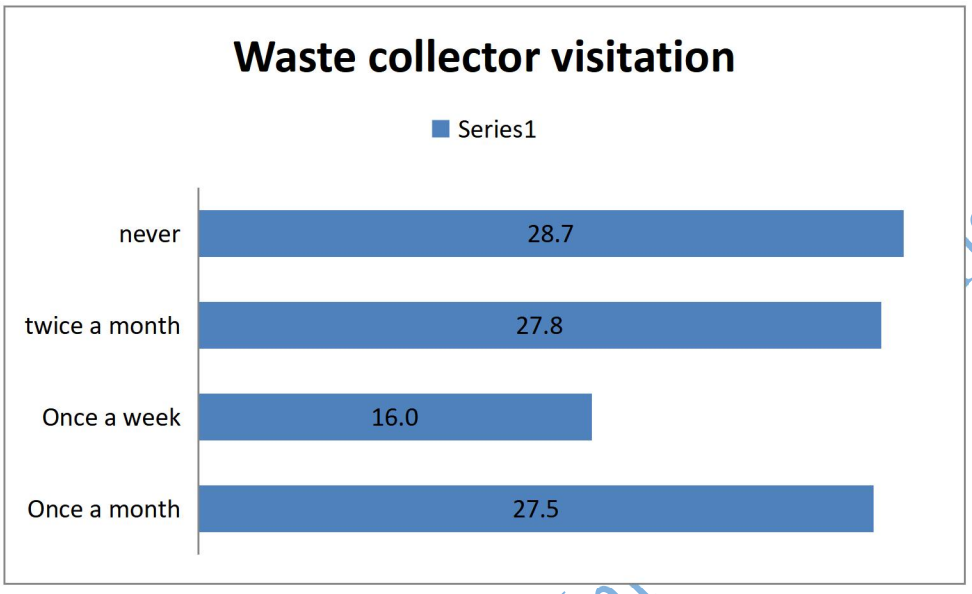
Source: Researcher's Field Survey 2022

Figure 4.1.shows the responses of respondents of who collect the waste in the house. In the chart above, it is clear that waste collection and the disposal by the formal and informal sectors, Though there is remarkable improvement in the collection by the waste management agency (60%), but the level of collection still remain low as about 26% of this respondents has no collection service, the collection is done on their own. However, the indiscriminate disposal of refuse cannot be wholly blamed on the inadequate communal containers in the area, it is clear that waste management personnel have a lot to do by carrying out their responsibilities as required.

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.

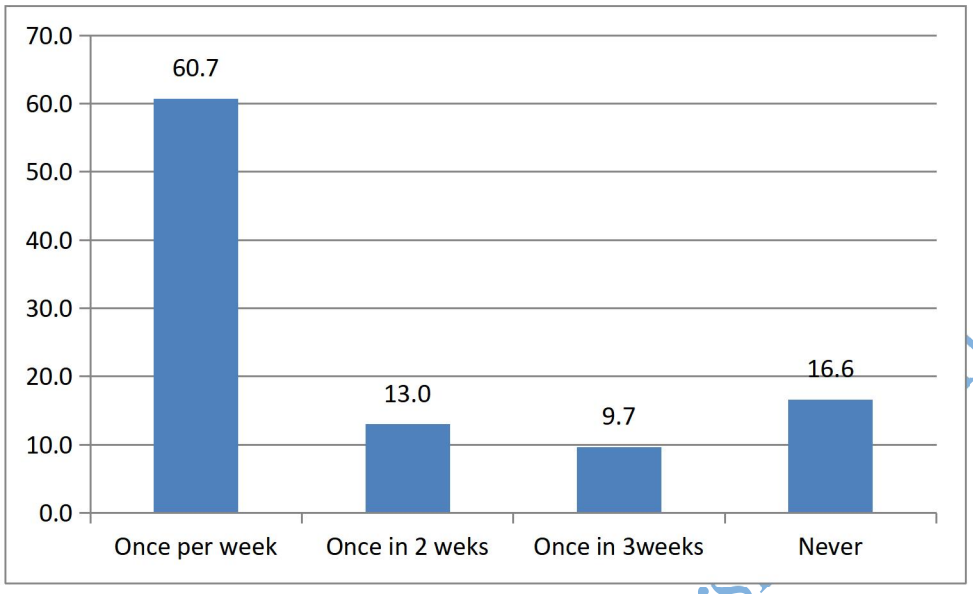
Figure 4.2: waste collector visitation in the locality



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.

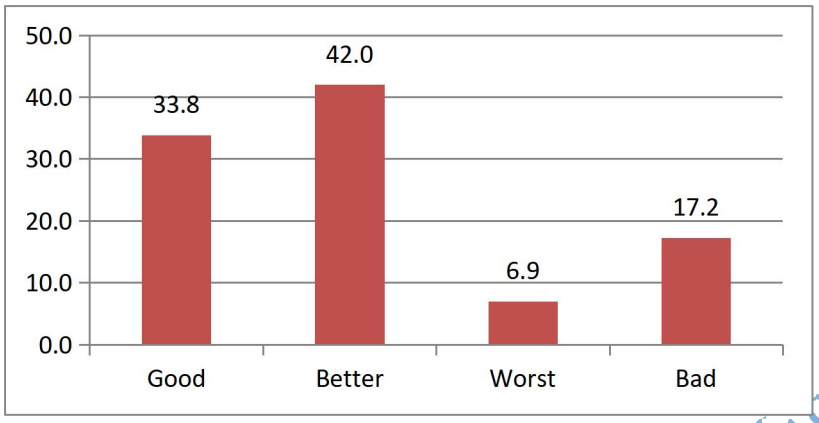
Figure 4.3: Environmental sanitation practices



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.

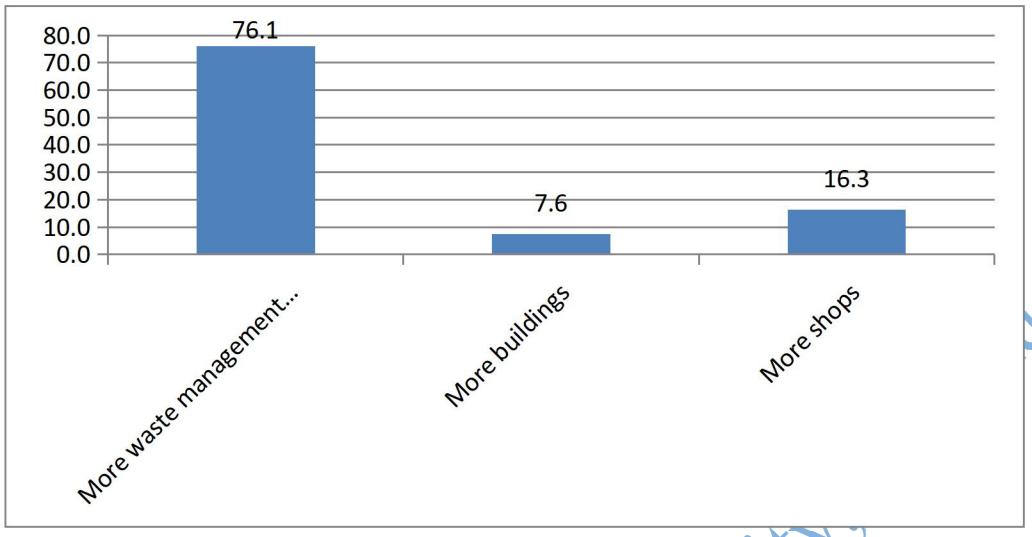
Figure Assessment Waste Management in the Locality



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 Improvement of waste management system



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 table below shows the that the majority of the respondents 76.1% would prefer to pay to have more and improved waste management system like dumpsters, bins recycling plants e.t.c to build in Ibadan southeast LGA. 16.3% prefers to pay for more shops while 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 knows that some waste could be transformed to wealth, Majority of the respondents 80.4% thinks it is right to treat/ manage waste. About 73.4% of the respondents thinks that waste management is the sole responsibility of 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% respondents shows 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 %
Do you know that some wastes could be transformed to wealth		
No	77	23.3
Yes	254	76.7
Do you think it is right to treat/manage waste		
Yes	266	80.4
No	65	19.6
Do you think that waste management is the sole responsibility of the government		
No	88	26.6
Yes	243	73.4
Would you be involved if there are waste management infrastructures in place		
No	78	23.6
Yes	253	76.4
What significant effects has the presence of Municipal Solid waste caused in your locality		
Flood	116	35.0
Air pollution	137	41.4
Disesase	32	9.7

None	46	13.9
In your opinion, how serious is 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 %**

Do you have dumpters/ large bins in your vicinity		
Yes	143	43.2
No	188	56.8
If yes, How often do you use them		
Occasionally	82	24.8
Not at all	150	45.3
Often	99	29.9
Do you think dumpters in your area are enough		
No	246	74.3
Yes	85	25.7
Would you pay to have more dumpters installed		
No	145	43.8
Yes	186	56.2
Are there any recycling programs in your locality/area/wards		
No	236	71.3
Yes	95	28.7
Do you dump your waste beside garbage bins instead of putting it inside those		
No	214	64.7
Yes	117	35.3
If yes, what could be the cause		
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
Are you involved in any recycling or waste management activity or programs		

No	239	72.2
Yes	92	27.8
If no, why		
Lack of such programs in your area	155	63.2
I don't know how	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 GarangManyok 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

Sex	Collected By Waste Management Agency	Done By Owner	P Value	Chi Square
			0.235	1.412
Male	39.2%	46.5%		
Female	60.8%	53.5%		

Age			0.004	11.052
10 – 24	23.3%	14.0%		
25 – 34	45.3%	34.9%		
35 and above	31.4%	51.2%		
Educational status			0.009	9.485
Primary or less	13.5%	24.4%		
Secondary	20.8%	27.9%		
Higher	65.7%	47.7%		
Marital status			0.296	2.436
Single	41.6%	32.6%		
Married	44.5%	53.5%		
Once married	13.9%	14.0%		
Occupational Status			0.027	10.979
Professional	31.4%	19.8%		
Clerical	12.2%	8.1%		
Skills	13.5%	18.6%		
Unemployment	22.4%	37.2%		
Number of People in the House			.290	2.476
1 – 10	83.3%	77.9%		
11 – 20	14.3%	20.9%		
21 – 30	2.4%	1.2%		

Source: Researcher's Field Survey 2022

4.3 Discussion of Findings

This study focuses onAssessment 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 response rate of 90.7%, 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. About 59% of respondents were females while 41.1% were males. This is also agrees with the finding of Owerri.

This finding also revealed that sizeable number of respondents 61.0% had Higher Education, Secondary school education 23%, primary and no education 16.3% this corresponds with the findings of Owerri study, which show that 60% had tertiary education, 20% 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 (64.7%) of the respondents had not gone to school and thus lacked formal education and about 14.7% of the respondents had tertiary level of education while 11.6% and 9.0% 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 area, household, shops or street were Food residue 29%, other class of waste with significant percentage are polythene/sachet water waste 24.2% and paper waste with 17.2% hence positively supporting studies which showed that the type of waste mostly generated is Food waste 24.3%, Polythene waste 19% and paper waste 16%[2].

A good number of my respondents 40% collect their waste in containers with covers and majority of 67.4% do not separate their waste before disposal; This is in line with the outcome of

study, which reported that 51.4% of the households in Owerri Municipal stored their waste in closed container outside the house and majority of the respondents 88.3% did not sort their waste prior to disposal[1].

The Findings of this study revealed that majority of the residents 60.1%, dispose of the waste generated via government agencies and 14% dispose the waste generated via private contractors,. A study in Onitsha also recorded a similar findings which shows that majority of the respondents 68.5% in Onitsha metropolis disposed their waste through waste management agency or private contractor, while 26.0% do not store their waste. No storage- direct disposal is practiced, which means the generated waste is not accounted for. This study has created a general picture of poor waste management practices among the residents of Ibadan south east because 12% of the respondent practices Burning of their waste while 13 (3.6%) preferred dumping in drainage channel like gutter. This agrees with the findings of other studies.

4.3 Assessment of Waste Management System

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, this is similar to the findings of study,the survey revealed that about 32% of the household do not have their wastes collected at all; 22% had theirs collected once a week while 19% of the household heads had their wastes collected once a month[3].

Majority of Ibadan southeast residents understands and properly aware of importance of sustainable waste management, 76.7% of the respondents knows that some waste could be

transformed to wealth, Majority of the respondents 80.4% understands that it is right to treat/ manage waste. About 73.4% of the respondents believed 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% respondents show it caused Air pollution and 33% of the respondents stated in their opinion, that the problem of waste management is very serious. This is in line with a study carried out in Onitsha by which revealed that 77.7% and 70.7% of the respondents answering affirmation to know that waste can be transformed to wealth and they know it is right to treat waste, a substantial percentage (54%) believes that solid waste managements is the sole responsibility of the government[2].

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

From my findings, the major challenges are: they have No dumpters in some part of the vicinity with 56.8% acceptance rate, while 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, Majority of the respondent 71.3% also revealed that there are no recycling programs in their area. The study further revealed that 61% 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 and the irregularity in collection pattern by the waste management authorities. 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/vicinity.

This study revealed that 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, improper waste disposal in Ibadan is linked with irregularity in collection pattern by the Waste management authorities. These findings are in consistent many other studies, Non-availability of waste collection center was also reported and could explain the unhealthy habit of disposal shown in this study[5].

Endnotes

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Chapter Five

Conclusion

This chapter presents the summary, conclusion, recommendation, as well as suggestions for further studies. This chapters 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 management of waste, methods of waste disposal, available infrastructure contributes immensely to the current state of solid waste management in the Local government.

Waste collection and the disposal by the formal and informal sectors, Though, there is remarkable improvement in the collection, but the level of collection still remain low than the

level of 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 behaviors and habits. A person's long held attitude can only be changed through education.

Unfortunately, 80% 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 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 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

The study was carried out in Ibadan south east to assess the Waste Management Practices among the residents. It looked at the current waste practices, disposal and management of waste in the area/locality. However, the resident attitude, behaviours, available infrastructure contributes immensely to the current state of solid waste management in the locality.

The study found that as a result of population growth, waste generation is higher than collection which leads to waste accumulation overtime, thereby, degrading the environment. Large numbers of the residents were aware of waste management and various methods of waste disposal even though there are evidence to the contrary considering the discovery that the most prevalent methods of disposal were burning, open dumping and drainages, this remains the most commonly used method of waste disposal, waste collection is irregular and non-collection in some areas especially in the neighborhoods.

Proper waste disposal management is essential to sustain healthy living conditions in any environment. Strict adherence to appropriate waste management practices in the locality will isolate residents from harmful and hazardous environmental conditions and improve the living standard of the people.

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) **Public awareness, enlightenment and campaigns** on the need for better solid waste management system. The public should be enlightened on the dangers of poor solid waste management and the important of sustainable waste management and health living

2) **Community participation:** There should be actively community participation and involvement of community based organizations in solid waste management since Ibadan southeast has few community based organizations. It is recommended that the government should encourage participation through involving the residents and EHO's in decision making on solid waste management process. Also, Non-Governmental Organizations should be more involved in the planning and execution of solid waste management in the state.

3) **Payment for waste management:** All neighborhood in the area should be made to pay for disposing their waste. Also, generators should be made to pay for solid waste collection charges.

4) **Pay as you throw principle:** This should be introduced but these should be done through education by letting residents know the importance of environmental cleanliness and how they can contribute to it. This will go to support the financial base of the waste management agencies.

5) **Public-private partnership**: The private sector should be actively involved; Informal waste collectors can be incorporated into public-private partnership as government alone cannot

provide the necessary funds to tackle solid waste management in the area. Yet, the presence of informal sector remains un-integrated into the formal waste management system in Ibadan southeast. Therefore, there is need for the government to regulate and register the activities of the informal sector. They should be involved in collection activities, waste recovery and supply of recovered materials for recycling and street sweeping.

6) **Adequate Resourcing of Waste Management Agencies:** The waste management agencies such as OYOWMA should be adequately resourced in terms of funding, personnel and equipment by the Oyo State Government to ensure efficient and effective waste management in the area.

7) **Monitoring and Supervision:** There should be regular monitoring and supervision of agencies by EHOs to determine the extent of coverage, frequency of collection, rate of collection and safe disposal.

8) **Use of Integrated Solid Waste Management Model**: This should be adopted to ensure efficient and effective solid waste management in the area. Residents should be encouraged to separate the waste generated into their various components before final disposal. Waste can be disaggregated into plastic, metals, cans, bottles and food waste. In this case rubber cans, bottles, metals can be reused; plastics like polythene bags and empty water sachets can also be recycled. The rest like food waste can be composted for manure, incinerate those that are combustible and land filled those that cannot be subjected to any of the above mentioned methods.

9) **Use of Appropriate Technology:** The disposal sites should be provided with sanitary landfill facilities to avoid open dumping and open burning. The landfill site should be upgraded and properly designed in accordance with environmental standards. These include the

weighbridge, gas recovery system and leachate collection system. Perhaps it is necessary for the government to device improved techniques for solid waste management.

5.4 Contribution to Knowledge

This study provides the understanding of the current waste practices and its management in Ibadan south east . It also provide the strategies to tackle the 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

Further in-depth research should be carried out on solid waste management and practices in the study area. Focusing on 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,

+2348161606841

Obisesannike2015@gmail.com

Purpose of Study

My name is ObisesanAdenikeOluwaseun, 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 ObisesanAdenikeOluwaseun; 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
iv. Biological Treatment

Bio – data

A. Personal Data

Name: AdenikeOluwaseun OBISESAN

Home Address: Block 88,Oke Ibadan EstateIbadan,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 - Sept2019

- 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.OkunolaIfeoluwa 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 AdenikeOluwaseun 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.

_____ _____ _____

Signature **Date**