Exploring Municipal Solid Waste Management in Nigeria: Challenges, Opportunities, and Roadmap for Sustainable Development

BY

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IT IS SUBMITTED IN PARTIAL FULFILMENT OF THE DOCTOR OF PHILOSOPHY REQUIREMENTS.

Abstract

The escalating generation of municipal solid waste (MSW) presents a grave environmental and public health concern, particularly in developing nations like Nigeria. Addressing this issue is imperative, yet waste management often takes a backseat due to socioeconomic challenges such as poverty and economic decline. Therefore, this study aimed to uncover the primary challenges within MSW management in Nigeria and construct an informed decision-making framework for stakeholders. The research encompassed an extensive literature review on MSW management in Nigeria and the extraction of best practices from developed countries. The research methodology takes a n interpretivism stance and employs a mixed-method approach to gather primary data through online interviews and surveys. Thematic analysis using NVivo software illuminated challenges such as deficient infrastructure, inadequate funding, and lack of awareness. Notably, novel challenges like ineffective sensitisation emerged, not previously highlighted in prior studies. These challenges were classified into government-driven (GDC) and public-driven (PDC) challenges. Based on the PDC, data was collected from the public via online surveys on social media platforms to validate expert opinions. Statistical analysis was employed using SPSS. The study's findings divulge that Nigeria's MSW sector has shown minimal improvement, with persistent challenges. Furthermore, a hierarchical arrangement of challenges was established based on their criticality, revealing interconnectedness wherein one challenge influences the occurrence of others. Notably, statistical analysis demonstrated the influence of age, employment status, and gender on PDC.

The culmination of this research is a comprehensive conceptual framework poised to guide decision-makers in advancing MSW management in Nigeria. The framework was informed by integrating qualitative and quantitative outcomes of this study, addressing pivotal issues like funding, infrastructure development, public awareness, and stakeholder involvement. Moreover, it delineates the stakeholders responsible at each recommended stage, offering a roadmap for tailored implementation. The framework's adaptability to diverse Nigerian regions, accommodating their unique challenges, underscores its potential as a catalyst for tangible change. This study holds significant implications for policy formulation practice enhancement and serves as a foundation for future research endeavours in municipal solid waste management.

Dedication

I dedicate this thesis to Almighty Allah SWT for allowing me to complete this research through his mercy and guidance.

Acknowledgement

First and foremost, I would like to thank Allah SWT for guiding me through this journey and granting me the strength and courage to take this journey and complete this research thesis.

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Declaration

I hereby confirm that no portion of the research reported in this thesis has been submitted for a degree or other kind of certification at the University of Salford or other higher learning institutions. As a result, this thesis is entirely the result of my own research efforts, and all references to articles/publications by other writers that were used within have been properly cited.

COVID Impact Statement

The University of Salford acknowledges that the COVID-19 pandemic, campus closure, social distance measures, and national and worldwide lockdowns have all influenced the work of many postgraduate researchers (PGRs). Although many researchers could continue working remotely, the campus reopened in August 2020. Fee-waived deadline extensions of up to 6 months were made available, acknowledging that some researchers would be disrupted until all appropriate research facilities were open and operational at total capacity, fieldwork could resume safely, and/or personal circumstances became more manageable. This section discusses the obstacles to this thesis and the solutions I devised to overcome them.

I started my PhD studies on September 23, 2019, before the COVID-19 pandemic. The pandemic's breakout substantially impacted my PhD studies/research because it disrupted my planned work and required me to change various parts of my study. For example, the first planned data-collecting design included face-to-face procedures. For example, the anticipated face-to-face interviews became online interviews, and the surveys became online surveys. This was due to travel limitations imposed globally during the pandemic, which limited my access to a broader range of respondents. For example, I couldn't visit participants in remote areas to collect data on their perceptions and experiences with municipal solid waste management in Nigeria. This influenced the course of my thesis, particularly the development of analytical abilities through personal interaction and talks with responders.

On a family and personal level, 'confinement' at home with my three and six-year-olds meant that my attention was divided daily as I had to respond to their needs, the household demands, and my research. I am a natural fan of libraries and library environments; sadly, this became unavailable with the epidemic outbreak. This was exacerbated by the absence of access to childcare, which would have allowed my older daughter to burn off some toddler energy. All of these obstacles had a significant impact on my mental health.

Due to stress and anxiety, I suffered chronic insomnia, which led to depression. I attempted to locate assistance but could not do so due to the circumstances. Because of my insomnia and suicidal thoughts, my GP sent me to a clinical physiologist at mind matters. It became evident that if I didn't get help, my life and my children would suffer. I was able to speak with a

therapist a few times and was assigned to priority supervision care. That was helpful, but I recognised I needed to pull myself together and negotiate the situation as best I could.

Unfortunately, I had to go through a divorce during that time, which brought back my anxiety and caused me panic attacks. During that period, I went through a supervisory team transition, adjusting to two new co-supervisors, getting to know them, and thoroughly explaining my duties. During that time, I also had my internal evaluation. However, I got the fortitude to get through that time and continue to grow as I adjusted to my new situation and environment. I saw the light at the end of the tunnel thanks to the help of my family and friends, and I wasn't going to give up on myself, my children, or my education.

Throughout the terrible circumstances of COVID and childcare and a difficult divorce, I worked persistently on my research while working part-time and giving hands-on care for my family, with occasional assistance from neighbours and well-wishers. As a result, I am pleased to offer this thesis on time.

Compromises were made since some assessments were impractical to undertake without the ability to meet with participants face to face. While the pandemic posed new obstacles for this PhD, it also allowed the chance to conduct assessments remotely with participants from a greater geographical range. I've also gained vital new talents. The approaches detailed in this thesis result from rigorous consideration, diligent research to ensure authenticity, and the use of imagination to overcome unforeseen problems.

List of abbreviations and meanings

DEFRA   The Department for Environment Food & Rural Affairs

EEA   European Economic Area

EPA   Environmental Protection Agency

EU   European Union

EPSU   European Federation of Public Service Union

FEPA   Federal Environmental Protection Agency

GDP   Gross Domestic Product

GHG   Greenhouse gases

GDC   Government-driven challenges

MSW   Municipal solid waste

MSWM   Municipal solid waste management

NESREA   National Environmental Standards and Regulation Enforcement Agency

OECD   The Organisation for Economic Co-operation and Development

PDC   Public-driven challenges

SDG   Sustainable development goals

UN   United Nations

UNEP   United Nations Environment Program

UNDP   United Nations Development Program

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Chapter 1:   Introduction

1.1   Background

Solid waste management is intricately linked to human advancement, as it has significant implications for public and environmental health (McAllister, 2015). With societies striving to exist and thrive, solid waste generation is inevitable, driven by population growth, economic development, and lifestyle changes (Okot-Okumu, 2015; Mereki, 2016). This has become a global burden, with a staggering increase in solid waste generation in recent decades, posing significant challenges for waste management (Nnaji, 2015). As a result, solid waste management has gained attention from governments worldwide in recent years (Amuda et al., 2014).

According to the World Bank, the world generates 2.01 billion tonnes of waste annually, projected to increase by nearly 70% by 2050, reaching 3.4 billion tonnes (World Bank, 2021). Consequently, solid waste has become a growing concern for both developed and developing countries due to the environmental impact of managing large volumes of waste, which can result in direct health and environmental effects (Tchobanoglous, 2012; Debrah et al., 2021). The issue has been further exacerbated by the COVID-19 pandemic, with increased usage of Personal Protective Equipment (PPE) leading to a surge in waste materials, particularly disposable PPE, at the household level. This poses significant challenges, especially in developing countries with inadequate waste management measures.

Developing countries, in particular, face significant challenges in waste management due to mismanagement of waste. Municipal solid waste management (MSWM) has become problematic for developing countries, affecting the environment, socioeconomics, health, aesthetics, and infrastructure (Farahbakhsh, 2013; Iyamu, Anda, and Ho, 2020). Economic growth and increased consumerism further contribute to higher solid waste generation. Additionally, most cities in developing nations have inadequate waste management systems, resulting in negative sustainability implications for urban growth and development (Ghani, 2017; Mmereki, Baldwin, and Li, 2016). However, a few developing countries, such as India, Thailand, China, and Malaysia, have shown increased attention towards municipal solid waste management (Chen et al., 2010; Abas, 2014; Yukalang et al., 2017; Liang et al., 2021). These countries, known for their high populations and rapidly emerging economies, tend to generate a large amount of solid waste, as evidenced by China's waste generation increasing by 9% per

year from 1979 to 1995, a period of tremendous economic growth, and projected to quadruple by 2030 (Forbes Economy Ranking in Africa, 2018). Similarly, other developing African countries such as Nigeria, with an estimated $172 billion economy, face significant economic losses due to poor waste management, with annual losses ranging from 1% to 2.5% of GDP (World Bank's Water and Sanitation Program). Therefore, it is imperative to establish an effective municipal solid waste management system in Nigeria, considering its rapid population and economic growth.

Numerous studies have been conducted on solid waste management in Canada, Malaysia, and other countries, focusing on stakeholders, socioeconomic conditions, legal and policy implications, and waste-to-energy initiatives (Soltani et al., 2015; Iheukwumere et al., 2020; Nyakuma et al., 2021; Abila & Kantola, 2013). Likewise, in Nigeria, there have been studies on the challenges of municipal solid waste management, including challenges to the adoption of sustainable practices, the current status of waste management, and possible solutions (Sylvester & Ikudayisi, 2021; Ezeah & Roberts, 2012a; Salami et al., 2019a; Amuda et al., 2014). However, there needs to be more in-depth, rigorous research into the factors that impact MSWM in Nigeria and empirically determine the potential opportunities for resolving waste issues in the Nigerian context. A framework is needed to provide a roadmap for stakeholders to address hindrances (Health Project Policy, 2014). While Schübeler (1997) developed a framework for waste management in developing countries, it did not specifically address Nigeria's unique challenges or consider current issues.

Additionally, Mwangi and Thuo (2014) developed a framework providing a synthesis that may be adopted in aiding in the formulation and design of sustainable municipal solid waste management practices in developing countries. The framework classified the waste management challenges into the general aspects of a socio-economic waste system, including institutional, legal, financial and environmental aspects. Similarly, in 2009, a conceptual framework was developed by the International Solid Waste Association of Asia (ISWA) showcasing concepts similar to Mwangi & Thuo 2009, which showcased the waste management process, stakeholders and the factors that allow an enabling environment for waste systems. Except for Schubler (1997), both frameworks did not detail the critical issues in municipal solid waste management but illustrated the process of handling waste and the socio-economic aspects involved.

Existing literature has highlighted the importance of various stakeholders at different levels, including federal/national, state and local government, municipal authorities, NGOs, households, private sector, and recycling companies, in the waste management value chain (Schübeler, 1997; Ezeah, 2010; Babaei et al., 2015). These stakeholders play crucial roles in the decision-making process, and their involvement is essential in the roadmap to effective waste management. These stakeholders indicate the actors' responsibility in the value chain and their roles in potentially improving MSWM in Nigeria.

1.2 The rationale of the study.

The imperative for undertaking this research is underscored by the pressing challenges posed by the exponential growth in municipal solid waste generation. This escalation not only jeopardises the well-being and survival of communities but also imposes severe health and environmental threats that demand urgent attention (Hoornweg, 2012). Developing countries like Nigeria are particularly vulnerable, which confront a disproportionately heavy burden of these detrimental effects.

The existing municipal solid waste management practices in such countries, including Nigeria, are often inadequate, resulting in multifaceted environmental consequences. The proliferation of greenhouse gas emissions, the pervasive scourge of ocean plastic accumulation causing the tragic demise of marine mammals, and the insidious spread of nitrogen pollution all bear testimony to the scale of this impending catastrophe (Iqbal, Liu, & Chen, 2020). Furthermore, the grim health ramifications in these regions cannot be overlooked, with diseases such as malaria, chest pains, diarrhoea, and cholera running rampant due to unregulated open dumps and blocked sewer systems (Ndukwe, 2019).

A projection of these concerns into the near future reveals a potentially catastrophic scenario. Sub-Saharan Africa, a region to which Nigeria belongs, is poised to experience a tripling of its waste generation levels by 2050 (Kaza, Yao, Bhada-Tata &With 2018), mirroring the trajectory of several parts of Asia. Compounding this is Nigeria's remarkable population growth, which is projected to soar to an estimated 229 million by 2025 (Statista, 2022). Population growth is intricately tied to waste generation rates (Hoorweng, 2012). Nigeria already generates over 320 million tons of solid waste annually, with only 20-30% of it being collected and a mere 12%

being recycled (Bakare, 2016). Therefore, Nigeria's rapid population growth and declining GDP pose economic challenges to (Aidi, 2016). These statistics paint a vivid picture of an impending crisis.

In the context of Nigeria, this research is magnified by the juxtaposition of rapid population expansion and a declining GDP. This paradoxical situation presents not only developmental challenges but also intricate economic conundrums. Despite being one of the largest economies in sub-Saharan Africa, Nigeria faces significant socio-economic challenges, including high poverty rates, power and water supply shortages, large-scale unemployment, economic recession, and underperformance in various sectors, including environmental and agricultural sectors (Ezeudu, 2020). These statistics indicate that waste management may suffer in development because Orhorhoro and Oghoghorie (2019) said Waste management ranks low on the government's priority list. There is a lack of clear direction in tackling the critical challenges hindering effective municipal solid waste management. To date, waste still needs to be dumped illegally or burnt within residential areas, increasing the chances of pollution and making it challenging to develop and maintain an effective waste management system as the population grows and the economy declines. The need for well-defined policy instruments to counteract these negative economic impacts further exacerbates the complexity of the Nigerian economic landscape. This study seeks to comprehensively analyse these interconnected challenges, offering a novel perspective that intertwines the dynamics of waste management with broader economic implications.

Moreover, this research responds to a critical void in Nigeria's current waste management discourse. While the challenges are evident, there needs to be an in-depth and systematic evaluation that limits the efficacy of previous studies (Ogwueleka, 2009; Akande, 2018). The gravity of the waste management predicament in low-income countries necessitates a nuanced understanding that delves beyond surface-level assessments. The need for updated and contextually relevant studies addressing contemporary challenges compounds this issue. Therefore, this research endeavours to bridge this gap by undertaking a comprehensive and empirically grounded exploration of Nigeria's waste management landscape.

By engaging with key stakeholders and experts entrenched in Nigeria's waste management sector, this study aspires to identify the pressing issues and unearth pragmatic mitigation strategies. Drawing from successful waste management models in other countries and tailoring them to Nigeria's unique circumstances, this research aims to develop a framework for

potentially improving the efficacy of Nigeria's waste management strategies. This endeavour is not only crucial for addressing the imminent waste crisis in Nigeria but also holds the potential to inspire similar approaches in other developing nations grappling with comparable challenges. This research transcends its immediate relevance and assumes a broader significance. By offering a well-informed and contextualised perspective on waste management, it aspires to contribute to sustainable development, foster economic resilience, and pave the way for healthier, cleaner, and more resilient communities in Nigeria and the developing world.

1.3   Research aim

This PhD thesis seeks to formulate a comprehensive framework designed to enhance the efficacy of waste management strategies within the Nigerian context.

1.4   Research question

How can a holistic waste management framework be developed to address Nigeria's municipal solid waste management system's complex socio-economic, environmental, and public health challenges?

1.5   Research objectives

The following are the research objectives of the current PhD thesis:

1. To identify the current challenges affecting municipal solid waste management in Nigeria.

2. To evaluate the criticality and level of influence of the challenges affecting municipal solid waste management in Nigeria.

3. To highlight the opportunities that can be utilised in potentially resolving the challenges based on the Nigerian context

4. Examining the public's perception and experience on waste management in Nigeria.
5. Developing a framework showing a roadmap that can contribute to developing municipal solid waste management in Nigeria.

1.6   Significance of the study

This study holds substantial significance due to its multifaceted contribution to addressing critical challenges in waste management in Nigeria. The study transcends its immediate scope to contribute to broader societal, economic, and environmental well-being. Addressing the intricate challenges of waste management in Nigeria can usher in transformative changes that resonate across sectors, leading to a more sustainable, resilient, and prosperous future for the nation and beyond. Its potential impact is far-reaching and extends across various dimensions, including socio-economic development, Environmental Resilience, Public Health and Quality of Life, Capacity Building and Knowledge Transfer, and International Collaboration and Global Impact. These potential impacts are explained below as follows:

Socio-Economic Development: The thesis offers practical and contextually relevant strategies for effective waste management. By doing so, it contributes to the socio-economic development of Nigeria. Improved waste management can enhance public health, reduce healthcare costs, and mitigate the adverse economic impacts of inadequate waste disposal practices. Implementing sustainable waste management strategies can create new economic opportunities, particularly in introducing a circular economy through the recycling and waste treatment sectors, bolstering local economies and fostering job creation.

Environmental Resilience: The study's focus on enhancing waste management practices aligns with environmental conservation efforts. The effective management of solid waste can mitigate greenhouse gas emissions, prevent soil and water contamination, and curtail the proliferation of plastic waste, consequently contributing to biodiversity preservation and overall ecological resilience. By addressing the environmental implications of poor waste management, the thesis aids in safeguarding Nigeria's natural resources and promoting sustainable development.

Public Health and Quality of Life: Inadequate waste management severely threatens public health, spreading diseases and health complications. By developing a contextual waste management framework, the thesis has the potential to improve public health outcomes significantly. Clean and organised waste management practices can reduce the prevalence of diseases linked to improper waste disposal, enhancing Nigerian citizens' overall quality of life.

Policy Formulation and Implementation: The research outcomes of this thesis can serve as an invaluable resource for policymakers and governmental bodies. The evidence-based insights and recommendations can inform the development of robust waste management policies, regulations, and guidelines tailored to Nigeria's unique socio-economic and environmental context. This, in turn, can lead to more effective and sustainable waste management practices and greater compliance and enforcement of waste-related regulations.

Capacity Building and Knowledge Transfer: The thesis contributes to the academic and professional communities by advancing knowledge in waste management. It offers empirical insights into the challenges and opportunities specific to Nigeria and provides a platform for sharing innovative waste management strategies that have proven successful in other countries. This knowledge transfer can empower local stakeholders, practitioners, and researchers with practical tools and approaches for sustainable waste management practices.

International Collaboration and Global Impact: The study's focus on waste management aligns with global sustainability agendas, making its findings relevant and applicable beyond Nigeria's borders. The thesis can contribute to international dialogues on waste reduction, recycling, and sustainable urban development by examining waste management through a comprehensive and contextual lens. Furthermore, it has the potential to foster collaborations and knowledge exchange between Nigeria and other countries facing similar waste management challenges.

1.7   Overview of methodology

The study's methodology employed an interpretivism philosophical approach in which, similar to this study, believes that the world is subjective and people's knowledge and circumstances are socially constructed (Chu, 2007). The study employed a mixed-method approach, specifically adopting a sequential exploratory design. As Creswell and Plano Clark (2011) articulated, this design involves the initial collection of qualitative data, followed by the collection of quantitative data. Therefore, the primary objective of this exploratory sequential mixed methods approach is to first gather qualitative data via online interviews with experts in various waste sectors to conduct an in-depth investigation on the current state of municipal solid waste management in Nigeria, as well as the challenges and opportunities currently being faced, and, subsequently, to gather quantitative data to elucidate outcomes that emerge from the qualitative data. In this study, the qualitative data's emerging themes were divided into

government-driven challenges (GDC), including inadequate funding, absence of policy, policy implementation, etc., and public-driven challenges (PDC), including refusal to pay for waste services, lack of awareness, etc.

In the context of this study, the quantitative data was acquired from the general public, validating the qualitative data provided by experts in the Nigerian solid waste management sector concerning the public's perceptions. Therefore, the quantitative data relied on the insights generated from the qualitative data and is subjected to analysis after the qualitative data has undergone analysis.

1.8   Research contribution

The studies presented in this thesis provide several unique contributions to the sparse research evidence on solid waste management in Nigeria. Importantly, using empirical evidence, it proposes a practicable framework for handling solid wastes in Nigeria, which previous research has yet to propose. Other important contributions. Includes addressing real-world challenges, proposes practical solutions, updates existing knowledge, contributes to the literature on waste management in developing countries, provides insights into public attitudes towards waste, and offers a framework for decision-makers with the potential for positive societal impact. The paragraphs below clearly outline the contribution of this thesis:

i)   A framework is proposed based on empirical data to identify feasible solutions for overcoming challenges and determining the level of influence of these challenges by engaging with relevant key stakeholders. The framework is informed by data collected from experts, indicating the parties' accountability and provides a viable approach to waste management in Nigeria. It provides a structured approach informed by empirical data and stakeholder interactions. It offers a valuable tool for policymakers, practitioners, and other stakeholders to address the identified challenges and improve waste management practices.

ii)   As done in this thesis, determining the criticality of a list of challenges contributes to knowledge by providing insights into each challenge's relative importance and severity. Furthermore, it allows researchers, practitioners and policymakers to prioritise and focus on addressing the most critical challenges that have the highest impact on a given problem or issue.

iii)   In addition to highlighting challenges, the body of work presented in this thesis identifies potential solutions for mitigation, thereby enhancing the effectiveness of the intervention.

iv)   By analysing the current state of municipal solid waste management in Nigeria and addressing challenges not covered in previous literature, this thesis contributes to the existing body of knowledge.

v)   The studies in this thesis extend the literature on improving municipal solid waste management in developing countries, particularly in Africa, where the experience of solid waste management is similar to that of Nigeria.

vi)   The studies reported in this thesis contribute to the literature on public attitudes towards waste by identifying Government-driven challenges, such as inadequate funding and lack of political will and public-driven challenges, such as awareness, payment for waste services, and participation in waste separation, and analysing their relationship with demographic factors such as age, gender, education level, location, and employment status. This empirical evidence sheds light on how different demographics influence attitudes towards waste management, providing valuable insights.

1.9   Structure of the thesis

Chapter Two: Institutional Background of Waste Management in Nigeria

This chapter presents robust background information on Nigeria's case study, including the early history of waste management in Nigeria from the colonial and independence eras to the present. It outlines current situations, including challenges in waste management in Nigeria, according to previous studies.

Chapter Three: Literature Review

This chapter presents a contextualisation of the report with relevant academic literature, including relevant literature on waste management in other developing countries and the determination of best practices from high-income developed countries that can be applied in Nigeria. It also includes previous studies on the relevance of public participation and discussions of the theoretical framework that informs the methodology.

Chapter Four: Research Methodology

This chapter includes a detailed account of the research methodology and methods and an explanation of the philosophical stance of the study. The chapter also provides rationales for the chosen strategies and methods. It also discusses the proposed process of data analysis.

Chapter Five: Qualitative Data Analysis

This chapter discusses the result analysis and processes for qualitative data collected in the study from interview responses.

Chapter Six: Quantitative Data Analysis

This chapter contains details of quantitative data analysis from survey responses.

Chapter Seven: Discussions

This chapter discusses the linkages between the reviewed literature and the study's outcomes.

Chapter Eight: Conclusion and Recommendations

This chapter gives a conclusion of the study's findings. It also integrates the study's qualitative and quantitative outcomes in a conceptual framework. The chapter then showcases the limitations encountered during the research process and provides recommendations for further research and policy development.

Chapter 2:   Institutional Background of Waste Management in Nigeria

2.1   Introduction

This chapter delves into the institutional context of waste management in Nigeria, shedding light on the historical evolution of waste policies and the contemporary challenges faced in ensuring adequate waste management. It is imperative to trace the historical trajectory of waste policies to understand Nigeria's present state of waste management. This chapter will explore three distinct eras, including the Colonial Era (1900-1960), discussing the state of waste management and waste policies when Nigeria was under British rule; the Independence Era (1960-1988), exploring the state of waste management when Nigeria received their independence, then the Current Era (1988-2020) discussing the current waste policies and how waste management has evolved over the years.

In addition to exploring the historical backdrop of waste management, this chapter will also address the key challenges that have hindered effective municipal solid waste management in Nigeria by reviewing existing literature. These challenges encompass a range of issues, including inadequate infrastructure, poor funding, lack of awareness, and rapid population growth. Understanding these challenges is vital for devising sustainable and effective waste management strategies for Nigeria's present and future.

2.2   About Nigeria

Nigeria is the largest country in sub-Saharan West Africa, with a population of 211 million as of 2020 (Worldometer, 2020). making it the most densely populated country in Africa, covering an area of 923,768 km^2 Akinyemi and Isiugo-Abanihe (2014). Nigeria was ranked as the seventh largest population in the world in the world factbook by the Central intelligence agency (CIA) in 2020. It is a multi-ethnic and culturally diverse country comprising 36 states and the Federal Capital Territory of Abuja. Figure 2.1 shows a map of Nigeria, including the 36 states and the federal capital territory, Abuja.

Abuja is the federal capital territory where all the federal government ministries and parastatals are located, including the Ministry of environment and several environmental agencies such as the National Environmental Standards and Regulations Enforcement Agency (NESREA) as well as other environmental agencies such as Forestry Research Institute of Nigeria (FRIN) National Biosafety Management Agency (NBMA), National Oil Spill Detection and Response

Agency (NOSDRA), Nigerian Conservation Foundation (NCF), Friends of the Environment Nigeria (FEN, NGO), Federal Ministry of Environment (FMOE), Abuja Environmental Protection Board (AEPB) Budnukaeku (2021).
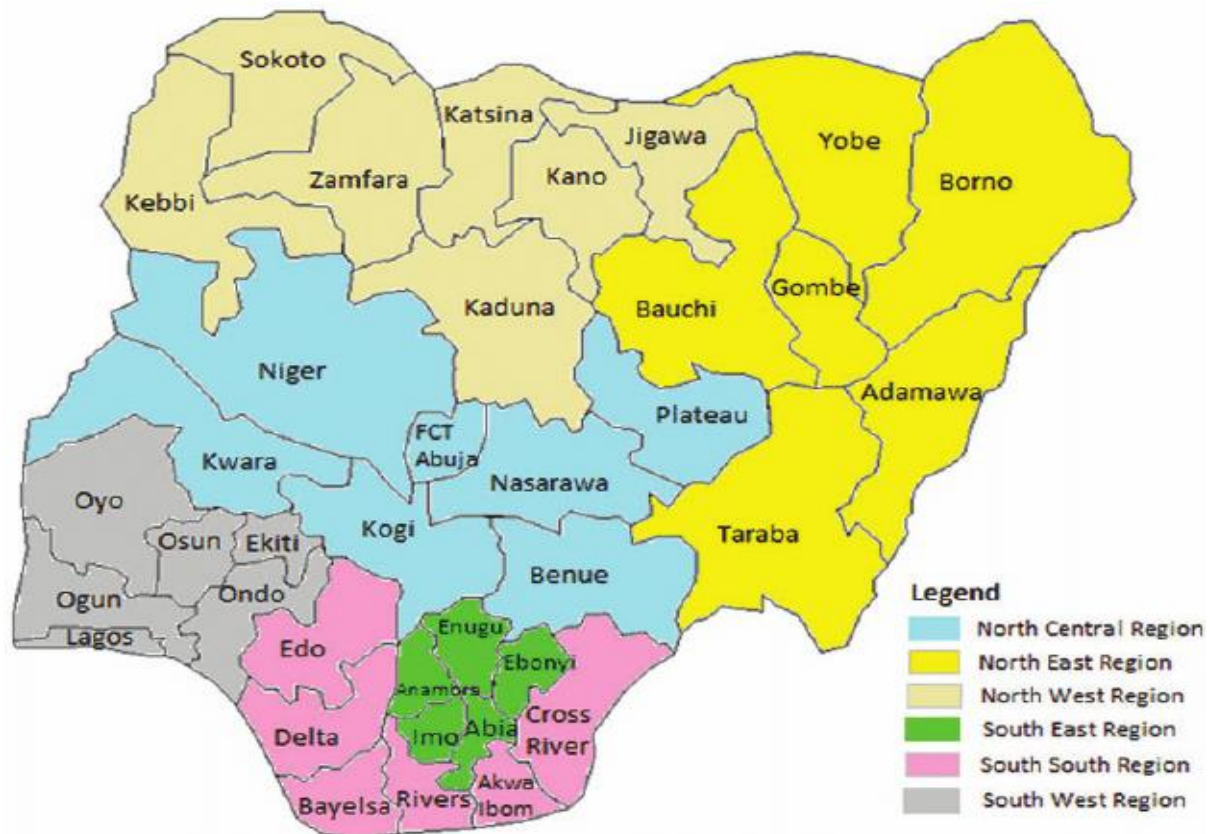
Figure 2.1 shows a map of Nigeria.

Adapted from (Gayawan, Arogundade, & Adebayo, 2014)

Nigeria was colonised by the British in the 19th century and regained its independence in 1960, transitioning into a democratic government (Falola & Heaton, 2008). The country is a federal system governed by three tiers of government: the federal government, state government and local government. The country practices a federalism system in which all decisions, policy-making, and budgetary allocations come from the federal government, as said by Omotso and Abe (2014); Nigeria's federalism is one in which the federal government has supremacy over the country's regions. This also means that Nigeria practices a top-bottom approach to policy implementation.

This is to say that the federal ministry holds supremacy of authority followed by the national ministries, state government, local government and then the private sector, where the public ultimately are the beneficiaries. Municipal solid Waste management is operated under the ministry of the environment at the federal and State levels and the environmental health department at the local government level under established legislations and guidelines relating to waste management (Ogechukwu & Emeka, 2020). Figure 2.3 illustrates the institutional structure of the federal govt with some ministries in Nigeria. It shows the government hierarchy in Nigeria adopted from (Ezeudu, 2020); from the federal government, the president appoints the ministers of environment, health, and education, including other federal government sectors. Under the federal government is the state government, where they have governors that the local government's councillors answer to the state governors. Also, at the state level, ministers for every sector oversee the state's affairs. For instance, a federal minister of the environment and the state minister for climate control their various commissioners.
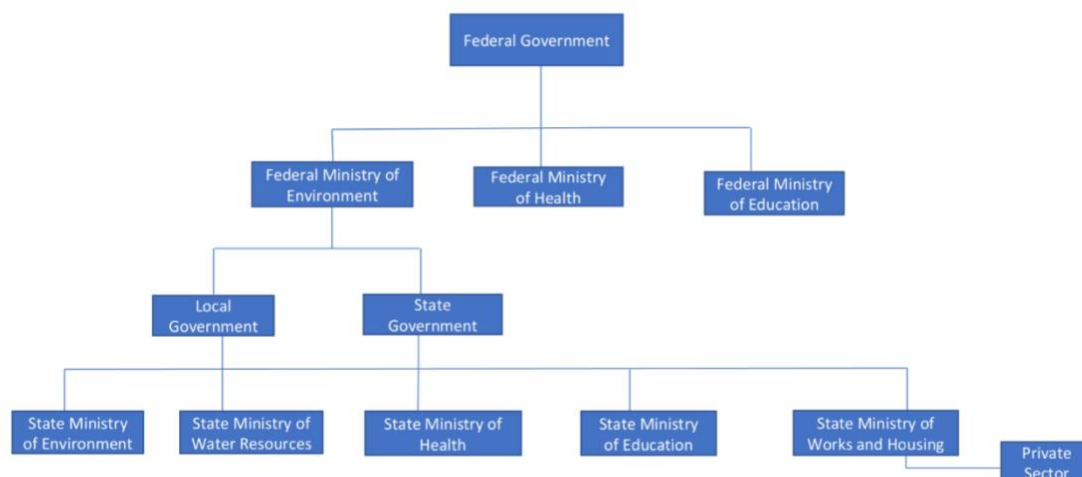
Figure 2.2: The institutional framework of environmental management in Nigeria.

Adopted from (Ezeudu, 2020).

By nominal GDP, Nigeria has the largest economy in Africa (Campbell, 2012). Nigeria has abundant natural resources and is the largest oil exporter in Africa. However, Nigeria's economy majorly depends on oil revenue, so the oil sector also affects other non-oil industries in Nigeria. For instance, the world bank reported that Nigeria is vulnerable to economic disruption due to covid 19, mainly due to the decline in oil prices globally (World Bank, 2020).

The world bank also reported that 40% of Nigerians fell below the poverty line (85 million), and 25% are vulnerable (53 million), which means they are likely to fall into the poverty bracket due to economic impacts.

Concerning waste management in the country, Adewole (2009) said that most Nigerians are accustomed to dirt on the streets. Evidence can be seen everywhere due to the indiscriminate discharge of solid waste into drains and, at times, on the highways. Currently, standard waste practices in Nigeria are illegal dumping on roadsides, open pits and gutters, giving rise to significant health and environmental impacts. The waste disposal site created through illegal dumping serves as breeding grounds for malaria parasite vectors (WHO, 1995). World Health Organisation estimated that the number of malaria deaths stood at 405,000 in 2018, and Children under five years are the most vulnerable demography affected by malaria. They accounted for 67% (272 000) of all malaria deaths worldwide in 2018, WHO (2018).

Furthermore, Nigeria has been widely reported as having produced up to 0.34 million tonnes of plastic into the ocean in 2010 and was ranked the ninth country in the world for pollution Dumbili and Henderson (2020). It is essential to discuss waste management background to understand how and why the country arrived at its current state. The historical set of Nigeria's waste management policies is discussed in the following section.

2.3 Historical Background of Nigerian waste management policies

This section discusses the evolution of environmental law concerning Municipal solid waste management in Nigeria, including how waste management was tackled back then and the challenges encountered from the colonial era till date. The section chronologically outlines the development of environmental laws, policies and regulations and their respective situations that have been in place since the British colonisation. It indicates the challenges and outcomes faced in developing waste management in Nigeria.

2.3.1 Colonial era (1900-1960)

Nigeria was colonised by the British in 1884. It became a part of the British Empire at the Berlin Conference, where European powers divided and shared Africa. The British could rule with military strength and strategic alliances with local rulers (Ogunba, 2016). The British forces first invaded Lagos in 1851 and formally annexed Lagos in 1901. Nigeria was colonised until 1960 the country gained independence (Kwarteng , 2012). Early historical reports showed

that the British considered Lagos the most strategic and convenient location for trade because of its location on the eastern West African coastline (Mabongunje, 1964).

During the colonial period, there was seemingly no interest in environmental protection in the region. The British administration's attention and significant goals were about accessing enough or all-natural resources available, emphasising national governance (Bratspies, 2015). This means that the focus of the administrators was on the help rather than the well-being of the inhabitants. According to Takang (2014), the administrators convened meetings for resource protection. Still, the reality was that these were meetings with the agenda of promoting trade and enhancing economic growth for the colonists.

According to Harris (2000), the imperial and colonial powers that dominated Nigeria and Africa in the 19th century made no effort to promote social or economic advancements in the developing regions. Thus, Nnadozie (1994) categorically indicated that if any environmental laws had restricted economic or mining activities in the colonial period, reducing access to resources in that region, they would all have been counterproductive. Hence, there were environmental impacts, but little attention was paid to the consequences. As a result, there were no limitations on the activities at that time (Abumere, 1999). However, during that period, It was discovered that there were legislations and laws relating to public health (Sridhar, Oluborode & Zacchaeus (2017); though these had little bearing on the environment but occurred as a result of some environmental activities. The legislation included the Criminal Code Act of 1916 and the Public Health Act of 1917, the Public Health Laws of 1917, the Water Ordinance of 1913, The Public Health Laws of 1957 to check Overcrowding Disease and Squalor, The Mineral Act of 1945 on the trench and Drainage Pollution (Raji & Abejide, 2014).

Some other environmental laws were later introduced when crude oil was discovered in Nigeria. Although Nigeria was an Agriculturally based economy, in 1056, crude oil was discovered in the country, and all the focus seemed to shift from Agriculture to petroleum (Ogunba, 2016). Currently, Petroleum is Nigeria's primary source of revenue. Crude oil became the most significant source of income via exports, and there was a national fixation on that sector, making Nigeria the new industrial hub. Naturally, environmental legislation followed suit to protect petroleum resources.

Dating back to these years, in the colonial era, it is now evident that environmental issues were never prioritised, especially when the administrations' sole purpose was to take as many

resources as they could get. Though it has been noticed that during this period, there weren't many studies and awareness about managing waste, the burden was less on administrators, who could get away with almost anything.

2.3.2 Independence era (1960-1988)

In Nigeria's history after independence in 1960, there are no records that any government policies on environmental protection were deliberately formulated. The Government was more focused on economic development and providing necessities for the people (Ogunba, 2016). All ecological protection systems were tackled on an ad-hoc basis (Ladan, 2012). However, this experience was not solely in Nigeria; countries like the United States also experienced environmental crises, including severe health impacts, before establishing its Environmental Protection Agency (EPA) in 1970 (Wisman, 1985).

The United Kingdom also faced environmental crises that can be traced way back to the Industrial Revolution when the issue of environmental protection surfaced due to outbreaks of cholera and typhoid. Firstly, ecological law was established in 1863 to deal with sewage problems, as Louis (2004) described. Like every country at its developmental stage, major ecological crises cause the realisation of the need to establish policy.

However, while other countries in their current states have applied technology, consistent policy review and proper operations strategies in recent times to attain sustainable environmental development, Nigeria still needs to work on maintaining basic strategy. Records show that several meetings were conducted among African nations during the 1960s, acknowledging the gravity of environmental problems that needed attention, and statements were issued to implement further actions (Ogunba, 2016).

Additionally, Several conferences and treaties were signed and agreed upon, but no solutions were yielded on environmental protection. During that era, Nigeria had no concrete policy addressing waste management, and there was no government body regulating the environment; there were no funds explicitly allocated to waste management, and people lacked awareness and education about waste management, Sridhar, Oluborode and Zacchaeus, (2017). Was further said by Ogunba (2016) added that, Like Nigeria, other developing countries, including Kenya and Ghana, endured significant environmental issues but lacked solid policies and legislation to control situations. This shows a similarity among developing African countries.

Since 1960, representatives of African countries have attended environmental conferences, including Sridhar, Oluborode and Zaccchaeus (2017).

- African Convention on the Conservation of Nature and Natural Resources Algiers (1968); 40 African countries signed the agreement, in which 32 were ratifiers, including Nigeria; African Union (2010).
- Convention for Co-operation in the Protection and Development of Marine and Coastal Environment of the West and Central African Region (Abidjan, 1981); International Union for Conservation of Nature (2005).
- Convention on the Ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Bamako, 1991).

Despite several conferences attended by many delegations, signing treaties for the legislations to be implemented in the respective African countries, including Nigeria. Still, insufficient attention was given to environmental protection, and no profound environmental culture was developed until the Koko crisis occurred in Nigeria in 1987.

2.3.3   Current era (1988-2020)

Only after Act 58 of 1988, when the Federal Environmental Protection Agency (FEPA) was established, Nigeria needed a systematic environmental policy framework (Tochukwu, 2014). After an incident in the southern part of Nigeria where an Italian businessman dumped over 200 drums and bags of hazardous toxic waste in the remote fishing village of Koko in south Nigeria in 1987, the Federal Environmental Protection Agency was formed. According to the united nations (2018), the dealer claimed it was useful fertiliser that would benefit the residents. After the land was discovered, it was declared uninhabitable, and more than 500 residents were evacuated from the contaminated area. FEPA was then created and charged with environmental management and protection responsibility. The functions of the agency were the protection and development of the environment in general and environmental technology, including initiation of Policy concerning ecological research and technology; and without prejudice to the generality of the preceding, according to the law, (FEPA, 1988)

- To advise the Military administration on national environmental policies and technological advancements related to the environment.

- To establish blueprints and master plans for environmental development.
- To collaborate with international allies in improving environmental protection using science and technology.
- To co-operate with government and agencies at international levels on improving and implementing environmental protection.
- To carry out all activities necessary for the full discharge of operations.

As a result of forming this new body, Nigeria became the first African country to establish an institution strictly for environmental protection, Doherty (2016). Also, in 1988, the Government followed up with the establishment of the Harmful Waste Act, which deals explicitly with the illegal dumping of harmful waste (Okpeyemi, 2016). In 1992, FEPA was amended to accommodate more regulations and united with relevant departments from other ministries to form the Federal Ministry of Environment. Currently, the Federal Ministry of Environment is assigned the authority to enforce the law and all undertakings that might influence the Nigerian environment.

The Ministry is mandated to coordinate the environmental protection and preservation of natural resources for sustainable development in Nigeria, FEPA (1988). FEPA was later labelled as dysfunctional due to various setbacks, and its targeted goals were not reached; it was plagued with weak enforcement of environmental laws /in light of F EPA's functions, it did not uphold its given responsibilities; with this, there is an understanding that various hindering factors could have come into hinder FEPA's success such as; lack of expertise, corruption, poor funding, lack of proper institutional structure because it was the very first agency specifically on the environment, the staff must have lacked appropriate training, and we all are aware of the government's lackadaisical attitude towards the environment in Nigeria, it is simply not given much relevance, Ladan (2012)

2007, FEPA was repealed, and the National Environmental Standards and Regulation Enforcement Agency (NESREA) was established, Ladan (2012). The NESREA Act created NESREA by the Federal Government in line with section 20 of the 1999 constitution, Ladan (2012), during President Olusegun Obasanjo's administration. NESREA is under the supervision of the Federal Ministry of Environment charged with.

The enforcement of environmental standards, laws, and policies, development and protection of the environment, conservation, biodiversity, and sustainable development in Nigeria. To

deliver her mandate, NESREA's strategy is to create awareness and education on the environment, form collaborations and partnerships with relevant agencies and countries, and strengthen institutional capacity to monitor compliance and enforce environmental laws NESREA (2019).

After the establishment of NESREA, the Minister of environment introduced 24 new regulations under the agency in 2009-2011 Ladan (2012). With the nation's current state, 32 years since the formation of FEPA and its repeal to form NESREA, not much has been achieved. NESREA is yet to accomplish its initial expected mandates fully. However, (Ladan, 2012) concluded that environmental affairs had significantly shifted towards enforcing environmental laws and rules instead of just creating regulations and standards. This also, compared to the achievements of FEPA, is commendable.

Furthermore, it is seen that NESREA has done an excellent job of implementing its mandates by promoting partnerships and collaborations with the likes of the United Nations Development Program UNDP, The United States Environmental Protection Agency USEPA etc. It has also been focusing on effective stakeholder participation in environmental affairs, and there is some awareness of environmental protection. However, Suleiman, Romoke and Monsurat (2019) believe there is a need for more vigorous enforcement of environmental laws and regulations. According to them, NESREA is yet to tap into its potential and fully exercise its powers to enforce and implement policies due to the current evidence of poor environmental management in Nigeria and missed targets on sustainable development.

All sustainable development goals concerning the environment still need to be achieved. Table 2.1 shows some ecological policies that have been used over time as guidelines for managing municipal solid waste in Nigeria. The Table is designed chronologically to indicate that there was no prior specific municipal solid waste management policy on the ground until 2021 when the President launched the two national policies (Odugwu, 2021). However, Uchendu (2016) said that among the list of policies above, the national policy on municipal and agricultural waste management 2012 was the one closest to focusing on solid waste management. The policy covers generation and sorting, storage, collection, transportation, resource recovery, treatment/disposal, and minimising the release of organic pollutants. This is the closest policy to tackling municipal solid waste until 2021. These policies were presented to the public in May of 2021, called the national policy on solid waste and the National Policy on plastic waste management.

This explains why municipal solid waste management has yet to be effectively implanted and needs a well-grounded system and strategy to manage waste. Without a specific solid waste policy, the stakeholders operated blindly without concrete guidelines and relevant implementation strategies. However, the new National solid waste policy 2021 statement states that Solid waste shall be harnessed as a resource to promote economic growth and managed to improve the quality of human and environmental health, Federal Ministry of Environment (2020) with the policy objectives stated as follows:

- Develop an integrated, coordinated, environmentally sound, efficient, safe, and economically sustainable Solid Waste Management system.
- Provide a national direction on Solid Waste Management for the Federal, State, and Local governments, the private sector and all stakeholders.
- Promote a healthy and aesthetically satisfactory environment by ensuring effective, sustainable, safe and sanitary Solid Waste Management.
- Provide guidance to policy and decision-makers regarding effective waste management options, technologies, and practices best suited for the nation in line with best global practices and tune with the "waste management hierarchy".
- Establish an institutional framework capable of ensuring an efficient national waste management system.
- Provide a basis for an integrated solid waste management legal framework to regulate solid waste generation and waste management service delivery.
- Ensure safe disposal of domestic, commercial and industrial solid wastes to protect public health during and after collection, storage, transportation, treatment and final disposal.
- Create an enabling environment for waste reduction, sorting at source, reuse, recycling and conversion to energy through incentives.
- Facilitate cost and resource recovery in waste management investment and ensure project replication and sustainability.
- Maintain adequate and regular waste management services at affordable cost.
- Institute cost recovery mechanisms and profit-making opportunities in waste management schemes to facilitate private sector participation to generate employment opportunities and thus act as a poverty reduction tool.

The new policy has encompassed all the necessary objectives to achieving a successful municipal solid waste management because it includes the utilisation of the waste hierarchy, which is the most effective solid waste principle globally and facilitates cost and resource recovery. However, policy implementation has always been a roadblock to achieving goals in Nigeria, especially in the waste management sector, due to its low level of priority Sylvester and Ikudayisi, (2021). Therefore, this study discusses the factors affecting implementing of municipal solid waste management systems in Nigeria.

2.4   Chapter summary

The chapter explored the institutional context of waste management in Nigeria, shedding light on its historical development and key policy eras, highlighting the status of waste management in Nigeria at every stage. This summary encapsulates the basic insights taken away from this chapter. In tracing the historical trajectory of waste management policies, the chapter revealed the following key historical insights. For example, during the colonial era, Nigeria's waste management practices were largely influenced by colonial powers, laying the foundation for subsequent policies. The independence era marked a pivotal phase in Nigeria's history and the present times where significant shifts occurred in Nigeria's waste management landscape, focusing on addressing the evolving challenges posed by various challenges identified in the literature.

Chapter 3:   Literature Review

3.1   Introduction

In this chapter, the thesis provides an overview of the literature surrounding waste management in Nigeria. It commences with the definitions of waste and municipal solid waste and management and further references relevant studies around waste management in Nigeria. It also gives an insight into Nigeria and its status on municipal solid waste management, including a historical background of environmental policies in Nigeria from colonisation to date. Finally, it provides an account of how waste was operated earlier in Nigeria in different eras, painting a picture of how Nigeria got to its current state.

This chapter also gives an overview of other literature that discusses challenges and opportunities affecting municipal solid waste management in Nigeria. It paints a picture of some factors challenging municipal solid waste management in Nigeria that other authors have identified in the same field. It further explains how some developed countries have created functioning waste management systems using best practices that drive them to a successful waste management system. It will allow the study to compare both approaches and identify what can be utilised as opportunities in the Nigerian context. The study used relevant search engines, including Google Scholar, Scopus, and Science Direct.

3.2   Definition of Waste

Waste has long been a by-product of human activity, Roberta (2013). Waste was also referred to as anything or material that must be disposed of due to being damaged, worn out, contaminated, or otherwise spoiled and hence no longer helpful (Anifowose et al., 2011). The European Union defined waste as any object that the holder discards, intends to discard or is required to discard Europa (2008). The fundamental similarity between these definitions is that they all agree that the waste producer must define the object's or material's value, whether necessary. This was also supported by Dijkema et al. (2000), stating that a substance regarded as a waste to one individual may be a resource to another. Therefore, the material can only be considered waste when the owner labels it as such. As for the value of waste, it is seen that from its historical nature, it mirrors the civilisation in which it is produced (Barles, 2014). The statement means that what was regarded as waste in earlier cultures might be helpful in a different society, though some may remain the same. For instance, organic waste has always

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served as manure for agricultural purposes and still has the same use in current times Wilson (1976).

In earlier human history, no one determined what waste meant to them; it simply consisted of ash, wood, bones, bodies, and vegetable waste (Barles,2014). During this period, waste was often disposed of in the ground, where it acted as compost and helped improve soil and food production (Wilson, 1976). Significantly, no waste management strategy could have been expected during the early civilisation. However, during the Middle Ages, waste composition began to evolve, and waste accumulation increased as the population grew, especially in larger cities, and disposal became a problem. Thus, waste was placed and piled in large pits, contributing to the high elevation of grounds in places like Europe. This continued until the 19th century, according to Wilson (1976). This shows the relationship between population growth and waste generation over time, as stated by Hoornweg (2012).

Consequently, Waste played an essential role in history, majorly in Europe, where they experienced deadly disease outbreaks termed the black death Barles (2014). This was due to rapid waste generation and improper disposal, claiming the lives of over 75 million people, with 60% from Europe. This drastically changed the population of Europe and their monarchies Roberta (2003). For this reason, European cities were among the first to develop a waste management system, starting with Rome Bello, Ismail and Kabbasi (2016). Likewise, the United Kingdom experienced a similar pile of waste following the industrialisation in cities due to a lack of waste management strategy, causing rapid deterioration in the general quality of urban life, leading to the first organised waste management strategy being established in London in the 18th century Nightingale (1954).

Similarly, in the 1770s, the United States initially experienced uncontrolled waste generation and disposal. There were polluted wells and poor sanitation, leading them to witness disease outbreaks and mass deaths (Louis, 2004). Like other countries, Nigeria also saw a waste disaster in 1988 during the Koko incident, claiming thousands of lives when an Italian businessman illegally dumped over 2000 drums of toxic waste in the Koko village located in the southern part of Nigeria, causing diseases, claiming lives subsequent of around 500 households as reported by the United Nations Environmental Program UNEP (2018).

The most common factor among the countries mentioned above is the experience of the disastrous negative impact associated with a lack of waste control, resulting in catastrophic

outcomes. Thus resulting in the creation of waste management strategies and the establishment of environmental agencies. This includes the development of waste policies and regulations governing effective waste management systems. These incidents evoked the need to develop strategic ways of managing waste, establishing institutions that would manage waste from inception to final disposal. The first strategic waste management was based in London in the late 18th century, Velis, Wilson and Cheeseman (2009). These waste management systems have all worked differently in various countries. These are due to certain factors, including development, income, and population (Hoornweg, 2012).

3.3 Types of Waste

solid and liquid waste represent two categories within the broader waste management landscape. Their disparities in physical characteristics, handling requirements, storage capabilities, treatment complexities, and environmental impacts underscore the need for tailored approaches to managing and mitigating their potential adverse effects. Understanding these differences is paramount for developing effective waste management strategies, environmental protection, and public health preservation.

Solid waste is characterised by its physical state, primarily stable or semi-solid. This category encompasses various materials, including paper, cardboard, plastics, glass, metals, and organic matter. One of its notable advantages is that it is generally easier to handle and collect when compared to liquid waste. Solid waste can be contained within containers, bags, or bins and transported without significant spillage concerns. Moreover, it can be stored for extended periods without the risk of leakage or the dissemination of contaminants. Solid waste treatment often involves methods such as recycling, composting, incineration, or landfill disposal, which, while requiring careful management, are generally less intricate than their liquid waste counterparts. However, if not managed appropriately, solid waste can still contribute to environmental challenges, including landfill pollution, greenhouse gas emissions from decomposition, and habitat disruption.

In contrast, liquid waste assumes a fluid state, encompassing materials like wastewater, chemicals, sewage, and various liquids generated from industrial processes. Its inherent liquidity presents distinct challenges. Liquid waste is notably more challenging to handle and collect due to its fluid nature, often necessitating specialised systems, such as pipelines and tanks, for containment and transportation. Unlike solid waste, liquid waste cannot be stored as

quickly, as it possesses the propensity to leak, contaminate soil and groundwater, and pose health risks. Consequently, the treatment of liquid waste is generally more intricate. It typically involves multiple stages of filtration, chemical treatment, and biological processes to remove contaminants and render them safe for disposal or reuse. Furthermore, improperly managing liquid waste can lead to severe environmental consequences, including water pollution, soil contamination, harm to aquatic ecosystems, and an elevated risk of waterborne diseases, underscoring its heightened impact on the environment and human health. However, this study focuses on solid waste, the most ubiquitous type of waste, especially ones generated by municipalities in various works of life.

3.3.1   Municipal Solid Waste

Municipal solid waste includes refuse from households, non-hazardous solid waste from industrial, commercial, and institutional establishments (including hospitals), market waste, yard waste and street sweepings (Rajaeifar et al. 2015; Ripa et al. 2017; Schubert 1997). Municipal solid waste is defined as solid waste generated in municipalities and collected by municipalities and other local authorities (Edjabou et al., 2015; Aleluia and Ferrão, 2016). Solid waste is usually defined by its composition, characteristics, and source. The source typically categorises the types of solid waste. They can be from municipalities (Municipal Solid Waste) and industries (Industrial Waste, agricultural waste, and biomedical waste). Table 2.1 shows waste streams classified by source. It also indicates how municipal solid waste can arguably be one of the most problematic sources of waste due to volume.

Table 3. 3.1 shows the waste streams classified by source.

Adopted from Tchobanoglous and Kreith (2002) through Davidson (2011)

Source	Facilities, activities, or locations where wastes are generated	Types of solid wastes
Residential	Single-family and multifamily dwellings; low-medium, and high- density apartments.	Types of solid wastes Food wastes, paper, cardboard, plastics, textiles, yard wastes, wood, ashes, street leaves, special wastes (Including bulky items, consumer electronics, white goods, universal waste) and household hazardous waste. Paper,
Commercial	Stores, restaurants, markets, office buildings, hotels, motels, print shops, service stations, auto repair shops. Schools,	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes, hazardous wastes
Institutional	Schools, universities, hospitals, prisons, governmental centres	Same as commercial plus bio medical
Industrial (non- process wastes)	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition	Same as commercial
Municipal Solid waste	All the preceding	All the preceding

According to Table 3.1, Municipal Solid Waste can consist of all the mentioned waste streams above, and all locations must belong to one municipality or another. This also means that all Individuals from other categories generate household waste in their cities. White et al. (1995) argue that this is because it is the waste stream that people frequently encounter daily, meaning it can pose dangerous impacts on health and the environment by spreading its effects quickly due to its ubiquity if not correctly managed. Therefore, municipal solid waste management services are considered a top priority by governments and local authorities, as Baranek (1992) mentioned. Municipal solid waste has the highest amount of waste generation per capita, making it one of the biggest universal problems affecting people globally World Bank (2018).

UNESCAP (2002) highlighted that municipal solid waste is generated from households, offices, hotels, shops, schools, and other institutions. These include biodegradable waste (organic), plastics, bottles, metal, furniture, appliances, grass clippings, etc., as stated by EPA (2016). According to extensive research, municipal solid waste is now the most generated globally due to its alarming growth rate, as explained by Ogwueleka (2009). This is why it became one of the two topics that needed to be urgently discussed at the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992 to call the world's attention to the undesirable environmental impacts of population growth and waste generation rate especially the accumulation of greenhouse gases caused majorly by municipal solid waste generation Beede and Bloom (1995).

3.3.2   Municipal Solid waste composition

According to the World Bank, food is the most generated component of municipal solid waste Kaza, Yao, Bhada-Tata and With (2018). It was also reported by Khalid et al. (2011) that the build-up of solid organic waste was seen to be reaching critical levels globally. In 2014, the Environmental Protection Agency reported that the United States produced 71 million tons of organic waste annually, including food waste and yard trimmings, making up 28% of the country's total municipal solid waste stream, EPA (2014).

Likewise, in most parts of Africa, the primary waste generated is composed of organic materials (Schluep and Wasswa, 2008; Ogwueleka, 2013; ,Bello, Ismail and Kabbashi 2016). Furthermore, fruit and vegetable waste production are also very high and becoming a concern in municipal landfills because of its high biodegradability (Bouallagui et al. (2005). This is to

say that the most alarming growth in municipal solid waste composition is organic waste, as highlighted by Kaza and Bhada-Tata (2018). This surge has occurred due to population growth and global food consumption.

Schluep and Wasswa (2008) also studied waste consumption in East Africa and established that the highest type of waste generated in Dare salaam, Moshi, Kampala, Jinja, Lira, and Nairobi were 71%, 65%, 77,2%, 78.6%, 68.7% and 65% respectively. Similarly, in China, the proportion of organic waste, mainly food remnants, reached as high as 60% in 2011 Tai, Zhang, Che and Feng (2011). Another study by Ogwueleka (2013) in Nigeria showed that the most significant waste components were organic waste, consisting of 63.6% in Abuja. This pattern shows a potential rise in disease outbreaks and pollution due to the production and subsequent exposure to toxic gases Bobeck and Assignment (2010). Thus, Palczynski (2002) warn that there is a need for an efficient collection system to forestall disease outbreak and other adverse health and environmental impacts.
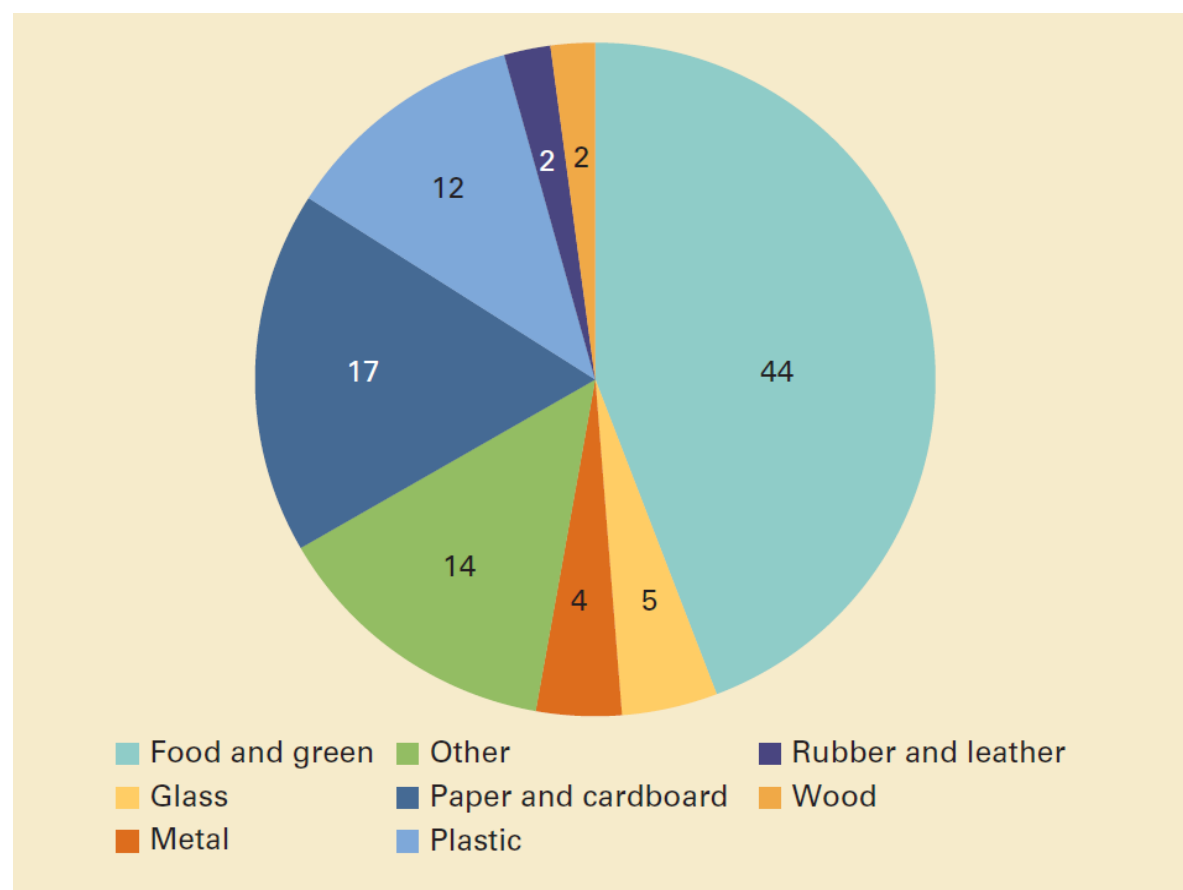
Figure 3. 1: shows the global composition of municipal solid waste management.

Adapted from Horweng (2012)

The World Bank states that waste composition varies considerably by income level, and the proportion of organic waste decreases as income levels rise. Consumed goods in higher-income countries include more recyclable materials used for packaging, such as paper and plastic, than those in lower-income countries. This statement is because lower-income countries like Nigeria still consume less processed and packaged foods than higher-income countries.

Although studies have shown that low-income countries have a lower number of recyclables, within Nigeria, it is said that the number of recyclables is higher in high-income communities than in low-income communities. For instance, in Ogwueleka (2013) study, organic waste was the highest, followed by food packaging recyclable materials in high-income areas. He concluded that although High-income families generate more organic waste per capita, they also produce more recyclables than low-income homes based on high purchasing power. Based on this result, a review has shown that organic waste is the most significant waste generated globally. However, there were variations in the generation level based on income level.

3.3.3 Municipal Solid Waste Management

Municipal Solid Waste Management was defined as the process associated with controlling the generation, storage, collection, transfer and transport, treatment, and disposal of Municipal Solid Waste following the best principles of health, economics, engineering, conservation, aesthetics, and other environmental considerations, including the response of the public (Schübeler et al. 1996; Khatib, 2011; OtengAbabio et al. 2013). More technically, it was defined by Onu et al. (2012) as the application of techniques that ensure the orderly execution of the functions of collection, transportation, processing, treatment, and final disposal of solid waste. Also, Tchobanoglus et al. (1993) added that the waste management process is environmentally compatible, embracing principles of economy, aesthetics, energy, and conservation. This study is more interested in the socio-economic aspects of waste management than the waste management process itself. Thus, the study will go by the definitions by (Schübeler et al., 1996; Khatib, 2011; OtengAbabio et al. 2013; Tchobanoglus et al. 1993). Concerning social aspects, municipal solid waste management involves multiple environmental and socioeconomic criteria (Soltani et al., 2015). The process involves systematic planning, engineering, organisation, administration, and financial and legal activities associated with the generation, growth, storage, collection, transport, processing, and disposal (Tchobanoglous et al., 1993).

Municipalities majorly manage waste management regionally (Silpa Kaza, Lisa Yao, Perinaz Bhada-Tata & With, 2018). This includes both developed and developing countries. Globally, Solid waste management programs are typically designed based on local conditions such as financing capacity, local norms, the spatial layout of communities, and revenue generation through taxes and service fees (. Although waste management is conducted at the municipal level, most policies governing waste management are formulated at the national level, which is a top-down approach (Koonts & Newig, 2014). For instance, the European member states conduct multi-level governance with centralised environmental policies from the European Union (Gollata & Newig, 2017). Nigeria is also a centralised government where the Federal government formulates policies and guidelines sent to the states and local government authorities (Dawodu et al., 2021).

"It must be noted that some political scientists argue that policy must be made at the local level", Matland (1995, p.146). The top-to-bottom approach is also criticised by Hjern and Hull (1982), arguing that central decision-makers should consider other social actors/stakeholders to make decisions that affect the public. The case of waste management involves local and regional actors, environmental activists and citizens, Nzeadibe (2009). On the other hand, Matland (1995) then warns that if a bottom-up approach is adopted, there is a possibility of overemphasising the level of local autonomy. Suppose the bottom-up approach is only applied to Nigeria. In that case, it might not come by practicality due to the lack of awareness and political will among people, including the local authorities, as stated by (Abila and Kantola, 2013; Ogwueleka, 2013).

Furthermore, it has been suggested by other schools of thought that the top-bottom approach and bottom-top approach should be integrated to benefit from the strengths of both methods (Diehl, 1985). It is an approach where the Federal government develop the policies and allows the local governments to develop strategies for implementation in the context of their respective municipalities and citizens (Diehl, 1985). However, this would work according to the type of policy involved and the country's nature. It could help build the best approach in dealing with people and their behaviour towards waste to achieve effective awareness campaigns. It was further emphasised by Joseph and Nagendran (2007) that concerning sustainable waste management in developing countries, there should be a combination of a Top-down approach for Policy intervention and a Bottom-up approach for public-private partnerships. However, results may vary depending on local circumstances.

Regardless of the approach, the waste management process is handled differently in various regions and countries. Generally, the waste management process is more efficient and effective in developed than developing countries. A typical solid waste management system in developing countries displays a range of problems, including low collection coverage and irregular collection services, illegal open dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and management of informal waste picking or scavenging activities, Ogawa (2000).

Developing countries face some typical problems when municipal solid waste management is discussed. These include poor and inefficient coverage and operation of services, inadequate recycling strategies and activities, lack of funding, lack of awareness, and lack of expertise (Salami et al., 2019; Ezeah, 2012; Kantola Abila, 2013).

Although the municipal solid waste generation rate is high in high-income cities of developed countries, they have effective operating systems, technology, and financial resources unavailable for low-income towns in developing countries (Jha et al., 2011). These issues have been found at the core of the Nigerian Waste Management system. Although it is widely accepted that solid waste management is a global issue, it is more pronounced in developing countries like Nigeria (Salami et al, 2019).

The most common approaches to waste management processes include recycling, composting, combustion with energy recovery and landfilling (Schneider, 2017). However, most municipal solid waste disposal sites in developing countries, especially in Asia and Africa, are open dumping grounds with insufficient or no covered soil (Jhaet al., 2011). Although, as mentioned in section 1.1, some developing countries have surpassed their counterparts in managing waste management systems. These include countries like China, Malaysia, and South Africa, and they have been categorised as developing countries in transition by the United Nations WESP (2014). They are also classified as medium-high-income countries by the World Bank (Serajuddin & Hamden, 2020). This shows that the above countries have an economic advantage compared to other low-income countries. The above statement indicates that waste management thrives with sufficient financing, which points out why low-income countries might struggle due to inadequate funding (Hoornweg, 2012).

In Nigeria, waste is commonly dumped openly in uncontrolled landfills, areas with waste collection services. Dumps are located along major roads. For instance, a dump site in Makurdi,

Benue State, is 2km from the city along Naka Road. In Onitsha, garbage overflows onto the streets, blocking traffic, and the waste is regularly burnt openly on the roadside (Ogwueleka, 2009). According to Ogwueleka (2003), there have been no formal recycling or resource recovery policy programmes in Nigeria and no policies on composting.

Several options have been used in managing municipal solid waste; thus, choosing the best available options usually involves decision-making based on the level of technology, location, and available resources (Achilles et al., 2013). Decision-making on waste management usually involves having considerations on various criteria such as environmental impacts (e.g., global warming, human health risks, resource depletion, ecosystem damage), associated economic costs and benefits, and regional characteristics (e.g., waste generation rate, and political and socio-economic factors (Soltani et al., 2015). Socioeconomic factors such as citizens' awareness of the subjects are crucial to successful waste management.

One of the main problems in municipal solid waste management is the need for more effective communication between the various stakeholders involved (Bani et al., 2009). Morrissey and Browne (2004) argue that frameworks for waste management should focus more on engaging stakeholders, especially the people, instead of just conducting technical assessments. (Achilles et al.,2013) also believe that effective waste management needs consideration of stakeholders' dialogues. However, solid waste management in Nigeria currently fails to consider the needs and interests of the Nigerian population, says Ogwueleka (2009). This problem occurs as discussed earlier in this section. Nigeria practices federalism and a Top-to-bottom implementation approach where only the federal government makes decisions about specific issues.

Moreso, Freeman (1984) warns about the importance of including all stakeholders in decision-making, especially the ones who benefit from those decisions. The study also believes that if the public is engaged and carried along, it could lead to a successful waste management system. The approach can likely lead to supporting some sustainable development goals (SDGs). Successful sustainable waste management can provide protection for the environment, provide jobs through private sector business and informal sector, improve economic growth by private sector waste management businesses and fixed taxes, reduce disease breakout through Malaria eradication, reduce carbon footprint through less open burning, and promote responsible production and consumption. Studies have identified essential links between waste management and SDGs, explained in the next section.

3.4   Waste management linkages to sustainable development goals (SDGs)

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" United Nations General Assembly, Brundtland (1987). Sustainable development is directly or indirectly linked to waste management (Wan et al., 2019). It was emphasised that Municipal Solid Waste Management is a complex issue that significantly impacts the economy, society, and the environment, making it a multidisciplinary concern (Mohsenizadeh et al., 2019). Thus, studies have shown that municipal solid waste management directly or indirectly affects targets of the Sustainable Development Goals (SDGs) when assessing its footprints across the spectrum (Ye et al., 2023). Also, research in this area has shown that waste management, including municipal solid waste management, is a cross-cutting issue directly linked to about 12 out of the 17 United Nations Sustainable Development Goals (SDGs), including SDG1 poverty alleviation, SDG7 affordable and clean energy, SDG 8 decent work and economic growth (Rodić & Wilson, 2017). However, many countries, particularly in developing and emerging regions, struggle to establish a connection between MSWM and the SDGs (da Silva et al. 2019). Figure 2.2 illustrates the links of waste management to SDG goals.

Lenkiewicz (2020) further argues that SDGs can only be met if waste management is addressed as a priority. That is due to the number of people generating and accessing waste globally. Furthermore, he argues that waste management is a strong driver of sustainable development. For instance, job creation in waste management could help reduce poverty SDG1, and more use of organic waste for composting will improve the agricultural system solving SDG2. Rodić and Wilson (2017) confirm that waste management is an essential utility service that more than 2 billion people currently lack globally, causing a slower pace of achieving sustainable development. When waste management is considered a starting point for addressing various such challenging, sustainable development concerns, the political case for action is significantly reinforced (Wilson, Rodic, Modak, & Soos, 2016). Lenkiewicz and Webster (2017) argue that waste management is a driving force behind and directly contributes to more than two-thirds of the Sustainable Development Goals. Figure 2.2 shows the link between waste management and how it can support the sustainable development goals adopted by Ledenkiewicz (2020).

Figure 3.3: shows the link between waste and sustainable development goals (SDGs).

Adapted from (Lenkiewicz, 2020).

The United Nations (UN) established the 17 SDG goals in 2015 post-millennium development goals (MDGs). They were embraced and adopted by 193 United Nations member states with a 2030 target agenda (United Nations, 2015). So far, some countries are leading in meeting the 2030 target, which are majorly developed countries, especially in Europe, while the countries lagging were found to be developing countries majorly in the African region with the likes of Niger, Nigeria, Central African Republic sustainability for all (2019).

Table 3.2 shows the SDG index rate between some developed and developing countries. It offers an index on the progress of leading developed countries achieving targeted SDG compared to developing countries below the target mark.

Developed country SDG index %	Developing country SDG index %
Sweden (84.5)	Nigeria (31.4)
Denmark (83.9),	Congo (31.3)
Norway (82.3)	Liberia (30.5)
Finland (81)	Central African Republic (26.1)

Table 3. 3.2 shows the SDG index rate between some developed and developing countries.

Source: Researcher (2023)

Policies are developed and implemented globally to achieve waste management. (Makinde, 2015; Smith, 1973) concur, however, that policies are better implemented in developed countries and rarely achieved in developing countries for the reasons outlined in the study due to the use of unsuitable policies. For instance, developed countries' successes in the waste management sector can be linked to the systematic use of the waste hierarchy principle. A study conducted by Sakai et al. (2011) among seven countries, including Japan, the United States, China, Vietnam, and the European Union, concluded that the waste hierarchy principle is given priority in these countries in terms of municipal solid waste management, though with varying implementation strategies but yielding positive results, nonetheless.

The situation is different in developing countries since they implement various policies. Ogechukwu (2020), for example, determined in research that Nigeria lacked a specific solid waste management policy until early 2021, instead borrowing from other areas such as public health, agriculture, etc. As a result, these policies will only be required to employ the waste hierarchy principle, implying that anything adopted outside of the waste hierarchy for municipal solid waste management will be practical. As a result, it is argued that the absence of concrete waste management policies in Nigeria has cost the country years of effective waste management systems. If the appropriate procedures were employed and relevant stakeholders were engaged, the issue would have been policy implementation, knowing that effective implementation can be conducted progressively and consistently. Therefore, this study employed the stakeholder theory as the theoretical framework to inform this study, ensuring that all stakeholders are engaged during any policy formulations and decision-making for effective implementation.

3.5   Theoretical framework

The study addresses the theoretical underpinnings that explain and provide a reason for this investigation. The study will go through two frameworks connected to this study: agency theory and stakeholder theory. The theories will be used as a starting point for the research but will not be used to forecast outcomes.

According to Abend (2008), theories are developed to rationalise, predict, and understand phenomena and to question and extend current knowledge within the constraints of assumptions. The theoretical framework is the structure that supports the topic of a research investigation. The theoretical framework presents and explains the reason for the research problem's existence. As a result, this chapter presents the theoretical foundations of this investigation.

The stakeholder theory is considered relevant to this investigation. When these two ideas are merged, the study will better understand the issues and opportunities affecting municipal solid waste management in Nigeria. The following parts, 3.6 and 3.7, provide more thorough descriptions of the chosen theories and their rationales.

3.6   Stakeholder theory

According to Freeman (1984, p.31). the Stanford Research Institute (STI) defines stakeholders as "those groups without whose support the organisation would cease to exist". According to Freeman (1984, p.vi), a stakeholder is "any group or individual that can affect or is affected by the achievement of a corporation's objective." A stakeholder, according to Freeman, is a broad range that includes business organisations and government agencies. He mentioned governments, competitors, consumer advocates, environmentalists, special interest groups, and even the media as stakeholders.

Stakeholder theory is related to three fundamental approaches: descriptive, normative, and instrumental stakeholder approaches (Donaldson and Preston 1995; Jones and Wick 1999). Understanding the relationship between an organisation and its stakeholders is a descriptive approach; a normative approach is when it is a moral responsibility for stakeholders to be considered in an organisation; and an instrumental approach is when an organisation finds vital stakeholders because they are critical to the organisation's success (Bailur, 2006). Relevant parties in Nigeria's waste management industry include the public, non-governmental

organisations, the private sector, activists, academia, and the informal sector. These stakeholders must be actively engaged to overcome waste management concerns and opportunities. Several solid waste management studies have used the stakeholder theory (Tennakoon & Kulatunga,2021; Guo & Chen, 2022).

Therefore, all stakeholders are addressed in this study, and the research collects data to understand their opinions and experiences on the current state of municipal solid waste management. The study focuses on the instrumental approach to stakeholder theory rather than a descriptive or normative approach because all stakeholders are instrumental to the success of any government, particularly in policy matters.

Stakeholder theory has been applied to project governance (Derakhshan et al., 2019), energy development (Gegg & Wells, 2019), mining operations (Cesar, 2019), emergency management (Goode et., (2017), non-profit management (Schubert et al., 2020), Stakeholder theory can also be used to examine the behaviours of waste management stakeholders. For example, Du et al. (2020) studied the decision-making behaviours of stakeholders involved in construction and demolition waste management. Long et al. (2015) investigated the relationships and distinctions among stakeholders in environmental and ecological fields, specifically defined interest as economic interest and established a tridimensionality method for identifying stakeholders using indicators of influence, involvement, and financial interest. Using stakeholder perspectives, Guo and Chen (2022) also investigated why China struggles with waste classification. Tennakoon and Kulatunga (2021) conducted a study on Stakeholder Management Models for Solid Waste Management Projects in Sri Lanka.

For specific purposes, stakeholders can be categorised into primary and secondary stakeholders Clarkson (1995), definitive, expectant, and latent stakeholders, Field Mitchell et al. (1997), and core and periphery stakeholders. The government, local authorities, neighbouring community, public, environmental activists and media have been identified as key stakeholders in the Tennakoon and Kulatunga (2021) study. Guo and Chen (2022) have also listed high-level government, local government, public, academics, Ngo's, and private sector as stakeholders in waste management but have classified them based on Mitchell et al. (1997) stakeholders and considered the high-level government (Federal government) and the incineration enterprises to be the core stakeholders. Figure 3.4 illustrates Guo and Chen's (2022) stakeholder classification, showing the three categories of stakeholders based on their level of influence, interest and level of involvement.
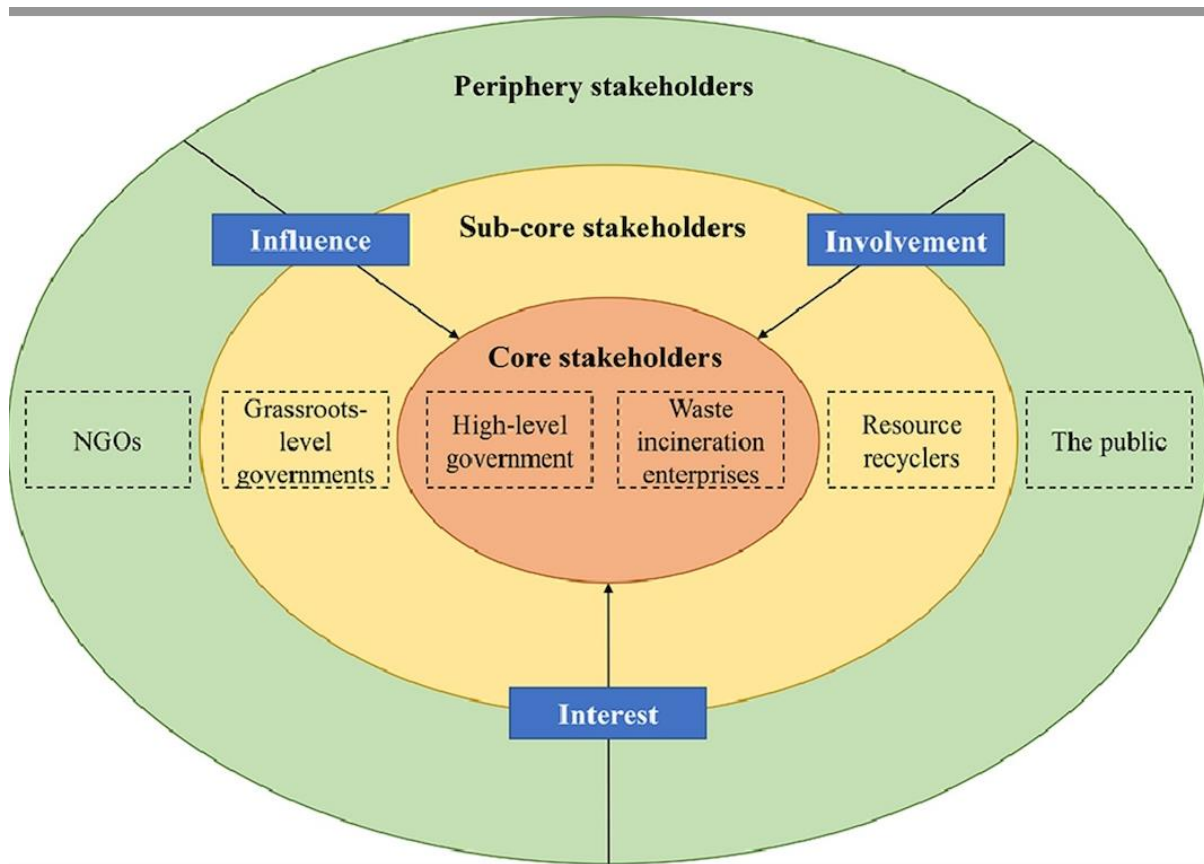
Figure 3.3 shows a stakeholder classification in waste management.

Adapted from: Hacking and Flynn (2018)

The Figure shows that the local government and incinerator enterprise are the core stakeholders in the Chinese waste management system. China's waste management employs a typical top-down governmental model Hacking and Flynn (2018), including the waste management system; thus, all other actors in the value chain participate under the federal government's guidance. The top-bottom implementation approach in China is similar to the case study in Nigeria, as a centralised federalism system is also applied to all government sectors, including waste management. Therefore, the study will consider the federal government as the core stakeholder in Nigeria's waste management system. However, this study will not consider the incineration enterprise as a core stakeholder because the incineration business and recycling are not yet grounded in the Nigerian waste management system, and this technology is not widely used; therefore, the study will focus on the core level, sub-core level and periphery stakeholders including the state and local government, recyclers (private sector), NGOs, academic and the public.

Because there are numerous actors involved in the current investigation, stakeholder theory is significant. All of the actors previously mentioned can influence the success or failure of municipal solid waste management in Nigeria but at different levels. Figure 2.5 shows the stakeholders involved in the waste management sector and how the stakeholder theory relates to this study.
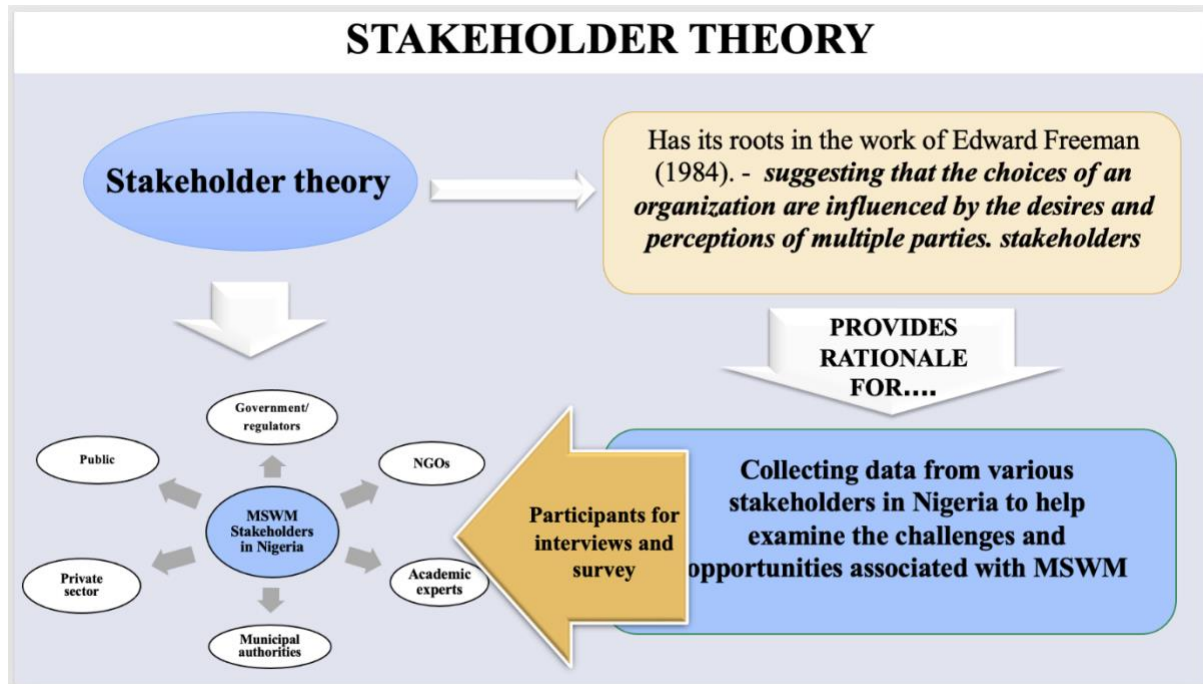
Figure 3.4 shows how stakeholder theory informs the study.

Source: (Researcher, 2023).

The Stakeholders in this study include the government (The Federal Ministry of Environment senior staff), The state and local government Ministry of Environment staff, the public and private sectors, NGOs, environmental activists, academics, and so on. Each of these stakeholders has different perspectives and expectations, and these perspectives may conflict. The system must strike a balance among the various stakeholders to develop a prosperous and inclusive waste management system. The study must collect and understand views from multiple stakeholder perspectives to attain this equilibrium in the Nigerian municipal solid waste management system.

3.7 Relevance of stakeholder theory in this Study.

The stakeholder theory also states that other stakeholders are relevant to the waste management system. These stakeholders are relevant alongside the critical stakeholders in the waste

management sector, and they must be included for the waste management value chain to be complete and adequate, so their views and perspectives are essential, as is their participation in decision-making. Schubert et al. (2020) used stakeholder and agency theory insights to investigate how non-profit leaders' perceptions of stakeholder power and representation are interrelated across various stakeholder groups and organisations. Therefore, this study conducts that due to their relevance to the research informing its methodology.

Theories	Relevance to study	Outcomes
Stakeholder theory	Stakeholder theory believes that all parties affected or influenced by a decision in an organisation are stakeholders and must be included in all decision-making process to achieve a successful outcome.	• The study will determine the level of inclusivity of stakeholders in making municipal solid waste management decisions. • It will help the study to understand stakeholders' different views and expectations to create a balance between all parties involved. Freeman (1984).

Table 3.3 shows how the stakeholder theories are linked to the current research.

The Table above explains the theories and expected outcomes from its connection to this research. The stakeholder theory is relevant to Nigeria's waste management sector because it provides a framework to identify and analyse the numerous stakeholders involved in waste management operations. Apart from the principal (federal government) and agents (state and local government ministries), other stakeholders, including NGOs, environmentalists, academics, waste consultants, private-sector actors, and foreign investors, play important roles in the waste management value chain.

The stakeholder theory helps identify the obligations and expectations of all relevant stakeholders critical to effectively managing municipal solid waste in Nigeria. Understanding the interactions and interdependencies between these stakeholders is crucial in achieving a successful waste management system.

Furthermore, the stakeholder theory also emphasises the importance of stakeholder engagement and participation in decision-making processes related to waste management. It recognises stakeholders' different interests and values must be considered in developing and implementing waste management policies and strategies. The stakeholder theory also informs the study's methodology, which includes collecting the views and perceptions of various

stakeholders to collect data from multiple municipal solid waste industry sectors and collect rich and robust data to make empirical conclusions.

3.8   Challenges affecting municipal solid waste management in Nigeria.

As a globally growing population crisis increases industrialisation and urbanisation, growth in waste generation will always be inevitable. The only viable solution to this growing problem is finding solutions to control it using a unique system suitable for every country or location, in this case, Nigeria (Farahbakhsh, 2013; Thomas-Hope, 2000).

This section will use relevant literature to discuss the challenges influencing municipal solid waste management in Nigeria. Literature has stated significant challenges that have greatly affected waste management, such as poor funding, corruption, lack of awareness, lack of education, etc. Numerous studies have also been carried out, indicating with evidence how dysfunctional the system has continued to become. This section mimics (Mahpour, 2018; Ezeah, 2010) by categorising challenges into factors considered when conducting implementation research they are behavioural, financial, institutional, legal and technical challenges.

3.9   Behavioural Challenges

During this literature search, people's attitude towards waste was one of the most mentioned challenges to have affected municipal solid waste management efficiency in Nigeria. In addition, studies cited the lack of awareness and education in schools. It was concluded by (Okoli et al. 2020; Abila and Kantola, 2013 Ogwu 2012, Agunwamba 1998) that lack of public awareness and lack of education are the most significant challenges in municipal solid waste management because they affect people's behaviour and attitude towards waste significantly.

Abila and Kantola (2013) argued that awareness needs to be improved among the Nigerian public. More efforts should be made to increase awareness of the potential negative impacts of waste on sustainable waste. This means that people cannot participate in waste activities because they must be aware of the risks involved. The relevant agencies and government must put in the effort required to enlighten and communicate with every reachable person. (Ezeah and Roberts, 2012b) went further to say that the lack of awareness is the most critical barrier constraining sustainable waste management in addition to the lack of awareness. This is a conclusion from his study.

However, as much as awareness is crucial in a waste management system, should other factors be in place before the public's attention is conducted correctly? For example, sufficient funds are required to complete awareness exercises; expertise must be well-trained to communicate effectively with the public, also requiring funding. So, If factors like funding are needed before creating awareness, then is public awareness the most critical challenge affecting municipal solid waste in Nigeria? This shows a gap in the waste management study. The relationship between these challenges must be analysed to determine their driving power and to understand what must be put in place first to create a functioning waste management system and structure in the value chain.

It was further mentioned that there need to be more communication channels, and the government should utilise media and posters instead of face-to-face practical interactions Abila and Kantola (2013). It means that the communication channels used to convey waste education to people need to be improved because meeting people one-on-one allows a more realistic approach to understanding the risks and how to participate in resolving them. This also tallied with a discussion by Agunwamba (1998), stating that the government and relevant agencies have not integrated human behavioural factors in waste management, meaning that they have not seen it suitable enough to be more proactive in educating the public towards changing and promoting a controlled behaviour towards waste.

In a study, Ifegbesan (2010) concluded that education is a prerequisite to achieving waste management success. He further said that environmental education needs to be integrated into the education curriculum in schools, especially secondary school curriculums, arguing that this will inform them about waste management and improve their behaviour and attitude towards personal waste practices. In line with this notion, Abila and Kantola (2013) said it is important to emphasise an education management approach to induce behavioural change towards waste management 2018.

Statistics show that the literacy rate of the Nigerian population was 62%, Knoema (2019). among educated Nigerians, not all are aware of the practice or any form of waste management, and Waste management is not a part of the educational curriculum in Nigeria. This leaves a smaller percentage of the population with an awareness of waste. In that case, how many educated people know the importance of proper waste management and its impacts? If so, where does that leave the remaining uneducated percentage?

Despite various searches on multiple databases, information in the literature or government reports was not found stating Nigerians' current general awareness level of waste management. This shows that the government needs to conduct research and development, monitoring, and evaluation to identify the people's level of awareness, including their demographic information. Also, should the government refrain from utilising research articles to acquire updates and current trends in developing waste strategies if monitoring and evaluation cannot be carried out? If this is done, they can identify areas that need more awareness campaigns and how. This indicates a gap in this study area, which needs to be carried out by the government or interested studies.

Some studies also believe that besides lack of awareness and education, cultural and religious beliefs are one of the challenges in waste management. It affects people's behaviour due to behavioural factors hindering implementation processes (Nabegu & Mustapha, 2014; Abila and Kantola, 2018). Some also argue that cultural and religious beliefs determine action behaviour (Chigbu, 2015). It was argued by Nabegu and Mustapha (2014) that Africa is known for their strong affinity to culture and religion, especially in rural Nigeria. Nonetheless, they agreed that several outreach programs have successfully educated people on health issues. For example, the World Bank outreach programmes, the Bill and Melinda Gates Foundation for tackling Malaria and polio and strengthening healthcare systems, and the Dangote Foundation. They believe that behaviour can be changed if awareness is consistently conducted.

Additionally, some argue that education is a prerequisite to achieving waste management success in Nigeria (Chigbu, 2015). He concluded that integrating environmental education in secondary school curriculums will inform them about waste management and improve their behaviour and attitude towards personal waste practices. In line with this notion, Abila and Kantola (2013) said it is important to emphasise an education management approach to induce behavioural change towards waste management. Although the public's attitude is believed to be the most crucial aspect of waste management (Abila and Kantola, 2013; Ezeah and Roberts, 2012; Nabegu and Mustapha, 2014), some studies have argued that financial constraints affect the entire success of waste management system. If that is the case, can it be said that finance is the most critical aspect of waste if it is a prerequisite to waste operations? This is discussed in the following section.

3.10 Financial Challenges

Nigeria is the largest country in Africa, with a GDP of 410 billion US dollars in 2019 (Trading Economics (2020). In addition, Nigeria is known to be one of the world's largest oil exporters. However, money has always been an issue in all its endeavours, and some will say it is due to mismanagement of funds and misplaced priorities.

From the early independence years, little attention has been given to the environmental sector because more emphasis is being placed on providing the necessities for citizens, like constant electricity and food. However, the government seems to have become accustomed to trivialising the sector where currently, the environmental industry takes a back seat during annual budget allocations. Consequently, the Nigerian ecological Management system is still plagued by low funding due to its low priority in the budgetary procedure. This affects the success of waste management in Nigeria (Amasuomo & Baird, 2016; Igbinomawanhia & Idaho, 2014; Abila& Kantola, 2019).

Several studies have identified inadequate funding as one of the significant challenges affecting the efficiency of municipal solid waste management systems in Nigeria (Winter & Ujoh, 2020; Salami et al., 2019). It was also argued that all waste management issues in Nigeria are because of a shortage of funds (Ezeah & Roberts, 2012). The point was further explained that the financial challenges faced in the waste management sector result from the country's generally poor economic status, including foreign exchange rates, lack of economic diversity, inadequate power supply, import dependency and so on (Winter & Ujoh, 2020). The poorer the economy, the lower the financing of the environmental sector, hence the waste management operations outcomes. Studies have shown that the waste sector generally depends on budgetary allocations to conduct waste operations.

For instance, a study in Port Harcourt reported that the state government is the sole financier of solid waste management, arguing that that system will never be sustainable Ayotamuno and Gobo (2004). Hence, charging the users is recommended to help unburden the government with finances on waste operations (Imam et al., 2008).

Studies have mentioned the need for a framework that guarantees cost recovery and return of investments to the waste management systems Winter and Ujoh (2020). The government can only recover the waste management expenses if there are returns on their investment. It was further argued that this problem is formed because of the people's unwillingness to pay for

waste services and council taxes to cater for waste operations. Total cost recovery is crucial (Cointreau-Levine, 1994; Winter and Ujoh, 2020). Hence, a functioning solid waste management system requires consistent funding.

Furthermore, Ezeah and Roberts (2013) critiqued the poor funding of waste management agencies, observing that a scarcity of funds often led to the purchase of substandard and old machinery for waste operations. It was further argued that the inefficacy of service deliveries is also because of non-payment for waste services by the masses (Awaisu, 2010; Adama, 2012). Therefore, studies have concluded that the lack of funding stems from several issues, including the incapacity to purchase new service truck collections, poor maintenance, unsubsidised waste storage containers, and equipment Sylvester and Ikudayisi, (2021).

Additionally, because of the low budgetary allocations, environmental agencies are incapable of performing their duties effectively, Ogwueleka (2009) argues that it also affects the remuneration of the agency workers, affecting their motivation levels to work well, hence the challenges to employ and retain experts in the waste sector. This is a crucial problem if a waste management agency needs more expertise to conduct operations.

It was argued that the main reason why waste management in developed countries works is that municipalities generate revenue from the fixed tax, environmental taxes, fine enforcement and promoting polluter pay principle Elebiju (2020). However, in most developing countries, Nigeria is non-existent. However, some urban areas, especially in the Federal Capital Territory, pay service charges, according to Daily Trust (2018). The statement hints that some locations in Nigeria are more inclined to pay for waste services than others. Only a little has been explained concerning payment for waste services based on site and how it affects people's ability to pay for them. Therefore, this study will bridge the gap by analysing if the area of the people has a relationship to the payment of waste services and how it influences it to happen.

3.11 Institutional challenges

Nigeria's institutional framework concerning waste management has been called out severely by (Sylvester and Ikudayisi 2021; Ezeah and Robert 2012; Usman 2013, Taiwo 2009). They have discussed issues concerning institutional challenges in various capacities; these include corruption, weak institutional framework, and scarcity of expertise. There is a link between the legal and institutional framework (Sridhar et al., 2017; Adama, 2007 Imam, 2008) because there needs to be adequate communication between agencies and the tiers of government. This

will prevent relevant stakeholders from conducting their responsibilities, and policy will not be communicated and implemented well. Does this mean no relevant stakeholders are included in the waste sector?

Some of these discrepancies in the institutional framework have resulted in situations whereby there is a lack of communication and coordination among staffing their relevant agencies, there is no proper communication in passing information, and workers are not fully aware of their responsibilities, creating a gap in information transmission from the government to the agencies and then on to the households and Local authorities do not communicate guidelines as directed. Also, (Igbinomawanhia and Ideho, 2014; Ijie 2018) discovered that waste policies formulated at both national and state level experience a gap in transmitting information on guidelines to households via local authorities as directed.

Another area mentioned by the literature that can affect the flow of communication and institutional functionality is the need for more expertise. For instance, it is no secret that there is corruption, nepotism, and abuse of power in Nigeria; several job positions are not appointed by merit, so it could be that some policymakers may not be qualified for their work to dictate how the waste policies should be developed. It could also be that effort is not put into deciding who the policy formulators are based on expertise and knowledge (Sridhar et al., 2017; Abila and Kantola, 2019) because Ezeah and Roberts (2013) also observed that the political class tends to interfere with general appointments including the environmental sector. This means nepotism, political affiliations, jobs, and political positions in Nigeria are primarily not awarded based on expertise or merit.

It was mentioned once that there could also be an issue with the multiplicity of agencies under the Nigerian Ministry of Environment, as pointed out by Ijie (2018). However, he could have explained how multiple agencies have affected municipal solid waste management. However, the issue of the multiplicity of agencies could have caused the lack of coordination and proper communication in relaying information to responsible agencies. This could cause confusion and more institutional challenges. A single environmental agency needs more structure, knowledge, and expertise, so a country like Nigeria might find it hard to control multiple agencies to which (Sridhar et al., 2017; Abila and Kantola, 2013) certainly agree.

Nigeria is known for its prevalence of bribery and corruption practices; it is no wonder that corruption has been mentioned multiple times by studies as one of the significant menaces affecting waste management practices. It has been at the forefront of Nigeria's

underdevelopment, causing a substantial impact on sustainable development. Unless contained, sustainable development and waste management might remain only a mirage, provoking dire consequences for the Nigerian economy (Usman, 2013).

Furthermore, it was also observed that concerning corruption, the officials responsible for environmental laws collect bribes, preventing them from complying with environmental regulations Agunwamba (1998). Corruption has always suppressed waste management regarding government officials syphoning public funds and bribery. It has become so bad that people do not take waste regulations and law enforcement seriously because they can give bribes to cover up their environmental offences; for instance, in Lagos state, people refuse to pay waste service bills and taxes but can bribe waste collectors to collect their waste and clear their garbage (Adewole, 1992; Agunwamba, 1998).

It was reported that market women must pay waste management operatives in Lagos before waste is removed (Taiwo, 2009). Nigeria still experiences having to bribe government officials to do their jobs. Also, truck pushers pay bribes to officials to allow them to dispose of waste at designated points, which is how illegal dumpsites spring up at random locations across Nigeria (Taiwo, 2009).

Nigeria's unemployment rate is at 33.5 % premium times (2020), making the labour market challenging. The level of corruption within political appointments contributes significantly to the problem of the need for more expertise in Nigeria's environmental system. The issue of corruption also includes politicians influencing decisions on waste facility locations for personal reasons and financial gain, which often leads to bad decisions and waste of resources (Usman, 2013).

The above statement leads to the issue of expertise in the Nigerian waste management sector. The agency workers responsible for implementing waste management are into bribes and need proper practical and ethical views on waste (Ogwueleka, 2009; Ezeudu & Ezeudu, 2019). Some workers in this sector lack the relevant knowledge and morals to know that allowing non-compliance will only cause more damage to the people paying the bribes. (Singh, 1995) argued that there needs to be more waste management professionals with the requisite knowledge and competence in Nigeria, and there is a shortage of expertise. Is it that the workers need to be trained better to be professionally and ethically sound? Or are the agencies and government just not strict with the working policy implementation and communication? This indicates that Nigeria's waste management institutional frameworks are weak. An institutional framework

must be valid for the policy to be implemented quickly because the institution holds the sector together. This means that there will also be policy implementation issues to deal with.

Moreover, various studies have discussed the issues of inadequate infrastructure to achieve a successful waste management process from waste generation to final disposal (Elemile, Ana, and Sridhar, 2017; Coker, Achi, Sridhar, and Donnett, 2016; Abd'Razack, Medayese, Shaibu, & Adeleye (2017). For instance, Elemile, Ana, and Sridhar (2017) said that Nigeria lacks the infrastructure for waste management operations, from recycle bins to adequately maintained vehicles and well-engineered landfills. Figure 3.6 illustrates a proper waste management infrastructural system.
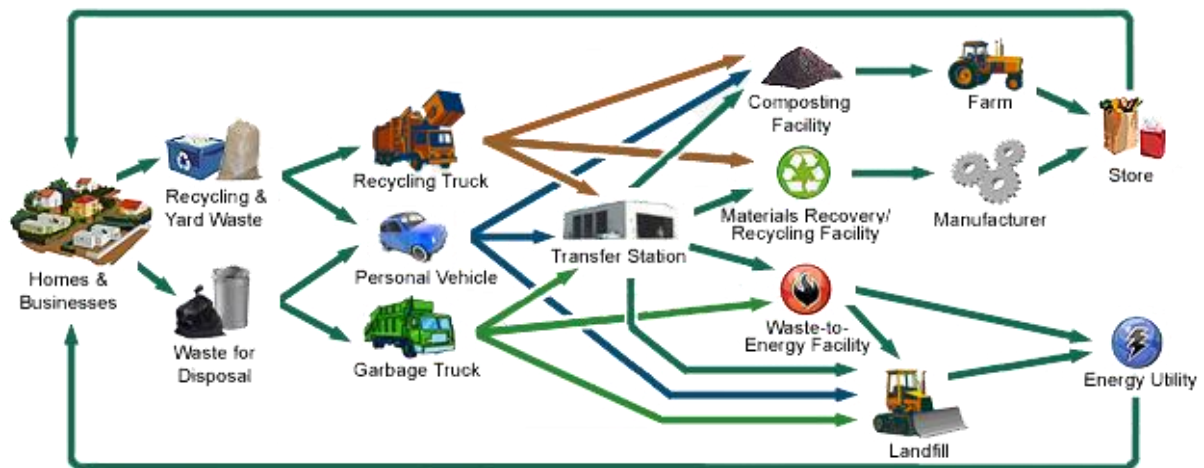
Figure 3.5: shows the solid waste management infrastructural process.

Source: The American society of civil engineers (ASCE, 2021)

The solid waste management infrastructural process begins from its source with the public, where waste is generated from their respective locations, be it homes or businesses and how they separate waste to be later handled by the experts thoroughly and appropriately.

Some studies have also evaluated to see if there is participation in waste separation activities despite the situation. Surveyed the residents of Kaduna state and concluded that they did not participate in waste separation but were aware of it. Another study by Coker et al. (2016) at Covenant University Ogun State concluded that no waste separation activities were conducted within the university grounds, and everything was dumped in one bin and transferred to a waste pit where informal waste pickers separated and sold to the secondary markets.

It is seen that various studies have discussed the infrastructural issues from generation to disposal, the lack of availability of bins, and the lack of efficient waste collection operations in Nigeria; however, it is now understood that Nigeria needs more infrastructure to promote source separation and recycling. Even so, the study is developing a framework that will indicate the variables that will be influential in promoting these activities since a national waste policy has been launched and includes the waste hierarchy Principle (Federal Ministry of Environment, 2020). This will create a roadmap for implementing such procedures.

3.12 Legal challenges

As discussed earlier in this chapter, the historical background of Nigeria's Waste policy indicates that some policies have been put in place but were not specifically for solid waste (Ogechukwu, 2020; Salami et al., 2019). Since the colonial era, implementation has been challenging for different reasons. Out of all the studies examined, only Dialoke and Ifeyinwa (2017) were seen to acknowledge and appreciate the presence of these waste policies, saying they were somewhat effective. However, assessments indicate that most literature still points towards poor policy formulation, incoherence, and ambiguity (Ezeah & Robert, 2012; Okoli et al., 2020). It was reported in the mentioned works of literature that the waste policies needed to be better documented, which was also attributed to a weak legal framework in Nigeria. Ezeah et al. (2012) further said that although policies were put in place regarding waste management, it was apparent that the policy documents needed more precise implementation. (Igbinomawanhia & Idaho, 2014) also believe that Nigerian waste policies must be more coherent and conform to modern waste best practices.

Some authors established that Nigeria's waste management system's critical challenges mainly lie in its institutional and legal framework (Sridhar et al., 2017; Adama, 2007 Imam, 2008). However, as much as the stated key challenges are valid, Nigeria's waste implementation problems reach factors far beyond only two elements; there are issues like behavioural factors and financial that have significantly affected the implementation of the waste operations. In a study on waste management in developing countries, the above claim limits the depth of the preceding impacts and could mislead the government from other critical challenges. Other studies concluded that even the implementation approach by the government is centralised and has hindered the prospects of a successful municipal solid waste system because the central government lack comprehensive knowledge to make informed decisions for local government areas and municipalities (Ndum, 2013; Sylvester & Ikudayisi, 2021). An efficient solid waste management system depends upon an adequate distribution of functions, duties, authority, and revenues between federal, state, and local governments and intra-urban entities such as municipalities (Schübeler, 1997). When essential tasks such as financial budgeting and revenue collection are centralised, but responsibility for operation and maintenance remains at the local government level, problems develop.

The constitutional strength of solid-waste management policy and implementation must be more robust and effective through adequate division of responsibility with monitoring (Sylvester & Ikudayisi, (2021).

The mentioned work of literature mainly discussed the incoherence of policy formulation (Ezeah & Robert, 2012; Okoli et al., 2020), but it was recently added stated that the main problem with waste policy in Nigeria is because of the absence of a solid waste management policy (Ogechukwu, 2020; Salami et al. 2019). The statement means that the problem was not mainly the policy formulation, but there was no policy specific to solid waste management in Nigeria. This is a crucial point because, In the earlier section about the history of waste management discussed in section 2.3, there is no specific policy that was created to deal with solid waste specifically management, but policies burrowed from the public health sector and the general environmental industry as well as the oil and gas sector. It was further explained that the policymakers in Nigeria need to gain relevant knowledge and expertise in waste management but are charged with formulating policy (Sridhar et al., 2017). Previously in this chapter, we discussed the institutional challenges of corruption and abuse of power, primarily when it affects the legal sector of policy formulation. This has led to a disruption in the institutional framework regarding waste management in relevant government agencies. This indicates how challenges are interrelated, and solving one critical barrier with high impact could also mean solving others.

3.13 Technological challenges

Studies have shown that Nigeria is lagging in technological advancement in all sectors, including the environmental sector (Abila & Kantola, 2013; Agwu, 2012). Although technology is essential, some studies believe it would be misleading to depend on technology to solve waste management problems because the country already lacks the technical expertise and applicable technology to use for waste management (Ionkova & Simonis, 2018). They explained that what is needed is the full utilisation of the workforce, beginning with an emphasis on awareness and education. It was similarly argued that Nigeria has an enormous availability of workforce that could be put to good use through employment in the sector with proper guidance (Abila and Kantola, 2019). The studies suggest that the Nigerian waste management system should be more people-centred than focusing on technology. This is a helpful suggestion because as it is to utilise technology, it needs funds, expertise, and maintenance, which we have seen in the previous sections 3.11.2 and 3.1.3 still need to be

improved. Instead, a basic functioning waste system should be the target, utilising the population to achieve results; then, technology can be used later for more advancements. Other challenges must be resolved before seeking full utilisation of technology. Therefore, it is important to investigate the challenges that have more significant influence and driving power to help decision-makers reach the level of proper utilisation of technology.

A study by the World Health Organisation WHO in 2015 mentioned that even the use of the waste hierarchy policy to manage waste is only sometimes advisable for developing countries due to its highly demanding nature for funding and technology. It advised that to reform a waste management system for low-income countries, a proper landfill plan must be applied before advancing to the following stages (WHO, 2015).

Various challenges that affect municipal solid waste management have been identified from the literature and classified into similar categories. During the analysis of these studies, Some gaps were identified, including.

3.14 Taxonomy Classification of Municipal Solid Waste Management Challenges in Nigeria

The diversity of the identified challenges highlighted by various studies must give a clearer picture of the most critical barrier. Forty-five challenges were identified from 15 works of literature in the above Table (Table 3.4). This will be challenging to identify and work on all challenges at once. The challenges were grouped into the implementation research study by Policy Project Policy Project (Peters et al., 2014; Health policy project, 2014; Contreras et al., 2010). Table 3.4 categorises challenges into the factors mentioned above. The Table also allows the study to accumulate the frequency of mentions for each identified challenge. For instance, this Table indicates that the legal challenges were most mentioned in the analysed literature. The elements mentioned under the legal challenges include policy documentation, policy ambiguity, over-ambitious policies, policy formulation, inadequate policies and legislation, policy incoherence, weak policy, and legal framework. Also, the second most mentioned category, according to the Table, is institutional challenges.

TAXONOMY	CHALLENGES
LEGAL CHALLENGES	1. Policy documentation (Ezeah,2010; Okoli et al, 2020) 2. Policy ambiguity Ijie (2018) 3. Over ambitious policies Ijie (2018) 4. Policy formulation (Igbinomwahia and Ideho, 2014; Sridhar et al, 2017; Ezeah et al, 2012) 5. Dialogue et al, (2017) 6. Inadequate Policies and legislation Amasuomo and Baird (2016) 7. policy incoherence Igbinomwahia and Ideho (2014) 8. weak policy Abila and Akintola (2013) 9. legal framework (Imam,2007; Adama, 2008) 10. absence of solid waste policy (Ogechukwu, 2020; Salami et al. 2018))
BEHAVIOURAL CHALLENGES	1. Lack of awareness (Agwu, 2012; Abila and Akintola, 2013; Igbinomwahia and Ideho, 2014; Amasuomo and Baird, 2016; Okoli et, al,2020; Ifegbasan, 2020) 2. lack of education (Abila and Akintola, 2013; Okoli et al, 2020) 3. lack of knowledge (Agwu, 2012; Amasuomo and Baird, 2016 4. Cultural beliefs Nabegu and Mustapha (2014) 5. Religious beliefs Nabegu and Mustapha (2014)
INSTITUIONAL CHALLENGES	1. lack of coordination and communication Ijie (2018) 2. multiplicity of agencies Ijie (2018) 3. Lack of expertise (Abila and Akintola, 2013; Sridhar, 2017) 4. Weak Institutional framework (Imam, 2007; Adama, 2008; Sridhar, 2017) 5. lack of implementation strategy Ezeah et al, (2012). 6. Corruption Okoli et al (2020)
FINANCIAL CHALLENGES	1. poor funding (Abila and Akintola, 2013; Igbinomwahia and Ideho, 2014; Amasuomo and Baird, 2016 Salami et al. 2018)
TECHNICAL. CHALLENGES	1. lack of advanced technology Okoli et al, (2020)

Table 3.4: Taxonomy Classification of municipal solid waste management challenges in Nigeria.

Source: (Researcher 2023).

Table 3.4 allows a clear identification of elements identified based on their categories. Judging by the number in each class, the study will be able to identify which challenges are frequently mentioned the most and by which author. This does not indicate the result of this study, but it suggests an idea of where these past studies are headed. It will later be compared to the variables from the data collected from the interviews explained in the chapter three methodology section. This Table represents the mentioned challenges showing the most mentioned challenges from reviewed Literature.

3.15 Overview of municipal solid waste management in developing countries

This section indicates the similarities in waste management practices among developing countries. As the world population grows, the rapid rise in municipal solid waste will continue to be a challenge globally (Ezeah, 2010). As established in the previous section, the higher the income and development of a country, the higher the amount of waste generated. This is to say that developed countries are at a higher risk of waste problems than developing countries due to population, consumption patterns and socioeconomic factors and economic strength (World Bank, 2019). However, ironically, the severity of the impact of waste generation is higher in developing countries where less waste is produced (Farahbakhsh, 2013). In contrast, developing countries need help with the initial stages of collection and removal (Di Maria, Lovat & Caniato, 2018). Advanced systems have worked successfully in developed countries but can hardly be accommodated in developing countries due to differences in policy, governance, socioeconomic status, and technological advancements (Farahbakhsh, 2013).

The rising problems in waste management are similar among developing countries (Hettiarachchi, Meegoda & Ryu, 2018). The reason is that they share identical historical backgrounds, socio-economic status, population growth, urbanisation and industrialisation rate (Diaz, 2011). The above-mentioned contributing factors make waste management more complex to handle beyond capacity resulting in inefficiency. Inefficiency in municipal solid waste management in most developing countries is attributed to the weak institutional framework, lack of expertise, poor staff welfare, lack of appropriate technology, lack of awareness, environmental indiscipline, and non-ethical disposal methods (Aderoju, Dias & Alberto, 2018).

Waste management challenges in developing countries also vary because some nations are more advanced. For instance, municipal solid waste management implementation is different and more successful in China. China is categorised as a developing country by the United Nations, but China has the advanced technology and funding required for waste management. However, Nigeria, alongside Ghana and the whole of Africa, including Ecuador, Sri Lanka, and Nepal, face at least one of the challenges mentioned earlier by literature in this section, including a lack of awareness, and it is said that developing countries need more awareness.

Table 3.5 shows a list of challenges from several developing countries obtained from various peer-reviewed journals searched through the University of Salford library databases, including Science Direct and Google Scholar, to find out if there are similarities between challenges affecting MSWM policy implementation among developing countries. The study has shown that developing countries show several challenges with similarities. The most noticeable challenges include lack of awareness and knowledge, poor funding, lack of enforcement, lack of technological advancement etc., which are suspected to most likely to be expected in the Nigerian context. Table 3.5 lists studies on developing countries and their respective municipal solid waste management challenges. Although developing countries have similar socio-economic atmospheres in waste management, there are some areas of disagreement within their contexts. For example, some authors have differing opinions on the use of technology in developing countries. For instance, Fabraksh (2013) argues that developing countries do not require innovative technology to run an effective waste management system but must utilise their workforce because they have the manpower. While some authors advocate for low-cost and appropriate technology options, like (Wilson, 2017) advocating for locally made technology to be used in developing countries for easy use and maintenance, he emphasises that if the technology must be used, then it should be made locally for easy use and maintenance. On the hand, others emphasize the need for advanced technologies to tackle waste management challenges effectively (Latika & Fernando, 2019)..

REFERENCE	COUNTRY	CHALLANGES	METHODOLOGY
(Haregu et al., 2017)	Kenya	• Corruption • Weak institutional framework • Weak regulatory enforcement	▪ Secondary data analysis using SWM policy documents and SWM policy reviews from gov't archives. ▪ 10 Focus group discussions ▪ Using 1225 heads of household from Mombasa ▪ 1158 heads of households from Nairobi household members ▪ 15 key informant, in-depth interviews
(Dangi et al., 2017)	Nepal	• Lack of gov't commitment • Lack of expertise • Absence of penalties for non-compliance	• Secondary data • Individual interview using 38 people having authority / responsibility in waste management. • Group interviews Using 336 households
(Vujic et al., 2015)	Serbia	• Corruption • implementation cost • slow economic development	• Secondary data Using govt reports
(Latika & Fernando, 2019)	Sri Lanka	▪ Lack of technology ▪ Poor regulatory framework ▪ Lack of awareness	▪ Secondary data analysis ▪ Interview and Focus group using 125 participants
(Abas, 2014)	Malaysia	▪ Poor governance ▪ Behavioural challenges ▪ Lack of enforcement	▪ Secondary data using government agency reports and policy documents
Amugs (2016)	Kenya	▪ Lack of regulatory enforcements ▪ Policy ambiguity ▪ Citizen's behaviour ▪ Lack of stakeholder participation ▪ Corruption ▪ Lack of awareness	▪ Secondary data analysis ▪ Interview ▪ Focus group. Using a total of 143 participants
(Moh & Manaf, 2013)	Malaysia	▪ Lack of information ▪ Insufficient data documentation ▪ Outdated data base	▪ Secondary data analysis using government report and journal Articles

Table 3.5: lists studies of challenges identifying municipal solid waste challenges in some developing

The above Table has highlighted that there are challenges affecting municipal solid waste in developing countries, and they include lack of enforcement, the people's behaviour towards waste, corruption, slow development and so on, lack of commitment of the government. Although the above-mentioned countries are also developing, there might be variations among them based on their socio-economic status and population as even the problems identified vary. This means that these countries may have a similar status in waste management as Nigeria but might be contextually different in terms of the impact of the criticality of the issue because each country has various factors that affect the degree of impact. For instance, Nigeria has a population of over 2011 million people, (Worldometer, 2020) and a GDP of 440 billion dollars and Malaysia has a population of just over 33 million people in 2021 with a GDP of over 372 billion dollars World Bank (2021).

The previous paragraph means that, with the high population in Nigeria, more waste will be generated. Hence, there will be greater waste issues in Nigeria than in Malaysia despite both being developing countries. Also, although Nigeria has a higher GDP than Malaysia, other relevant factors can affect performance in waste management, such as the government's political will to act, good governance, law enforcement, the right policies, and whether or not there is corruption in the country. In 2022, the Global Coalition Against Corruption ranked Malaysia 61st in the least corrupt nations out of the 180 countries evaluated. Nigeria ranked 150th among the 180 countries Transparency International (2023), while the same organisation ranked Nigeria. this means that Nigeria is more corrupt in the global corruption ranking than Malaysia, which raises the assumption that Nigeria is most likely more vulnerable to diverting funds from waste management activities to corrupt stakeholders.

Furthermore, most methods used to collect data include secondary data, interviews and focus groups. These might be useful in informing this study on data collection methods because understanding the current state of municipal solid waste will require experts with knowledge and experience in the sector. some of the methodologies also involve surveys, collecting data from the public who are key stakeholders in the waste management value chain, especially in their households, to get informed outcomes of the nature of waste the management situations from. Their methods indicate the relevance of the public in the waste management value chain

and the need for their involvement in waste management. The public's participation is discussed further in the next section.

3.16 Public participation in municipal solid waste management practices

This section discusses the relevance of public participation in waste management. It also shows the outcomes of studies conducted on public participation in Nigeria's waste management space. This is relevant to objective four of this study, to showcase why the analysis of public participation is essential to this research based on their relevance in the waste management value chain and contribution to the effectiveness of waste management systems. Studies including (Babaei et al., 2015; Chung and Lo 2004) argue about the relevance of the public's participation for any waste system to be efficient. For example, Babaei et al., 2015, emphasised that Public participation is a globally accepted element which is crucial for the success of any waste management plan, including source reduction and recycling. It is seen to have had attention globally, most likely due to its economic and environmental impacts. Chung and Lo (2004) Stated that it is worth noting that effective waste management begins with understanding the public's behaviour for compelling municipal solid waste management research besides providing waste management infrastructure. Therefore, he emphasises that three issues should be covered in waste management research, i.e., public participation, waste recycling/reduction, and public awareness of waste management. Therefore this study will investigate the factors mentioned above in the Nigerian context. Also, there is a range of other issues that have been researched on the topic of Municipal waste management, including the financial, technical, and legal factors (Beede and Bloom, 1995; Khalid, Arshad, Anjum, Mahmood, and Dawson, 2011; Kinnaman, 2009). Scholars believe that public participation and waste hierarchy activities are equally essential to be explored. (Beede and Bloom, 1995; Babaei et al, 2015; Al-khatib, 2015; Olukanni, 2020; Otoma et al., 2013; Ezeah (2012).

The issue of public participation in waste management has been recorded in developing countries, especially in Nigeria (Abila & Kantola, 2013). The focus on improving municipal solid waste management has been mainly on cost-effective waste management practices and not introducing the waste hierarchy system (De Feo and De Gisi, 2010; Krool et al. 2007). Despite the advantages of waste hierarchy in developing countries, implementation encounters social opposition, such as public participation and awareness in waste management activities

(Jamshid et al., 2011, Nasrabadi et al., 2008). This statement could be true for some developing countries. However, Nigeria has not yet introduced the waste hierarchy principle; hence, there is no record of opposition from the public on implementation, Although the principle has just been introduced in the new national policy, there are no studies recording source separation activities in the country. Therefore, since the study is investigating the current situation in this sector, it will investigate to see if there have been any effective implementations and changes so far.

Therefore, it is essential to focus on the experience and perception of the public in this study. Besides, the most economical way of waste reduction includes public awareness and encouragement to participate in the strategy of implementation (De Feo & De Gisi, 2010). Moreover, public participation in source separation activities strongly affects the realisation of recycling programs (Kereamitsoglou and Tsagarakis 2013; Krook et al. 2007).

The Assessment of public behaviour, including knowledge, attitudes, and practices, has been conducted extensively across a wide variety of literature, as explained in this section by Babaei et al. (2015). Various studies were conducted in waste management to explain the relationship between demographic variables and recycling involvement (Pakpour et al., 2014). Some residents often misunderstand complicated solid waste management programs, negatively impacting participation rates (Pakpour et al. 2014; Farahbakhsh 2013; Purcell and Magette 2010). Thus, gender, age, education, and income are commonly employed variables (Pakpour et al., 2014; Saphores et al., 2006).

It is essential for a study to understand the demographic data of a group of participants to understand the reasons for certain behaviours (Connelly, 2013). For instance, Vidanaarachchi et al. (2006) surveyed 1200 households in Sri Lanka about source separation and reduction in rural and urban areas. They discovered that most residents in Sri Lanka performed source separation, indicating they were aware of the topic. However, they did not assess the demographic data of those residents. This would have given more detailed data on the category of people performing source separation and understanding that of those who do not. Therefore, this study will bridge this gap in understanding how demographic data influence public participation in waste activities. The study will give decision-makers an idea of the groups and areas with awareness and participation challenges. It will also provide information on the

demography to focus on while resolving the various challenges of waste management in Nigeria.

Studies have been conducted to understand the public's perception of waste management in Nigeria. This includes their awareness level, level of participation and the ability to pay for waste services. For example, Olukanni, Pius-Imue, and Joseph (2020) conducted a study in Ogun state. It concluded that age plays a role in the public's awareness as maturity is a prerequisite for awareness of one's attention and knowledge of the environment, explaining that it means the respondents have the level of reasoning to understand the waste management concept.

3.17 Analysis of municipal solid waste drivers in some developed countries

A literature review was conducted to identify potential drivers for an effective waste management system. It provides a complete, exhaustive literature summary relevant to the research objective. This was also shown in some waste management studies (Moher et al., 2009; Mekenon 2022). The drivers are identified in some developed countries. These countries have successfully implemented municipal solid waste management and have succeeded in advancing their waste management systems by implementing waste policies and achieving expected outcomes. These countries include the United Kingdom, Japan and the European Union member states. The countries were chosen because they are world leaders in municipal solid waste in their regions. However, the European Union is not a country but a union governing 27 member states, including the most prosperous countries in waste management under its governance. Japan is also one of the leaders in waste management from Asia and the UK. For example, Wales and Great Britain are also leading in waste management on the global scene.

Indeed, numerous facets, from public environmental consciousness to government policies, have played essential roles in successful solid waste management. Thus, defining a common approach to analyse these drivers is difficult. This is primarily due to the differences between countries' realities in conducting waste management (Contreras et al., 2010). This means that there are variations in waste management practices that drive success in municipal solid waste management implementation among world countries. For example, the 28 member states of the European Union.

Although there has generally been significant success in the EU waste management systems, the success of the individual member states varies. In other words, some are more successful than others. Likewise, some generate more waste than others based on population and economic strength. The municipal waste generation rate per capita in the EU declined between 2005 to 2015, it increased in select countries like Germany, Croatia, Slovakia, and Denmark during the same period (European Federation of Public Service Union, 2017) (EPSU). This means that waste is not unilaterally generated and managed at the same pace at the same time, even among EU member states. However, general success rates have been recorded in all mentioned countries based on varying best practices that will be mentioned in other sections.

In managing waste, context must be analysed to be well understood; this includes the social, cultural, economic, political, legal, and physical environment and the institutional settings (Peters et al., 2014). Furthermore, understanding the waste management context of a particular location includes engaging diverse stakeholders in constructive policy dialogue to identify and address challenges appropriately for this reason. Therefore, this study also categorises implementation drivers and challenges into legal, financial, behavioural, institutional, and technical factors categorises challenges into legal, behavioural institutional, economic, and technological factors. The classification was also applied by Contreras et al. (2010), who used an analytical framework consisting of four general driver categories representing different areas related to solid waste systems. This taxonomic classification will clarify the opportunities matching each type of opportunity to the challenges at hand.

3.18 Legal drivers

The most common practice of municipal waste management in developed countries is the waste hierarchy principle consisting of reducing, reusing, and recycling, including the world's leading countries, i.e., the United States, United Kingdom, Portugal, and the European Union (world bank group, 2018: DEFRA, 2013: Chen, 2010: Pires and Martino, 2011). This concept originated from the European Union when it was introduced to the waste framework derivative in 1975 (European Commission, 2014). According to DEFRA (2011), The waste hierarchy positions waste management options based on what is best for the environment. In the 2011 report, DEFRA explained that the waste hierarchy prioritises preventing waste in the first place. When waste is unavoidably created, it gives priority to re-use; if not, then recycling, waste

recovery, and last of all, disposal (e.g., landfill, incineration). Figure 3.7 shows a waste hierarchy pyramid.

Figure 3.6: Waste hierarchy pyramid. It was adapted from the European Commission.

To achieve the waste hierarchy and effective waste management anywhere in the world, all stakeholders must participate to ensure success at all levels of the waste hierarchy, from households to business owners to agents to national and local governments. However, as seen in the earlier section 2 discussing the challenges, (Ogechukwu, 2020) mentioned that until the year 2020, there was no specific solid waste management policy in Peace (Ogechukwu, 2020), which means that Nigeria had no waste hierarchy policy solutions. Studies also mentioned that even the policies in use needed to be better formulated (Ezeah &Robert, 2012; Okoli et al., 2020). In developed countries, the relevance of policy and implementation has been widely understood, as well as how policy development and legislation require close and proper consultation among stakeholders to gain support and commitment and ensure their participation. However, previous research has established that in developing countries, policy wrongly focuses on the content of the reform and neglects the actors involved in policy reform (Walt & Gilson, 1994).

It is now well understood that establishing and passing environmental policy and legislation needs to be a gradual, consultative, and inclusive process where the public sector sponsoring the initiative reaches out to business owners, social groups, environmentalists, and the public

at large to come together and achieve the same target, (Kremena & Gerard, 2018). For instance, the E.U. goes through vigorous planning, well-coordinated policy development and consultation with the 27 member states, even though they are well aware that introducing ambitious policy plans may sometimes meet resistance from some individual member states Ionkova and Gerard (2018). In Nigeria, the issue of inclusion and ineffective communication was raised by (Igbinomawanhia and Ideho, 2014; Ijie 2018), where the institutions needed more proper communication to transfer guideline information to other entities. If this is the case, then policy will not be passed down clearly to relevant stakeholders.

Additionally, other countries such as the United States and China focus on stakeholder participation, especially during initial deliberations on waste policy, to ensure smooth decision-making that works for all stakeholders (Ebrahim & North, 2016: Chen et al., 2010). On the other hand, as a single entity, Japan focuses on consistency in critical policy reviews to improve policy formulation and strategic plans in promoting waste Hierarchy while including stakeholders (Ionkova & Gerard, 2018).

The UK also promotes the waste hierarchy principle. However, challenges have been experienced, giving rise to the need for consistent policy reviews (DEFRA, 2013). These are efforts in constant policy review, as seen in Japan, and this is a problem faced in developed countries.

3.19 Institutional drivers

A well-established institutional framework is required for waste management to thrive. Field Assane and Grammy (2003) support that good institutions improve efficiency and accelerate growth. Field Rodic (2010) further described that the strength and structure of an institutional framework are fundamental to good governance in solid waste management.

Concerning the institutional framework of waste management in Nigeria, (Sylvester &Ikudayisi, 2021; Ezeah & Robert, 2012; Usman, 2013, Taiwo, 2009) concluded that it is weak and lacks proper structure. For instance, the responsibility to carry out waste management is practically handled at the local level; countries in the EU have shown that successful waste management operations are achieved by making thoroughly planned locally managed operations (Kaza et al., 2018).

Nigeria handles the implementation approach centrally, and the local governments have no authority. Campbell (1999) mentioned that one of the issues faced in development is the need for a more robust institutional framework. It is assumed that if key stakeholders implement institutional change, spelling out clear responsibilities to implementors could strengthen institutions in developing countries.

The EU and the Japanese government have shown that proper coordination between the national government and municipalities improves the success of municipal solid waste management. They have developed a well-detailed plan describing roles and responsibilities assigned to all stakeholders in 'The Waste Management and Public Cleansing Act', where key responsibilities are well defined at all government levels (Ionkova & Gerard, 2018).

 The UK has also achieved success in waste management implementation by empowering local communities by creating a proper communication channel adequate between the multi-level arms of government; they also recognise that there is a need for joint collective work between the government and local authorities (Dreyfus, Töller, Iannello, & McEldowney, 2010). They guide local authorities and the waste management industry on all revised Waste Framework Directive requirements through the Waste and Resources Action Programme (WRAP) (DEFRA, 2013).

Zhou et al. (2019) reported that just like the UK, China has been using incentives as best practices to drive waste management; however, the UK's perverse incentives to downgrade waste collection services, absurd fines on householders causing clashes between householders and local authorities and too much data requirements burden on local authorities (DEFRA, 2013).

Local governments. However, as seen in the earlier section 2 discussing the challenges, Ogechukwu (2020) mentioned that until the year 2020, there was no specific solid waste management policy in Peace (Ogechukwu, 2020), which means that Nigeria had no waste hierarchy policy solutions. Studies also mentioned that even the policies in use needed to be better formulated (Ezeah & Robert, 2012; Okoli et al., 2020). In developed countries, the relevance of policy and implementation has been widely understood, as well as how policy development and legislation require close and proper consultation among stakeholders. However, previous research has established that in developing countries, policy wrongly

focuses on the content of the reform and neglects the actors involved in policy reform (Walt & Gilson, 1994).

It is now well understood that establishing and passing environmental policy and legislation needs to be a gradual, consultative, and inclusive process where the public sector sponsoring the initiative reaches out to business owners, social groups, environmentalists, and the public at large to come together and achieve the same target, (Kremena & Gerard, 2018). For instance, the E.U. goes through vigorous planning, well-coordinated policy development and consultation with the 27 member states, even though they are well aware that introducing ambitious policy plans may sometimes meet resistance from some individual member states (Ionkova & Gerard, 2018). In Nigeria, the issue of inclusion and ineffective communication was raised (Igbinomawanhia and Ideho, 2014; Ijie, 2018), where the institutions need more effective communication to transfer guideline information to other entities. If this is the case, then the policy will not be passed down clearly to relevant stakeholders.

Additionally, other countries such as the United States and China focus on stakeholder participation, especially during initial deliberations on waste policy, to ensure smooth decision-making that works for all stakeholders (Ebrahim and North, 2016: Chen et al., 2010). On the other hand, as a single entity, Japan focuses on consistency in critical policy reviews to improve policy formulation and strategic plans in promoting waste Hierarchy while including stakeholders (Ionkova& Gerard, 2018).

The UK also promotes the waste hierarchy principle. However, challenges have been experienced, giving rise to the need for consistent policy reviews DEFRA (2013). These are efforts in constant policy review, as seen in Japan, and this is a problem faced in developed countries.

3.20 Behavioural drivers

For behavioural drivers to influence a successful municipal solid waste management, resources and energy are channelled to strategies in managing public perception through knowledge and awareness of key stakeholders. This primarily translates to behavioural change (Jackson,2005; McKenzie-Mohr and Smith, 1999). Public attention has been one of the key drivers for successful municipal solid waste management. It is also the key to effective waste management

systems (Evison and Read, 2001; Vincente and Reis, 2008; Wilson, 2007), especially in promoting the waste hierarchy principle. This, however, is barely achieved in developing countries due to a lack of education, resources and consistency (Marshall & Farahbakhsh, 2013). Several works of literature have discussed the public's behaviour towards waste in Nigeria due to the same behavioural challenges mentioned above, including lack of awareness and public participation. This section shows the relevance of public involvement in waste management, which must be achieved to achieve a successful waste management system.

Unlike developing countries, the EU member states thrive due to effort and consistency in public awareness to gain public support and participation. Also, a field of dedicated staff with ample information and full knowledge helps to drive the process (European Commission, 2010). Similarly, it is seen that the Japanese government discovered that the best implementation drivers are high citizen participation, especially their voluntary efforts in source separation, which contributes not just to recycling rates but also reduces the cost of waste management (Ionkova & Gerard, 2018). Public awareness plays a crucial role in an inclusive waste management strategy.

Abila and Kantola (2013) argue that education is the other part of creating behavioural change. In some countries, the government's efforts in environmental education in schools have raised public awareness and increased adherence to waste regulations on disposal. Consequently, efforts have promoted high waste recycling levels in countries like Japan Hotta and Aok-Suzuki, (2015). Similarly, in 2017, China piloted this strategy using School education from the elementary level in Shanghai, where teachers are required to educate students on municipal solid waste and the students are required to return home and teach their parents what they learned Zhou et al. (2019). This has proven to be successful. Also, Countries like Hong Kong, the United Kingdom, and Germany leverage public awareness to get the public involved in waste activities and promote sustainable waste culture (Drazkiewicz et al., 2015; Lu and Tam, 2013).

However, besides environmental education, countries like the UK give incentives to encourage citizen participation. They recognise that to promote the waste hierarchy principle, householder behaviour must be changed to improve performance; they used incentives such as equipment

upgrades in community schools, lottery systems, etc. DEFRA (2006). In this case, there is a high level of awareness, but participation is critical.

3.21 Financial Drivers

Finance is a prerequisite to municipal solid waste management success (Ionkova and Gerard, 2018). Waste management depends heavily on financial input. For example, within the E.U., the high-income member states have achieved more waste management success and reached their targets in good time compared to the low-income member states, (Ionkova & Gerard, 2018). It was estimated by Hoornweg (2012) that municipal waste management takes up about 20% of the local government annual budgets in municipalities, and low-income countries need help with funding waste management. This could be because they need systems that allow revenue generation in cities aside from funding from the federal government. In Nigeria (Awaisu, 2010; Adama, 2012) argued that the inefficacy of service deliveries is also because of non-payment for waste services by the masses. For instance, Ayotamuno and Gobo (2004) reported that in Port Harcourt, the state government is the sole financier of solid waste management, arguing that that system will never be sustainable. This means that, in general, the Nigerian waste management sector only relies on budgetary allocations to function. Winter and Ujoh (2020) agree that an absence of a framework that guarantees cost recovery and returns of investments to the waste management systems will never be sustainable.

Generally, the federal government must provide subsidies for innovative waste activities. Likewise, the municipal government give grants to low-income households and other activities. However, in low-income countries like Nigeria, environmental agencies solely depend on government funding (Agunwamba, 1998), to which annual budgetary allocations do not serve their expected purposes due to corruption.

In most developed countries, municipal authorities generate revenue from tax collection. For instance, the EU uses the "polluter pays principle" Ionkova and Gerard (2018). The polluter-pay principle is a model where the waste producers are expected to pay for the waste they produce from households to businesses. This principle has been adopted in Switzerland, the United States, and the United Kingdom (Sweden, Jaligot & Chenal, 2018). However, recent evidence shows that some developing countries, including India, Malaysia, Taiwan, Ecuador, Chile, Costa Rica, Kenya, and South Africa, generate waste revenue. Still, the study suggests

that it primarily compensates victims of the environmental arm, not for waste project developments (Luppi et al., 2012). Revenue generation is a focus in Japan, too, through tax collection. The municipalities generate funds by making their citizens purchase plastic bags, for which fees are used for Waste management activities (Ionkova & Gerard, 2018). This will allow implementors to consistently focus on waste management planned projects and general daily activities without waiting for government allocations. Table 3.5 summarises municipal solid waste drivers and best practices in the three significant countries used for this study.

Developed by: (Researcher, 2022)

COUNTRY	LEGAL DRIVERS	BEHAVIORAL DRIVERS	FINANCIAL DRIVERS	INSTITUTIONAL DRIVERS
EUROPEAN UNION	Well-coordinated policy formulation by gradual, consultative, all-inclusive process including all stakeholder i.e. business owners, social groups, environmentalists, and general public (Lonkova & Gerard, 2018).	Introducing a field of dedicated staff with ample information and full awareness into the public to enlighten people (European Commission, 2010).	Generating income from using the polluter pay principle, pay as you throw, house, charge based on extra services. Sweden. (Jaligot & Chenal, 2018; Ionkova & Gerard, 2018)	Initiating a thoroughly coordinated operational system planning approach at local level (Kremena & Gerard, 2018)
JAPAN	Constant review of waste policies using comprehensive reports and meeting policy targets, constant waste hierarchy policy evolution (Lonkova & Gerard, 2018).	Aggressive and consistent awareness schemes, dedicated staff on field creating awareness, environmental education in schools at all levels, promoting high level of public participation. source separation enforcement (Lu and Tam, 2013).	Revenue generation through several streams including, plastic bags sales and government subsidy for promoting plans to improve waste management. (Lonkova & Gerard, 2018)	Developing well detailed plans clearly stating role and responsibilities for stakeholders from national level to the public.
UINITED KINGDOM	Data collection, monitoring, and evaluation for constant policy review (DEFRA, 2013)	Use of incentives to promote participation and improve behaviour towards waste hierarchy (Drazkiewicz et al., 2015; DEFRA, 2016).	Fixed Tax (Jaligot & Chenal, 2018).	Empowerment of local authorities, frequent training of local staff (DEFRA, 2016)

Table

Table 3.6: shows identified municipal solid waste management implementation drivers in developed countries.

Table 3.5 above is an indication of many strategies that can be adapted to serve as solutions to various waste issues. For instance, applying the polluter-pay principle is very common among these countries. According to Aguwamba (2012), Nigeria only generates funds through budget allocations. However, Lovonko and Gerard (2018) have explained that a proper waste management system must create a revenue generation stream to function and achieve increased development.

The studies in the literature have shown the basic nature of a waste management system. The system involves various socio-economic factors involving various stakeholders at different levels and stages of the waste management value chain. Studies in the literature have conducted research involving the public, informal sector, experts and so on. This indicates that for any information or data to be obtained about waste management, the input of the stakeholders is required to conduct the research. Even the secondary data used in studies were initially collected as primary data using data collection from actors who are all relevant stakeholders in the waste management value chain. Therefore the study begins to ask how to investigate using multi-stakeholder perceptions. After investigating suitable theoretical underpinnings concerning stakeholder involvement, the study will utilise the stakeholder theory to inform the research methodology. the stakeholder theory is discussed in the following section.

3.22 Gaps in the Literature.

So far, no contradictions or debates have been found about the issues and challenges affecting municipal solid waste in Nigeria. It is a collective agreement, though, in different versions, that waste management is in a poor state, as discussed in various literature. However, these challenges have never been analysed in-depth to investigate how they relate to and impact the success of waste management in Nigeria. Therefore, the gaps found after the literature review are as follows:

i)   Most recent studies on municipal solid waste management in Nigeria are scarce. The studies reported in this PhD thesis add to Nigeria's sparse evidence base for solid waste management.

ii)   Studies have not evaluated the criticality of Nigerian municipal solid waste management challenges in Nigeria.

iii)   Previous studies have not empirically identified potential opportunities for waste management in Nigeria. This thesis has presented significant advancement in the literature by identifying global best practices and collating expert opinions to propose a framework for effective solid waste management in Nigeria. Studies previously conducted have not investigated the public's general awareness and participation level in Nigeria holistically nor analysed the public's ability to pay for waste services.

iv)   Existing studies seemed to have generalised the challenges and drivers of sustainable waste MSWM. Still, different countries have different socioeconomic, institutional, and cultural realities that could influence how people experience such factors.

v)   There is a lack of a comprehensive framework to guide stakeholders and policymakers to decisions towards improving MSWM. Therefore, this study will bridge the gap.

3.23 Addressing the Knowledge gaps in this study

This research addresses critical knowledge gaps significant to stakeholders, including policymakers, researchers, practitioners, and the wider community. It addresses knowledge gaps across various domains, from policy formulation to cultural understanding and sustainable practices to community engagement. Doing so offers practical insights and recommendations that can guide stakeholders at various levels toward more effective and sustainable waste management in Nigeria, ultimately benefiting the wider society and environment.

i)   **Policy Formulation and Implementation:** This research fills the knowledge gap for policymakers and government agencies by providing empirical insights into the specific challenges and opportunities within Nigeria's waste management landscape. It offers a nuanced understanding of the socio-economic, cultural, and environmental factors influencing waste management practices. This information is invaluable for formulating evidence-based waste management policies, regulations, and guidelines tailored to Nigeria's context, thus bridging the gap between policy formulation and implementation.

ii)   **Effective Resource Allocation:** Policymakers often struggle with resource allocation for waste management projects due to the limitation of resources. The study can help

fill this gap by offering data-driven recommendations through the conceptual framework that showcases the challenges affecting municipal solid waste management at different levels of criticality and influence indicating where and how to allocate resources effectively. By identifying the key challenges and opportunities, policymakers can prioritise interventions that are likely to have the most significant impact on waste management outcomes.

iii) **Behavioural Insights:** Understanding the cultural and behavioural factors that influence waste management practices is essential for policymakers and practitioners. This research delves into these aspects, providing insights into why certain practices persist and how they can be changed. This knowledge can inform the design of public awareness and sensitisation campaigns for behaviour change programs.

iv) **Sustainable Practices:** For researchers and practitioners in the field of waste management, this research contributes to filling the knowledge gap regarding sustainable waste management practices in Nigeria. It identifies successful strategies from other well-developed countries in the waste management sector, that can be adapted to the Nigerian context. This can guide the development of practical, innovative, and sustainable waste management solutions.

v) **Capacity Building:** Capacity building is a crucial aspect of improving waste management. Researchers, NGOs, and international organisations working in Nigeria can use the findings to design training programs and capacity-building initiatives. By addressing specific areas of need identified in the research, these stakeholders can empower local communities and organisations to manage their waste better.

vi) **Cross-Country Learning:** Waste management challenges are not unique to Nigeria; many developing countries face them. Researchers and policymakers in other nations can also benefit from the research findings. By understanding the factors contributing to success or failure in waste management in Nigeria, they can draw lessons applicable to their contexts. This can inform their decision-making on waste management issues as they share similar socio-economic as Nigeria.

vii) **Community Engagement:** Community involvement is essential for the success of waste management initiatives. Through quantitative studies, this research identifies ways to engage communities effectively, including key groups most influential in driving effective waste practices and building on cultural norms and practices. This

information can be valuable for community leaders, NGOs, and local organisations working on waste management projects.

viii)   **Environmental and Public Health:** Stakeholders concerned with environmental conservation and public health will gain insights into the specific environmental and health impacts of poor waste management practices in Nigeria. This knowledge can be used to advocate for improved waste management to reduce environmental pollution and health risks.

3.24 Chapter Summary

In this chapter, there was an overview definition of waste and , municipal solid waste. Also, the theoretical framework found suitable to guide this research that is the stakeholder theory which encourages the involvement of all stakeholders to achieve diverse and effective outcomes terms municipal solid waste management in developing countries to give an idea of current similarities and differences in waste management among the countries. The chapter has shown vast data and information collected through various literature. During the literature review, the study has identified several differences and similarities in opinions among authors concerning municipal solid waste management in Nigeria.

The study identified challenges affecting municipal solid waste management in Nigeria, through findings from some Nigerian authors. As discussed earlier in this chapter, these challenges included a lack of funding, awareness, waste education, expertise, policy formulation issues, poor policy implementation, etc. The study grouped the elements into a taxonomic classification, categorising all the factors under similar themes, including financial, legal, institutional, behavioural, and technological challenges, as shown in Table 3.4. No specific process was followed in the method. However, the study identified a pattern where behavioural and legal difficulties were the most mentioned in the literature. The same was done for developing countries when opportunities were identified.

The study also conducted a literature review on select developed countries with success in waste management. The countries include the EU member states, the United Kingdom and Japan. Each was chosen based on their steady success in waste management operations. This was done so that lessons could be drawn from them to identify what drivers and best practices are suitable to be adapted and utilised in Nigeria based on the Nigerian context. Several drivers

were identified and summarised in table 3.5 , e.g, policy reviews, awareness, partnership with local authorities, stakeholder inclusivity, and fixed tax were all identified. As mentioned in the previous section, these were all categorised into a taxonomic classification. the table comprises of the challenges affecting municipal solid waste management identified in literature including the authors that discussed them. This chapter also addresses the gaps identified withing the reviewed literature as well as the value this research brings in addressing these gaps. Table 3.5 summarises municipal solid waste drivers and best practices in the three significant countries used for this stud

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x)   There is a lack of comprehensive or framework to guide for stakeholders and policy makers to decisions towards improving MSWM. Therefore, this study will bridge the gap.

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x) **Effective Resource Allocation:** Policymakers often struggle with resource allocation for waste management projects due to the limitation of resources. The study can help fill this gap by offering data-driven recommendations through the conceptual framework that showcases the challenges affecting municipal solid waste management at different levels of criticality and influence indicating where and how to allocate resources effectively. By identifying the key challenges and opportunities, policymakers can prioritise interventions that are likely to have the most significant impact on waste management outcomes.

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LITERATURE REVIEW

(e.g. Ezeah, 2010;Ijie, 2018; Sridhar et al, 2017; Amasuomo & Baird, 2016; Igbinomwahia & Ideho, 2014; Abila & Akintola , 2013; Adama, 2008; Ogechukwu, 2020)

LEGAL CHALLENGES
- Policy documentation
- Policy ambiguity
- Over ambitious policies
- Policy formulation
- Inadequate Policies and legislation
- Policy incoherence
- Legal framework

(e.g. Ifegbasan, 2020; Okoli et al, 2020; Agwu, 2012; Amasuomo & Baird, 2016; Nabegu & Mustapha, 2014)

BEHAVIORAL CHALLENGES
- Lack of awareness
- Lack of education
- Lack of knowledge
- Cultural beliefs
- Religious beliefs

(e.g. Ijie, 2018; Sridhar, 2017; Abila & Akintola, 2013;Ezeah et al, 2012)

FINANCIAL CHALLENGES
- Poor funding

(e.g. Okoli et al, 2020; Igbinomwahia & Ideho, 2014; Amasuomo & Baird, 2016)

INSTITUTIONAL CHALLENGES
- Corruption
- Lack of coordination & communication
- Multiplicity of agencies
- Lack of expertise
- Weak of institutional framework
- Lack of monitoring
- Lack of implementation strategy

(Okoli et al, 2020)

TECHNICAL CHALLENGES
- Lack of advanced technology

Challenges

MSW IMPLEMENTATION

Drivers

e.g., Lonkova & Gerard (2018); DEFRA (2013)

- Awareness and education
- Incentives/Penalties
- Enforcement
- Stakeholder participation
- Investment in infrastructure
- International corporations.
- New/ advanced technologies
- Continuous monitoring and evaluation
- Detailed feasibility studies
- Strong government structure
- Privatisation
- Good governance
- Capacity building
- Timeline commitment

What are the GAPS

- ❑ *Previous studies have identified common challenges of MSWM without analysing the criticality of the challenges.*
- ❑ *There is limited empirical studies analysing the challenges of MSWM in Nigeria and improvement opportunities*
- ❑ *Previous studies did not capture the opinions of various relevant stakeholders (in the MSWM sector in analysing findings).*
- ❑ *Previous studies did not analyse the general awareness and participation level of the public in waste management.*

Figure 3.7: shows a summary of the literature review.

The Figure also shows the best practices that have driven developed countries, countries including the 27 EU member states, the United Kingdom and Japan to successful waste management systems. It also highlights the gaps that were identified in the course of reviewing the literature which will be bridged in this study suitable methodological approaches for the study.

Also, there was an overview of municipal solid waste management in developing countries to give an idea of current similarities and differences in waste management among the countries. Studies have been seen to discuss the problems associated with Nigeria's municipal solid waste but there are few studies on this particular topic, of which relevant literature are only found over ten years back. Except for Schubler (1997), no studies have been seen to develop a current framework highlighting Nigeria's current state of waste management. This can help guide decision-makers into making decisions on waste management using current data. Therefore this study will collect primary data from experts about the current state of municipal solid waste in Nigeria and its development. framework using the collected data.

Additionally, a literature review was done on public participation and studies highlighted the relevance of public participation in waste management including public participation. However, there were no data on the general results of the public's awareness level of waste and its impacts. No studies analysed the level of public revenue generated by the public and the rate of people's participation in the entire nation. Therefore this study will bridge those gaps using some theoretical frameworks that have been found relevant in informing the methodology of this study.

Chapter 4: Methodology

4.1   Introduction

In this chapter, the study discusses and justifies the methodological approaches and data collection methods while considering the aim, objectives, and research question. After an in-depth look into the research's philosophical assumptions, qualitative and quantitative methods are used to answer the research question: what is the current status of municipal solid waste management in Nigeria? Both methods are used because in-depth qualitative data is required for the study, and subsequently, quantitative data is required to validate the qualitative data outcomes. Also, the study is conducted through a multistakeholder engagement, including experts and the public, constituting different modes of data collection and analysis.

From the reviewed literature, it was discovered that municipal solid waste management faced several challenges. However, those challenges were only mentioned and discussed without being further investigated to determine the criticality of the challenges and identify empirical information on contextualising potential solutions to address the challenges. Thus, a quantitative approach was necessary to collect data from a group of experts to inform the study on the current state of municipal solid waste management in Nigeria, including its challenges and opportunities. Furthermore, research in the literature did not validate their findings about the public's attitude towards waste to assess the public's general level of awareness and participation. Thus, quantitative data was required to consult the public to thoroughly grasp the issues. As a result, a mixed-method approach was employed.

The chapter will explain the study's research methodology, methods, and justifications. This includes the philosophical stance of the study and a detailed explanation of the mixed method approach in the study regarding explaining what, how and why.

4.2   Definition of Research

The research was defined by Smith (1981, p.585) as a 'disciplined enquiry" that needs to be effectively conducted and reported with logical arguments so it can be carefully examined. It was also defined by Creswell (2014) as "a process of steps used to collect and analyse information to increase the understanding of a topic or issue". For research to be successfully

conducted, specific steps involve the study's philosophical adoptions before deciding on research strategies. Antwon and Kasim (2015) stated that research is grounded on underlying philosophical assumptions about what creates 'valid' research and what research methods are appropriate for developing knowledge in a study. Studies use some tools to help guide them in making those decisions.

Tools illustrating methodological approaches have been widely used to determine a study's methodology for instance, Saunders et al. (2015) research onion has also been widely used successfully by doctoral candidates to defend their PhD thesis. Likewise, this study will use the Saunders research onion to map its methodology. Figure 4.1 is a diagram of Saunder's research onion showing layers of methodological options for studies to choose from based on the nature of their study.
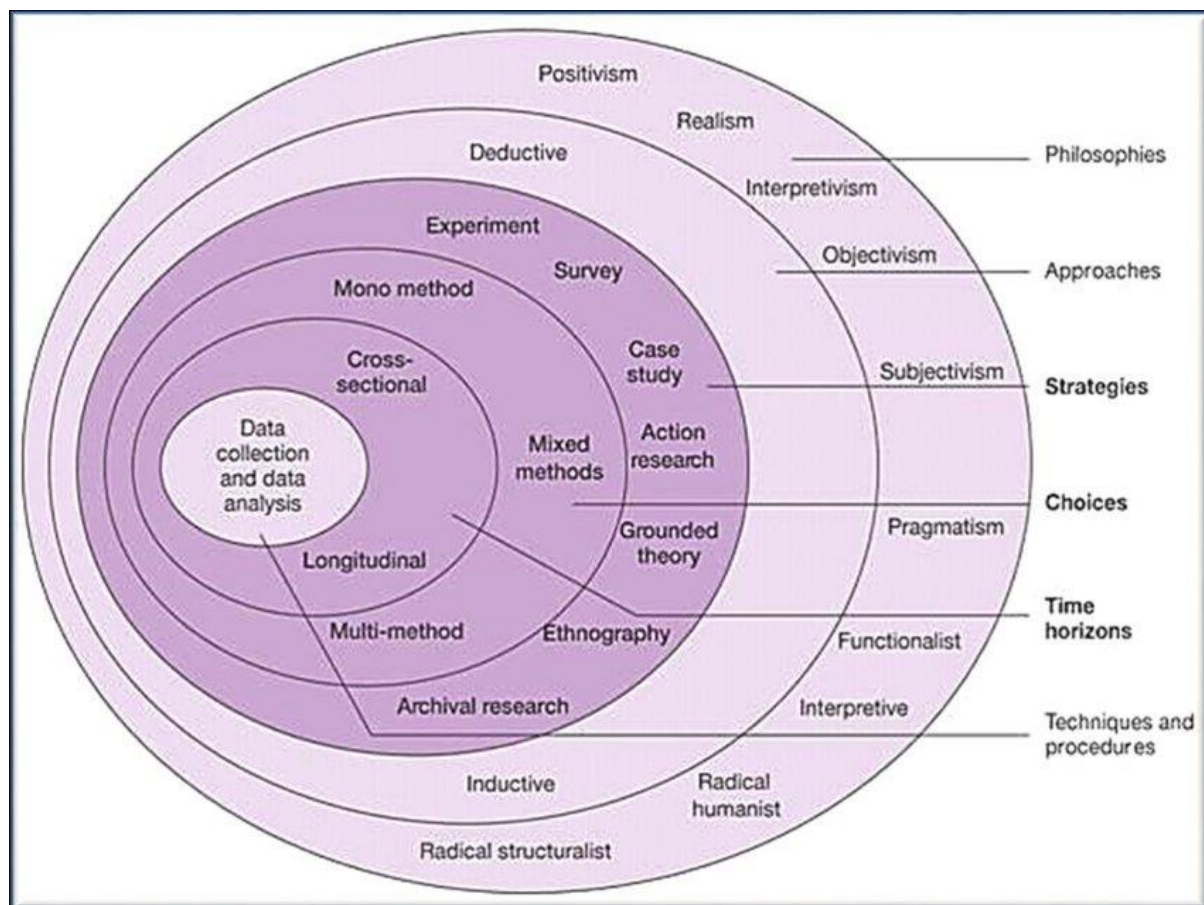
Figure 4.1: Saunders research onion.

Adapted from Saunders et al. (2012)

According to Saunders et al. (2012) research onion, the research consists of six main layers for a study to determine what strategies, designs, and approaches to take for the study. The layers include the research philosophy, research approach, research strategy, research design, data collection methods etc. All layers will be explained, including the chosen methodologies and research methods, with justification in further sections, starting with the philosophical stance. This research utilised this onion as a guide to understanding the different layers of research study. this study has learned from the opinion that the study's philosophical stance must first be determined, then the study's approach, and its strategies down to the analysis techniques, Therefore this stud begins by explaining its philosophical stance.

4.3 Philosophical stance

Research philosophy refers to a system of beliefs and assumptions about knowledge development (Saunders, Lewis, & Thornhill, 2009). It refers to the philosophical assumptions or fundamental beliefs that guide the actions and define the study's worldview (Lincoln et al., 2011). Patton (2002) states that it is a way of thinking about and making sense of the complexities of the natural world. The philosophical stance is formed on certain paradigms or views of the study. The research paradigms offer the study an insight, foundation, and direction on the methodological bearing of a study (Black, 2006).

4.3.1 Research Paradigm

The research paradigms are characterised by how a study responds to three basic ontological, epistemological, and methodological questions" (Guba, 1990, p.17). The world has different philosophical views based on its perceived ontology and epistemology. Thus, the epistemology and ontology of this research are discussed in the following sections.

4.3.2 Epistemology and Ontology

The epistemological stance is the initial essential element that needs to be stated as it directly impacts the research methodology, thus providing a rationalisation for the specific techniques used to collect data in research methods (Carter & Little, 2007). Epistemological paradigms consider the appropriateness of the research methods used to reveal knowledge (Saunders,

Lewis, & Thornhill, 2012; Creswell, 2013), while Ontology deals with what is considered reality to the study based on the assumptions that a topic can either be viewed subjectively or objectively (Farquhar, 2012; Bryant and Lasky, 2007).

Ontology is about the perception of truth, a branch of philosophy based on reality perception (Saunders et al., 2016). Ontology also relates to the values a study believes about what is known as accurate and what others believe to be realistic (Bryman, 2008). For Ontology, the study asks questions like what is being studied, while epistemology asks about the basis of prior knowledge in the study (Bryman and Bell, 2013; Saunders et al., 2012). This means that, despite the difference of opinion in knowledge among studies, it is affirmative that, in finding the truth about human behaviour and that of nature on a topic, the epistemological and ontological choices are unavoidable regardless of how facts and information are chosen to be represented. The ontology of this research is a subjective and an interpretive epistemological standpoint, which will be further discussed in the following sections.

In the reviewed literature for this study, it is evident that data was collected from experts in the waste management industry and the public to understand their experience in the waste sector. For example, Haregu et al. (2017) collected data from 15 key informants through in-depth interviews, ten focus group discussions, and a survey from household members in Nairobi and Mombasa, all consulting people for their subjective views. Similarly, Latika and Fernando (2019) conducted a waste management study in Sri Lanka, collecting data via interviews, focus groups, and surveys that highlight the crucial role of actors' subjective perceptions based on their experiences in waste management studies.

Therefore, this study's epistemological and ontological stance is an interpretivist approach and subjective view that acknowledges the importance of the stakeholders' opinions in the waste management value chain. They are the ones who can give an account of events and socio-economic issues faced in the sector. This stance recognizes that the subjective experiences and perceptions of the participants are valuable sources of data for understanding the complex nature of waste management issues.

4.4 Research Philosophy

The types of research philosophies and their characteristics are based on the influence of the research paradigms discussed in the previous section. The four research philosophies categorised based on the epistemological paradigm that Creswell (2013) presented are positivism, realism, interpretivism and pragmatism. These philosophies possess strengths and weaknesses, as highlighted by Farquhar (2012). Thus Farquhar (2012) warns that for each philosophy applied in research, there must be an emphasis on applying consistency and rigour throughout the process to increase the study's validity and minimise bias in the research findings.

Apart from the main philosophies mentioned above, there are various other social science paradigms, including naturalism, functionalism, Ethnomethodology, Role theory, Micro theory and Macro theory, conflict paradigm, feminist paradigm, Marxism, Neo-Marxism Etc., some of which have been approaches taken by studies in various studies (Hattery, 2009; Kalina, 2020). This study will explain three basic philosophies by Creswell's (2013) list of philosophies. Although the above-mentioned philosophies are highly unpopular in the waste management sector; Marxism was found to be used by Kalina (2020) to conduct critical observation of intellectual trends within waste management in Sardinia. However, the study will discuss the main philosophies mentioned above.

4.4.1 Positivism

Positivism is a scientific method that values objectivity and proves or disproves hypotheses (Ryan, 2018). According to the Positivist's view, it is assumed that positivism may be applied to the social world on the assumption that "the social world can be studied in the same way as the natural world, that there is a method for studying the social world that is value-free, and that explanations of a causal nature can be provided" (Mertens, 2005, p.8). In basic terms, Partington (2002) stated that positivism assumes that every study is a spectator of the object or topic of inquiry and that the subject's reality is independent of the study's beliefs, perceptions, and biases. Therefore, excellent research consists of uninterrupted observation records of the process using efficient means of investigation.

Furthermore, it is believed by positivists that to attain quality assurance in a research body, and there must be observation rigour using proper systems of cross-referencing Partington (2002). Thus, to ensure the validity and reliability of collected data, a study must think objectively in its research process. Positivism, as we now know it, is on extreme ends with interpretivism both epistemologically and ontologically; however, there has been an emergence of another type of positivist approach which evolved from the positivist approach called post-positivism, also known as methodological pluralism (Morris, McNaughton, & Mullins, (2009). This approach has moved away from the purely objective stance of strict logical positivists and is more interested in subjective reality, like the interpretivist approach. The post positivists believe that not everything is entirely knowable (Krauss, 2005).

Though positivism is found not suitable for this study, various studies have been found to use a positivist approach. For instance, Frempong, Chai, Ampaw, Amofah and Ansong (2020) took a positivist approach to the research to assess the relationship among customer operant resources, online value co-creation and digital branding through electronic word-of-mouth in the Ghanaian waste collection industry.

4.4.2 Pragmatism

The pragmatist philosophy believes that in interpreting the world correctly, there is not only one but different approaches to undertaking research (Saunders et al., 2012). The world may have various realities attached to it, and a single point of view cannot paint a picture of the world's realities (Obiora, 2020). Additionally, the pragmatist believes in actions, circumstances, and outcomes, contrary to the positivist philosopher, who believes in antecedent events (Bryman & Bell, 2013).

The supporters of the pragmatic viewpoint argue that the most critical factor of a research strategy is not necessarily the epistemological and ontological aspects but the research questions (Bryman, 2012; Saunders et al., 2012; Simons, 2009). The pragmatic approach rejects positivism and interpretivism as separate views; instead, it integrates both approaches into one unit for a research study.

The idea of a pragmatic approach is not just to use multiple methods in research but to utilise any suitable methods that ultimately answer the research questions in the study, using reliable data collection methods (Maxwell, 2010; Kelemen & Rumens, 2018).

4.4.3 Interpretivism

Interpretivism is the ideal approach for this study because it believes that the world is subjective and knowledge and circumstances are socially constructed by people (Chu, 2007). In this study, there is an emphasis on the people's perception based on their knowledge and experience on the topic. Regarding its ontological, epistemological, and methodological foundations, the interpretive paradigm primarily adopts a relativist ontology. Based on its epistemology, the interpretive paradigm is grounded upon the belief that knowledge is socially constructed Nelson, Groom and Potrac (2014).

Contrary to the positivist approach, interpretivism fundamentally rejects the belief that the social world, including people, cultures, social practices, and public institutions, can be assessed and understood through the assumptions and methodologies of natural science Nelson, Groom and Potrac (2014). In illustrating this point, Popkewitz (1984) elaborated, To an atom, the language of culture means nothing. However, to people immersed in Azanda or American life, the ideas, concepts, and languages of interactions create ways of expressing and defining the possibilities and limitations of human existence.

The interpretive perspective, then, is primarily based on the premise that the social world is complex and that people, including studies and their research participants, define their meanings within their various respective social, political, and cultural surroundings (Jones and Wallace, 2005; Markula and Silk 2011. P.31; Purdy and Jones, 2011). However, epistemologically, positivists believe that the study and the world are separate, with the world existing regardless of the study's presence (Bryman, 2008; Howell, 2013). Additionally, a positivist, Rene Descartes, suggested that opinions, values, and beliefs might be false, inaccurate, and not securely established, even if people accept them. Therefore, a vital point of the philosophical difference between positivism and interpretivism relates to how each approach examines and explains human behaviour Bryman (2012).

Ontologically, interpretivism rejects the opinion that the social world consists of hard, concrete, and relatively irreversible facts that can be observed, measured, and known for what they are, Sparkes (1992). The previous point ultimately means that no defined patterns can define a situation, and it is never stagnant or irreversible. Situations change based on human nature and other factors that may affect them. Therefore, interpretivist study believe that the social world is constructed within the subjectivities of an individual's interests, opinions, emotions, and values, Sparkes (1992). Therefore, interpretive studies concluded that the only way to investigate the certainties that exist in people's thought process is via personal interaction, most especially concerning impacts of a person's life and its corresponding values of theories that they subscribe to, that is both implicit and explicit (Sparkes, 1992; Kelchtermans, 2009). Accordingly, those following an interpretive approach believe that research is a subjective, collaborative, and interactive activity that involves both the investigator and the investigated (Guba and Lincoln, 1994; Howell, 2013).

The interpretive paradigm identifies that our opinion of reality may be subjective to several political, cultural, and social factors supporting such understandings (Stryker, 2002; Howell, 2013). From this perspective, social reality is the product of how people, individually and collectively, interpret their social world (Smith, 1989; Markula and Silk, 2011). Subsequently, this logic process is not reflected as a fixed and stable phenomenon, and it can change based on an individual's experience and logical capacities Sparkes (1992). Also, the kind of meaning an individual assigns to situations is constantly open to revision, as situations can be re-interpreted based on some changes in oneself, experiences, and other people's behaviours, sometimes contradictory to one's initial opinions (Biestaet, Hodgkinson, Macleod, and Goodson 2011; Goodsonet al.2010).

The interpretivist approach is particularly well-suited for this study due to its emphasis on understanding the perceptions and experiences of stakeholders. To gain deep insights into stakeholder's perspectives on the topic of waste management in Nigeria, it is essential to connect with participants on a personal level. This connection is primarily achieved through one-on-one conversations, employing suitable means of data collection such as in-depth interviews and surveys.

Critics often argue that the interpretivist approach yields findings that cannot be readily generalised and is limited to subjective qualitative analysis. However, it is important to note that the interpretive paradigm is not inherently limited to qualitative methods alone. In fact, there is a growing recognition that, in certain cases, a combination of both qualitative and quantitative methods, known as a mixed methods approach, can enhance the comprehensiveness and depth of interpretive studies (Creswell, 2003).

Numerous studies have successfully employed mixed methods within an interpretivist framework, demonstrating its versatility and applicability (Bernardi, Keim and Von der Lippe, 2007; Burton, 2004; Nee, Sanders, and Sernau, 1994; Sandelowski, 2000). As some may argue, it's crucial to understand that mixed methods research is not exclusive to pragmatism. Recent studies, as articulated by Gobo (2023), emphasise that various research paradigms, including interpretivism, can effectively utilise mixed methods approaches to achieve their research objectives.

Furthermore, the core of this research centres on leveraging the perceptions and experiences of social actors, aligning perfectly with the tenets of interpretivism. For instance, qualitative data is collected through interviews with experts, while quantitative data is gathered through surveys targeting the wider public to capture their perceptions and experiences related to waste management in Nigeria. While pragmatism is often associated with mixed methods due to its flexibility in incorporating both quantitative and qualitative data, it's important to recognize that interpretivism is also amenable to this approach.

The interviews serve as a means to collect narrative data, extracting rich details from the conversations to provide a profound understanding of the participants' viewpoints. In parallel, quantitative data acts as a complementary tool, helping to validate and corroborate the findings derived from qualitative sources. However, it is paramount to emphasize that the qualitative data takes precedence in this study because the primary focus centres on the insights and narratives provided by experts during the interviews.

Finally, the interpretivist approach, when combined with a mixed methods research design, offers a powerful framework for this study. It allows for a holistic exploration of stakeholder's perceptions, providing a nuanced understanding of waste management in Nigeria that extends

beyond a simple dichotomy of qualitative versus quantitative data collection. Through this approach, the research can attain robust data and gain deeper insights into the multifaceted dimensions of the subject matter. Table 4.1 shows the main research paradigms discussed in this study and their common data collection methods.

Paradigms	Methods	Data collection tools
Positivists	Quantitative. "Although qualitative methods can be used within this paradigm, quantitative methods tend to be predominant" (Mertens, 2005, p. 12)	Experiments, Quasi-experiments, Tests, Scales,surveys
Interpretivist (Utilised for this study)	Predominantly qualitative methods but quantitative methods may also be employed.	Interviews, Observations, Visual data analysis, survey
Pragmatic	Both qualitative and quantitative methods may be employed. Methods are matched to the specific purpose of the research	Tools from both the positivist and interpretivist paradigms may be used. For example, interviews, observations, tests, and experimentation.

Table 4.1: shows the main research paradigms.

Adapted from McKenzie and Knipe (2006)

Table 4.1 implies that the paradigm and research question should be used to identify whether research data collection and analysis methods are best suited to a study. Studies are neither quantitative, qualitative, nor mixed methods studies in this way; rather, a study may use the data gathering and analysis methods that are best appropriate for a certain research topic. It is possible for any and all paradigms to use mixed techniques rather than being bound to a single approach, which may potentially weaken and limit the depth and richness of a research effort.

Some paradigms may still direct a study to favour either qualitative or quantitative approaches. It has been argued that both quantitative and qualitative research methods need not be distinguished, and it can, in fact, be argued that to some degree, almost every study represents a multiple methods research study, Onwuegbuzie and Hitchcock (2015). However, this may not be agreed upon by studies who are strongly affiliated with a particular research approach. For instance, Trauth (2001) claims that interpretivism is the lens most frequently influencing the choice of qualitative methods. He believes that an interpretivist approach is synonymous with qualitative data collection, but there are some reservations against such views. Myers and Avison (2002) argued It should be clear that the word qualitative is not a synonym for interpretivist approaches.

Furthermore, many studies, including (Creswell, 2003; Thomas 2000, and Krathwohl, 1993), see qualitative and quantitative data collection methods as complementary, choosing the most appropriate methods for the investigation. Almost certainly, in each paradigm, both approaches need to be applied if the research is to be fully effective Mackenzie and Knipe (2006). Mackenzie and Knipe (2006) explained that quantitative data might be employed to support the qualitative data and essentially strengthen the narrative in an interpretive approach. The study agrees that all necessary data collection methods should be utilised to acquire rigorous and robust information because the strictness of the approach will most likely limit the acquisition of robust information as a result, less effective results. Hence, this study utilises a mixed-methods approach for data collection.

The interpretivist approach is used in various waste management studies. For instance, Johansson and Osterman (2017) took an interpretivist approach using mixed methods to explore Conceptions and operational use of value and waste in lean manufacturing. Also, Peres

(2016) took an interpretivist approach to investigate the interactions of waste pickers on the streets of Cape Town and the consequences for the agency. The most common factor in these studies is the involvement of social actors in acquiring information. For example, other waste management studies like Bowan and Mumuni (2013) used an interpretivist approach in a waste management study in Ghana, employing a mixed-method approach that included interviews, surveys, and focus group discussions. They argued that the approach is required to provide details about the circumstance and comprehend the reality of the problem. Menon and Palackal (2021) took an interpretivist approach in their analysis of stakeholder engagement in municipal solid waste management in India, doing a multi-stakeholder analysis and discussing the many elements of stakeholder participation in municipal solid waste management.

Similarly, this study incorporates a multi-stakeholder engagement and requires experts from various waste management sectors and the public's perspectives on the current municipal solid waste management situation. This will include the previously specified data collection forms, such as interviews and surveys. As a result, an interpretivist approach is appropriate.

The rationale for integrating both data collection methods within one study is that both quantitative and qualitative methods are sufficient to capture the details of a research Ivankova, Creswell, and Stick (2006). Primarily, this study employs the approach to adopt thorough research to arrive at accurate results. (Green, Caracell and Graham 1989; Miles and Huberman 1994; Tashakkori and Teddlie 1998) also believe that, when combined, the two methods (mixed method) complement each other and allow for a more robust analysis while taking advantage of the strengths of each other, in this quantitative study method is a priority while the survey complements it.

The quantitative study is used to access a larger group of stakeholders (public) to better understand the current situation of municipal solid waste management in Nigeria and understand why some of these challenges occur from those who are meant to benefit from it. A survey is ideal for public participation. Fowler (2013, pg. 2) stated, "Survey research is aimed primarily at tapping the subjective feelings of the public". However, Ivanova et al. (2006) acknowledge that the mixed-method approach could have certain disadvantages, such as time limitations and the actual feasibility of data collection. The study's research approach is further discussed in the following section.

4.5 Research approach

The two main research approaches for analysis are inductive and deductive. They are referred to as "Two broad methods of reasoning, the inductive and deductive approaches by Trochim (2006, p.1). He defines an inductive approach simply as moving from the specific to the general and deductive, starting with the general and then the specific. Creswell and Plano Clark (2007, pg.23) state that an inductive study is someone that begins work from the "bottom-up, using the participants' views to build broader themes and generate a theory interconnecting the themes," while a deductive study "works from the 'top down', from a theory to hypotheses to data to add to or contradict the theory".

The main difference between these two approaches is based on whether the study collects data to test existing theories (deductive) or generates a theory (inductive) based on analysis of the data collected (Saunders et al., 2012). Additionally, both approaches are known to have some general similarities. Onwuegbuzie and Leech (2005) indicate that data collected from both approaches emerge from research questions based on some observation. They also indicated that both approaches would undergo data analysis and interpretation for verification to find meaning.

The study utilises an inductive approach mainly because it is more suitable for data collection than a deductive approach. This is because, to begin with, waste management, especially in Nigeria is a complex and dynamic field, and various factors may affect the management practices in different contexts. Because of the country's increased population and economic growth, there are rapid changes occurring in the sector which previous studies may not capture in their own time and current informed data is constantly required to make informed decisions. Hence, it is necessary to collect and analyse data from the ground up to develop a comprehensive understanding of Nigeria's current waste management practices and its underlying factors.

The study requires collecting data from real-world observations and experiences and will then generate theories and hypotheses based on the patterns and themes that emerge from the data outcome. This approach will allow the study to explore new ideas and perspectives that may not have been previously considered and identify key themes and factors relevant to this study.

While the deductive approach may be useful in some cases, it may not be as effective in this study, as it may not capture the complexity and diversity of Nigeria's waste management practices and the factors that affect them.

4.6   Research methods

The most important factors that influence a study's decision on research methods are Philosophical assumptions, research questions, research objectives and the type of data required for the study (Saunders et al., 2012). The three major research approaches are quantitative, qualitative, and mixed methods (Saunders et al., 2012; Bryman & Bell, 2005; Yin, 1994; William, 2007). The mixed methods research is the chosen data collection method for this study. The mixed methods are used because the study requires both qualitative and quantitative data. However, the qualitative method takes precedence and is the main focus of the research.

4.6.1   Qualitative and Quantitative methods.

Qualitative research involves discovering and formulating theories, Marvasti (2008). Qualitative data involves description, explanation, interpretation of data and formulation of new theories, which makes it less structured than quantitative data, (Leedy & Ormrod, 2001). In a (2004) article, Creswell described qualitative research as an unfolding method occurring in a natural setting, enabling the study to develop highly detailed data from involvement in the experience. Qualitative research allows the study to investigate an experience of a topic from the viewpoint of the participants.

This study used qualitative data through in-depth interviews to obtain detailed information to identify variables on the challenges affecting municipal solid waste management in Nigeria among experts. The interviews have enabled the first part of the research question and objective to be examined.

On the other hand, quantitative research is utilised in response to relational questions of variables within the research topic. It begins with a problem statement, hypothesis formation, a literature review, and data analysis (Marvasti, 2018). It was stated by Creswell (2003 p.18)

that quantitative research "employ strategies of inquiry such as experimental and surveys and collect data on predetermined instruments that yield statistical data".

Quantitative data is used in this survey to validate the statement made by the experts from the qualitative data outcome. The quantitative data is collected from the public and they are the key stakeholders directly affected by waste management impacts. The results will help confirm or contradict the challenges identified in objective 1. The quantitative survey is ideal because Williams (2007) says that the result of a quantitative approach can be predictive, explanatory, and confirming. Also, Leedy and Ormrod (2001, p.102) stated that, for a qualitative approach, "the intent is to establish, confirm, or validate relationships and to develop generalisations that contribute to the theory". In Table 4.2 below, the qualitative and quantitative methods are linked to the objectives that emerged and why they are both required as the data collection method for the objective, for instance,

Objectives	Research methods	Data collection
To identify the current state, key challenges affecting municipal solid waste management in Nigeria. To evaluate the criticality and level of influence of the identified challenges. To highlight the opportunities that can be utilised to potentially resolve the waste challenges in the Nigeria context	Qualitative method	In-depth Interviews (online)
To examine the public's perception and experience of waste management experience in Nigeria	Quantitative method	Survey (online questionnaire)

Table 4.2: Linkages of research objectives to research methods

The qualitative data will satisfy objective 1, the investigation of the key challenges affecting municipal solid waste management, It will satisfy objective 2 which is evaluating the criticality and level of influence of the identified challenges. Finally, the qualitative data will satisfy objective 3 which is identifying the opportunities that can be utilised to potentially resolve the waste challenges in the Nigeria context. The quantitative data will satisfy objective 4, examining the public's perception of waste management perception and experience in Nigeria by collecting quantitative data from the public via surveys. As seen in the previous sections, this study combined both qualitative and quantitative data collection methods; therefore, thus took a mixed-method approach combining both methods for robust and in-depth data. Table 4.3 describes both strengths and limitations of qualitative and quantitative approach.

Methods	Features	Strengths	Limitations	Linked objectives
Qualitative method	Aims for a study acquire detailed, rich, and robust data that enhances knowledge of the topic. For instance, one on one in-depth interview conducted in the study allowed study to ask questions to acquire for more in-depth details.	Collects data with detailed and descriptive account of knowledge experience and of a topic inductively without premeditated answers.	- Increased potential of bias. - Lacks objectivity. - Results may not be generalisable due to a small number of participants.	(Interviews-Objective 1): To collect and examine a detailed account of key challenges. Affecting municipal solid waste management in |Nigeria. Nigerian context.
Quantitative Method	Research is conducted without study's influence on participants. For instance, survey questionnaire used in the study were filled without study's presence.	More objectivity in research and reduces the potential of bias, yielding more generalised results.	- Yields little information or no information of behaviour towards a topic. - Does not provide a detailed account of topic.	Objective 3 to determine the level of awareness and participation of the public in municipal solid waste management activities in Nigeria.

Table 4.3: Strengths and limitations of qualitative and quantitative methods.

Sources: (Creswell & Plano, & Clark 2011; Smith, 2015; Creswell, 2014)

Qualitative research is a sort of research that investigates and delivers more in-depth insights into real-world issues. Qualitative research collects information about individuals' experiences, perceptions, and behaviour. It might be designed as a stand-alone study depending solely on qualitative data or part of a mixed-methods study combining qualitative and quantitative data (Tenny et al., 2017). This study requires qualitative data because in-depth interviews collect in-depth robust data from a group of experts. It will help in gathering robust details on the exact situation in the Nigerian waste sector because there is a flow of information during an interaction between the study and the respondent and the study can ask follow-up questions to gain a deeper understanding on a point made. However, as shown in the above Table, with qualitative method there is a potential bias in the subjective views of the respondents. For instance, an expert working with the ministry of environment can be biased in their responses about the government's inadequate performance to defend their actions, or an activist can dismiss any efforts made by the government to prove a point based on their own criticism.

On the other hand, quantitative research involves collecting data so that information can be quantified and subjected to statistical treatment to support or refute "alternate knowledge claims" (Creswell, 2003, p. 153). Quantitative research also entails data gathering, which is often numerical, and the study's data analysis process is typically mathematical models. This study requires quantitative data to validate or serve as an alternate claim for the qualitative data. The quantitative method is helpful in this research because it allows the study to collect data from many participants. However, it does not often yield much information, no follow-up questions can be asked, and the respondents cannot give on their experiences in great detail.

The primary difference between qualitative and quantitative approaches is the ability to explore claims to knowledge and used to answer specific sets of research questions. In contrast, the quantitative method tackles an objective form of reality and the qualitative method a more subjective form of reality Williams (2007). Both approaches have their strengths, limitations, and goals, as described earlier. The mixed methods approach aims to utilise the strengths and minimise the limitations of the quantitative and qualitative research approaches (Johnson & Onwuegbuzie, 2004). Thus, combining the two methods can help to overcome some of these

limitations and provide a complete and more accurate picture of municipal solid waste management practices.

4.6.2 Mixed method

A mixed-method approach is defined by Creswell (2014) as a methodology for conducting research that involves collecting, analysing, and integrating both quantitative and qualitative research in a single study or a longitudinal program of inquiry. It integrates both methods to better understand a research problem than either research approach (Creswell, 2011). It was also defined by Tashakkori and Creswell (2007) as research in which the investigator collects and analyses data, integrates the findings, and draws inferences using qualitative and quantitative approaches in a single study or a program of inquiry. Both definitions are very similar, and the most important word used in these definitions is integration, which infuses both methods to work as a Single unit in research.

As discussed in the previous sections, this study uses a mixed methods approach to data collection. The mixed method research is used in this study because it will allow both data collections to attain extensive information and perception of a broader range of stakeholders. For example, in this study, the qualitative data will provide rich descriptions of expert's knowledge, experiences and insights into the factors that influenced the success or challenges of municipal solid waste management in Nigeria, while the quantitative data can provide validation with objectivity to the claims made by the experts. The study will achieve enhanced validity by using different methods (Tashakkori & Creswell, 2007). The research can enhance the validity of its findings. For instance, after the state of municipal solid waste management is highlighted and challenges are identified through interviews with experts, the quantitative data with validate those challenges mentioned by the experts through surveys to consult people to confirm or refute the claims made by the experts.

As the philosophical stance of this research, interpretivism, has been primarily related to qualitative collection methods, many studies reasonably believe studies should be positioned in either a qualitative or quantitative approach (Rossman & Wilson, 1985). However, Howe (1988) believes that this division has produced studies that constrain their works with this disruptive belief, working with a single approach and perpetuating the Incompatibility Thesis, which postulates that paradigms and methodologies can never be integrated. However, this

opinion has been rejected as untrue by those who believe that epistemology does not state the data collection and analysis method in a research study (Cohen, Manion, & Morrison, 2007; Onwuegbuzie & Leech, 2005). Thus, research can be viewed from a cohesive perspective of Onwuegbuzie and Leech (2005), in which the research question determines the methodological approaches to be employed in a study (Tashakkori & Teddlie, 2003).

After a comprehensive review of the literature, it has been shown that mixed methods research has been employed in various waste management studies. For instance, Goonan, Mirosa and Spence (2014) used mixed methods to understand reasons for hospital food waste before consumption and offer recommendations on waste minimisation within food services, Nzeadibe, Anyadike, and Njoku-Tony (2012) used a mixed methods approach to evaluate vulnerability and quality of life assessment of waste picking in urban Nigeria, Ajayi et al. (2017) also investigated Critical management practices influencing on-site management of waste minimisation in construction projects using a mixed methods approach, with evident successes the utilisation of mixed methods approach in waste management research, it will also be employed in this study to gain rigour and robust data. Creswell (2008) suggested that for a mixed method design to be utilised, specific approaches need to be considered beforehand, that is, the sequence of implementing the data collection methods, which method takes priority, and when the data will be integrated. Likewise, Takkashori and Teddy advise the study to answer these questions before proceeding to mixed methods research, as shown in Table 4.2.

4.7   Criteria for mixed methods

To avoid an incredible selection of mixed method design, Tashakkori and Teddie (2008) advised studies to undergo the five steps outlined in Table 4.4, Showing how the step was practical in selecting a suitable mixed method design for the study.

Having confirmed a mixed method approach as the chosen method of data collection, (Kroll and Neri, 2009) state that not only identifying the data collection method is crucial, but it is also essential for a study to map out the research process such as aim, priority, sequence and integration. Tashakkori and Teddie (2008) proposed five questions the study must address at the planning stage of mixed methods research. The questions include a sequence of data collection, priority among used methods, and integration stage. Table 4.4 demonstrates how

this study answers these questions as part of the research process and the different typologies in mixed-method research in the following section.

Key steps	Relevance to study
1. Do the research objectives or research question require mono or mixed method design?	Yes, a mixed method approach is required due to the nature of the objectives.
2. Are both qualitative and quantitative data required for the study?	Yes, the research objectives require a mixed method design, for instance, Objective1, 2 and 3 require a qualitative approach (in-depth interviews, discussions respectively) and objective 3 requires a quantitative approach. • Objective 1 seeks to identify the current challenges affecting municipal solid waste management. • Objective 2 highlights the criticality of the identified challenges. • Objective 3 identifies the opportunities to potentially resolve challenges affecting the identified challenges. • Objective 4 requires a quantitative approach to examining the public's perception and experience on waste management in Nigeria.
3. Have the different typologies of mixed method design been considered?	Yes, the study reviewed the different typologies associated with mixed method, the chosen research design is a concurrent triangulation design explained in; Chapter 3.
4. Which type of data collection takes priority in the study?	The qualitative method takes priority in this study.
5. At what stage will the qualitative and quantitative methods be integrated?	The qualitative and quantitative methods will be integrated at the discussion stage.

Table 4.4: Criteria for selecting mixed method approach.

Adopted from Tashakkori and Teddie (2008)

4.8   The implementation sequence.

Mixed method data is collected either sequentially or concurrently. In sequential studies, one data collection method is collected after the other sequentially, whereas, in concurrent studies, both data collections are conducted at the same time Concurrently (Kroll and Neri, 2009). This study is conducted sequentially, where the quantitative data was collected based on the outcomes of the qualitative data.

4.8.1   Priority

Priority determines if the quantitative or qualitative method is emphasised more in the study (Creswell, 2003). Kroll et al. (2005) reserve priority as the relative weight assigned to qualitative or quantitative methods components. For instance, in exploratory research, the qualitative method discovers variables. It may be subsequently studied quantitatively, while the quantitative method is given priority in explanatory research, where the quantitative method substantiates findings. This study uses exploratory research because the qualitative data is first collected, leading to the quantitative data collection (Creswell et al., 2003).

4.8.2   Integration

It is stated by Kroll and Neri (2009) that an actual mixed-method design includes a purposeful integration of qualitative and quantitative methods. Bryman (2006; Creswell and Plano Clark (2011) acknowledged that integrating quantitative and qualitative data can considerably improve the value of mixed methods research. Fetters, Curry and Creswell (2013) explained how qualitative data could be employed to evaluate the validity of qualitative results. In contrast, quantitative data can also be used to explain findings from qualitative data. For this study, the latter is applicable. According to Fetters, (Curry & Creswell, 2013), mixed methods integrated results can be at the design, methods, or interpretation level. The study integrates both methods so the quantitative data can validate the qualitative data. These studies are integrated at the discussion stage of the thesis. The decision for integration can be made based on four typologies of mixed-method designs. What is the exploratory sequential design, explanatory sequential design, parallel concurrent design, and embedded concurrent design

approach? Table 4.5 explains the four typologies of mixed method design, which determine the integration stage of a mixed method design, showing the design types and stages of integration of qualitative and quantitative data.

4.9   Mixed methods research designs

Four main research designs are further subdivided into sequential and concurrent designs (Creswell, 2010). They are convergent parallel concurrent design, Embedded contemporary design, Explanatory sequential design, and Exploratory sequential design. In this study, the exploratory sequential design is used because the quantitative data is formed as a result of the qualitative data outcome, which means the interviews are first conducted and the result necessitates further research among a wider audience hence a survey data collection.

Design type	Data collection timing	Phase of Integration	Weight of data
Explanatory	Qualitative then quantitative (Sequential)	Interpretation Phase	Usually quantitative but can qualitative or equal
Exploratory	Qualitative then quantitative (Sequential)	Interpretation Phase	Usually qualitative but can be quantitative or equal
Triangular	Qualitative and quantitative at the same time (Concurrent)	Interpretation or analysis phase	Preferably equal but can be qualitative or quantitative
Embedded	Concurrent and sequential	Analysis phase	Qualitative or quantitative

Table 4.5 shows mixed-method research designs.

Adapted From Creswell et al. (2003) in Tashakkori and Teddlie (2003) and Creswell and Plano Clark (2007)

Based on Table 4.5 and the methods of data collection utilised to satisfy the research objectives 1, 2, 3, and 4. The exploratory sequential design is the most suitable mixed method design for

the study because the quantitative data emerges based on the outcomes from the qualitative data Creswell et al. (2003).

4.10 Chosen research design.

This mixed-method approach will be a sequential exploratory design. According to Creswell and Plano Clark (2011), in exploratory sequential design, the study first gathers qualitative data and then quantitative data. An exploratory sequential mixed methods approach aims to collect qualitative data to investigate a phenomenon and then quantitative data to explain relationships discovered in the qualitative data. In this study, the quantitative data collected from the public is used to validate the qualitative data provided by experts in the Nigerian solid waste management sector about the public. Thus, the quantitative data depends on the outcomes from the qualitative data and is analysed after the qualitative data has been analysed; therefore, the study data is dealt with sequentially. That means the research design for this study is an exploratory sequential design. Figure 4.2 below illustrates how the exploratory sequential design transitions in this study.
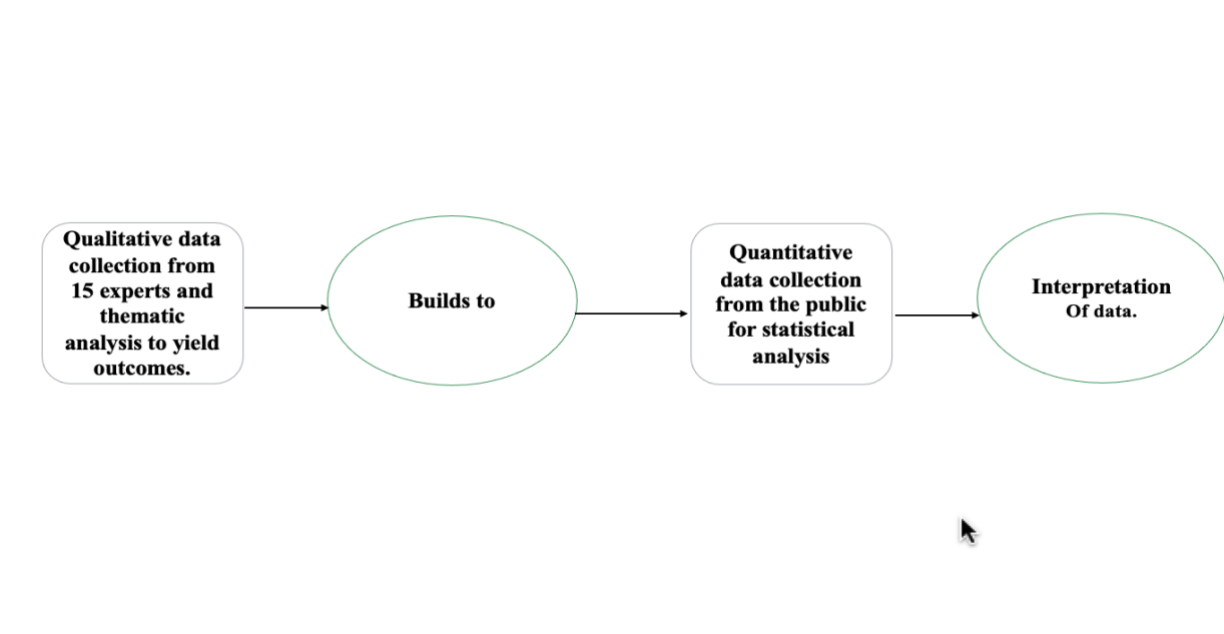
Figure 4.2 shows the study's transition of exploratory sequential design.

Adapted from Subedi (2016)

The Figure depicts how qualitative data is gathered through online interviews to gain insight into Nigeria's present state of municipal solid waste management, including challenges and opportunities. The data is thematically analysed, and the resulting outcome prompted the need for validation of the qualitative data results to confirm some of the information provided by experts; thus, quantitative data is collected from the public via online surveys, and the interpreted result provides in-depth, more robust information.

4.11   Data collection technique

Various literature has shown different data collection techniques in research (Bryman, 2015; Morgan & Harmon, 2001). According to Bryman (2015), the study's objectives or research questions, philosophical underpinnings, level of access to data, and the research issue being researched must all be addressed when deciding on data collection methods. Hence, this study was informed by its philosophical viewpoint because social actors (stakeholders) need to account for their subjective ideas, perceptions, and experiences in the Nigerian municipal solid waste management sector. Hence, As a result, an interpretivist approach was used, which inspired the data collection procedures used in this study. These stakeholders include industry experts as well as members of the general public who benefit from the value chain. Due to the nature of the study's objectives and the number of experts involved, qualitative data is required at this stage in order to conduct one-on-one interviews and acquire in-depth and comprehensive information regarding the current state of municipal solid waste management in Nigeria. Still, with an interpretivism approach, quantitative data is required in the study to corroborate the experts' statements about the public, but, due to the nature of their population and to collect a more objective take on the topic, a survey is required this time. Other data collection methods, such as observations and visual data analysis, are equally appropriate for interpretive philosophical viewpoints; interviews and surveys are found to be the most appropriate data collection methods for this study. The data collection methods are explained in the following sections.

4.11.1 Interviews

Interviews are a set of questions usually presented orally by the study and, in return, responded the same by the participant (Morgan & Harmon, 2001). The questions are mostly more open-ended, allowing the study to acquire more detailed answers. The purpose of an interview in

research is to explore individuals' views, experiences, beliefs, and motivations on the research topic, (Gill et al, 2008). This study seeks to understand the experiences and views of experts in Nigeria's municipal solid waste management sector. Thus, the Interviews will provide in-depth information and a deeper understanding of phenomena, including examples of events and feelings about certain experiences in the waste sector much more than a quantitative method would (Silverman, 2000).

There are three basic types of interviews: i.e. structured with predetermined questions, semi-structured interviews are more flexible questions that give room for further elaborations yet define the areas to be explored, and unstructured interviews have no preconceived ideas and are less organised, (Gill et al., 2008). The interview issued semi-structured interviews guided from the literature based on the identified challenges, including their opinion on funding in the waste management sector, the public's awareness of waste impacts, their opinions about policy and how it is implemented. This study designed semi-structured interview questions.

The study was conducted online to acquire qualitative data using expert opinion. The interview was linked to the research objective by determining Nigeria's most critical challenges affecting municipal solid waste management. The idea of utilising experts' opinions was burrowed from literature and the study utilised a systematic way of conducting the expert's interviews from the fuzzy Delphi model (FDM). As Habibi, Jahantigh and Sarafrazi (2015) explained, the Delphi method is a group data acquisition method that has been used for over half a century, and its information is based on experts' opinions.

The fuzzy Delphi Method of data collection was burrowed in this study to guide the study in dealing with experts, like what experts to use and how many of them are ideal. It will help the study to understand the subject of enquiry from the expert's point of view. However, contrary to the two-step survey FDM model, this study will conduct a one-on-one in-depth interview because the interview will allow the study to access well-detailed information from the experts' perceptions. Based on this, new information may emerge from the interviews that may inform the research further. Also, non-verbal communication to voice tone and reactions are observed by Knox et al. (2009).

Various studies have incorporated interviews from the fuzzy Delphi method for data collection (Mohammed, 2015; Bui et al., 2020: Bouzon et al., 2016; Hsu et al., 2010). Interviews have

also been conducted in waste management studies by Yukalang, Clarke and Ross (2018) to review municipal solid waste management in northeast Thailand. It was also used by Zia and Devadas (2007) in identifying the main obstacles to the efficiency of solid waste management and the prospects for improvisation of the solid waste management system in Kanpur, India.

During this study, it has been seen that waste policies and regulations have been changing quite frequently over time, as seen in chapter one of this thesis from the historical background. The change indicates that current data needs to be acquired to gain more robust data and extensive information on variables that will inform this research. Therefore, an interview is one of the most suitable forms of acquiring data, and they often emerge as very popular, Hannabuss (1996).

Furthermore, Hannabuss (1996) believes this is so because interviews give you a high return of information, and information is most likely to be correct. This interview will be conducted online due to covid-19 limitations. Although the online interview will be conducted based on unforeseen circumstances, online interviews have noticeable advantages.

Apart from reducing the risk of transmission of the virus by preventing human contact, online surveys draw a potentially global pool of participants and can aid participant recruitment through social media platforms, (Griffiths, 2010). That is for this Study, experts can be interviewed in locations throughout the nation, not just those located in one state and recruitment can be on social media platforms such as LinkedIn, Twitter Etc. Online data collection can also accelerate 'snowball' sampling techniques Wood and Griffiths (2007), where one expert invites an eligible colleague to join the study.

Online interviews allow flexibility, giving room for the interviewer to ask follow-up questions enabling the study to see issues from other perspectives to achieve a degree of understanding of the topic (Coiro, Knobel, Lankshear, and Leu, 2008). For instance, during these interviews follow up questions might be required to deeper understand a stamen made by the experts and so, more information can be collected. However, there are also some disadvantages to online data collection, including issues like reliability, validity, and generalisability. However, it could be argued that these are just as likely in offline, face-to-face scenarios (Griffiths, 2010). It may also be challenging to verify that the participants are whom they say they are. However, the snowballing technique plays an important role here, where the experts identify eligible

participants from their societies, organisations, or institutions. The interviews are analysed thematically using the software NVivo following the step by step guide by Braun & Clarke (2006)

4.11.2 Survey

In this study, a survey questionnaire is used as a tool to obtain information from the public. It was chosen in this study considering the population of the public being investigated. Jones, Baxter, and Khanduja (2013) confirmed that one of the advantages of a survey is reaching a large population and, therefore, greater statistical power. Also, for this study, an online questionnaire survey was conducted.

The survey was defined by Check and Schutt (2012 p. 160) as "the collection of information from a sample on individuals through their responses to questions ". A survey is generally used to acquire information from a large sample of participants of interest (Ponto, 2015). Additionally, Creswell (2003) described a survey as a tool that provides a numeric description of trends and attitudes of a population by studying that population.

The survey was conducted to understand the public's perspective and experience on municipal solid waste management in Nigeria. The public is essential to the stakeholders involved in the municipal solid waste management process. The survey was distributed online, targeting literate adult citizens using social media platforms across the country in a cross-sectional research design that is conducted at one point during the study, as explained by Babbie and Mouton (2007) as opposed to a longitudinal research design that requires a study for a certain period which was not suitable for the study. The survey was conducted online due to covid-19 limitations.

However, although the online survey is based on circumstantial reasons, Evans and Mathur (2005) state that if appropriately conducted, online surveys have noteworthy advantages over other formats. Online surveys give access to global reach. The survey will also allow the study to reach a broader range of respondents across Nigeria regarding various works of life and demography. It will also save time and cost, ease of entry and data analysis due to the advancement of technology (Evans and Mathur, 2005).

4.11.3 Observations

The observation was defined by Marshall and Rossman (1989 p. 79) as "the systematic description of events, behaviours, and artefacts in the social setting chosen for study". Observation is known to allow the study to observe and study participants in their natural setting by watching and participating in those activities, (Kawulich, 2005). Observation is used in two distinct ways in research through structured and unstructured observations, (Pretzlik, 1994). Structured observations are used to observe participants' physical and verbal behaviour of participants, while in contrast, unstructured observations are used to understand and interpret the cultural behaviour of the participants involved (Mulhall, 2003).

DeWalt and DeWalt (2002 p. 8) believe that the observation method improves the quality of collected and interpreted data and facilitates the development of new research. However, DeWalt and DeWalt (2002, p.91) warn that there is a potential for gender bias during observation, which can limit or interfere with observation results. For instance, Hooks (1990) reported that some feminist and ethnic writers argue that to achieve an accurate portrayal of the participant's voice, the study must be close to the participant's gender; however, Lunsing (1999), a gay European man conducted research in Japan, among a group of women and they much more open to him about their sexual harassment experiences. This research instrument does not fit the qualitative data required in this research because the study needs to collect the actors' knowledge and experience, not watch their actions.

The decision and justification to use a survey as the primary technique of data collecting in this study is affected by a number of reasons, as has already been discussed in the methodology chapter. Also, studies have examined some of the major benefits of employing surveys as a data collection technique, which also influenced the study's decision to use this approach for the study. For instance, surveys are easy to respond to Breece 2014, and the participants are able to respond at their convenience and won't feel pressured Fautrel et al. (2017). However, it is believed that the survey questions could be ill-measured and unclear Fowler (2013). Although in this study, a pre-test was conducted as a pilot study explained in section 6.5 to review the questions, corrections were made for easy understanding and responses.

4.12 Ethical considerations and data management

Data collection, analysis and interpretation should be guided by certain principles during research (Saunders et al., 2012). The process includes acquiring consent from participants. Compliance with GDPR, obtaining ethics approval from the primary institution to protect the participants and study and ensuring anonymity and consent of participants. In this study, the study ensured that:

- The confidentiality of participants was protected, and they were reminded that their participation was voluntary.

- We obtained ethical approval from the university.

- Adhered to the code of ethics of the university diligently.

- Sent out consent forms (survey and interviews), research information sheet containing a detailed overview of the study including aims and objectives, risk assessment form elaborating how data will be handled and ensuring participant's information is protected and kept safe.

- The study did not use documents with personal data and information obtained from participants during the study.

4.13 Qualitative data sampling

The qualitative data were collected using a non-probability purposive sampling technique, meaning only the subjects with the required criteria are selected. It also involved a snowballing technique, which means one expert in the field can recommend an experienced colleague to participate. The sample size for experts in FDM falls typically within the range of 3- 20 experts (Bueno and Salmeron, 2008; Hsu et al., 2010; Bouzon et al., 2016). Stakeholders in this study include experts such as Academics, activists, top management at the Federal Ministry of Environment, and waste management consultants, all in a total of 15 experts.

4.13.1 Qualitative data (Interview) analysis

The qualitative data was collected, stored, and transcribed. All GDPR guidelines for data management were followed, and confidentiality, including the personal information of participants, was preserved throughout the study. The qualitative data was collected to give in-depth and robust information on Nigeria's current state of municipal solid waste using interviews as a data collection tool. The participants were selected using a snowballing technique comprising fifteen experts from various waste management sectors, including academia, private business, consultants, managers from the federal Ministry of Environment, and staff from the state Ministry of Environment and local government areas. The interviews were conducted on different dates based on the availability of the experts. Interviews were conducted online via Zoom meetings as it was Nigeria's most used video calling platform. All discussions were recorded with the consent of the participants, and the study, for future reference, wrote down vital notes. The results from the interviews were transcribed and analysed through thematic analysis using Braun and Clerk's (2021) steps for conducting thematic analysis, including Contextualisation, theme development and report writing. The study utilised NVivo software to identify emerging themes and patterns in the qualitative data.

4.14   Quantitative data sampling

This study's quantitative method (survey) is referred to as a self-completion survey. This method is also known as the self-administered survey method (Fautrel et al., 2017). This involved a survey that was created and distributed online using the Microsoft Teams forms. Invitations to take the survey are sent to potential participants via email along with a link to the survey's online location. The original survey has been added to the appendix section. The email invitation also guaranteed participants' privacy. Ethical issues have been considered, and a section was introduced to ensure that the participants know they can either continue with the survey or withdraw at any time.

One of the main advantages of using the team's forms is that the study can track partial responses in real-time. Additionally, it enables the respondents to finish the survey with a single click of the survey link at their own pace, convenience, and location. Some significant benefits and drawbacks of conducting online surveys are listed in Table 4.5 below:

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Table 4.7: shows the advantages and disadvantages of an online survey.

Authors	Advantages	Disadvantages
(Ball, 2019)	• Includes speed and reach, ease, cost, flexibility, and automation. • Self-administered questionnaires are not suitable tools for studying uneducated people.	• Responses that are open-ended cannot be reviewed with follow up questions.
(Fautrel et al., 2017)	• It allows a longer duration for data gathering, so, participants can be sent reminders to complete the survey.	• It is Challenging to track and see if specific respondents have responded.
(Callegaro et al., 2015)	• Minimal costs involved as delivery of the survey questions and the capture of the responses is automated.	• The respondents may share the survey with friends and family with similar perspectives and may lead to the over-representation of a particular viewpoint.

4.14.1 Questionnaire development

The study began by reviewing literature on the challenges affecting municipal solid waste management in Nigeria. Challenges were identified and informed the development of the qualitative data collection questions with experts. The experts discuss several points and key emerging themes, classified into government-driven and public-driven challenges. As discussed by the experts, these public-driven challenges needed to be validated for the robustness of the study. It required the public's perspective and experiences and understanding of factors that influence them. The purpose of the survey is listed in detail below:

- To validate the statements made by the experts about the public lack of awareness, non-payment for waste services and lack of participation in waste activities.
- To quantify and understand the public's level of awareness, payment, and participation.
- To understand the key factors influencing improving each of the above challenges.

4.14.2 Survey questionnaire structure

The first part of the survey includes general demographic questions, including age, gender, level of education, etc. The second stage is a Likert scale, to answer on a scale of (1-5). For

example, using a range of strongly disagree to a scale of strongly agree, including variables from a combination of the identified challenges from the literature review and the ones acquired from the in-depth interview. The essential items included in the survey were adopted from previous studies (Drimili et al., 2020; Finn, 2007) and modified to suit the present research. The survey utilised all required documents, including an informed consent request; participants were asked for consent provided from the first page of the survey. The participants had a right to withdraw their participation (Regmi et al., 2016). These initial survey questions were subjected to some changes after a pilot study was conducted. Some questions were added, and some were reviewed.

4.14.3 Questionnaire design

The questionnaire's design details have been explained in the methodology chapter (chapter 3). As summary, the following four different sections have been identified within the survey:

Section A: demographic information. This includes information on the location, age, gender, occupation, and educational level of the participants.

Section B: assessing the participant's knowledge and awareness of waste management.

Section C: investigating their level of participation in waste activities such as waste separation as well as their experience and perception of waste services provided to them.

Section D: evaluating the people's efforts in paying for waste services.

4.14.4 Pilot study

The pilot study is used to evaluate the adequacy of planned methods and procedures of a research study (Polit & Beck, 2017). According to Saunders 2019 (P.540), data must be collected Before administering a questionnaire for proper data collection. The data should be tested with respondents of similar backgrounds to those who will complete it. The outcome will help refine the questionnaire so respondents can answer quickly, and the study can get the necessary answers and record data easily. A pilot study was first conducted by distributing the survey questionnaire to evaluate the questionnaire before the primary data collection.

Among others, Oppenheim (2005) and Zikmund (2000) have highlighted the significance of conducting a pilot study, which includes: estimating the costs and duration of the main study, testing research methods and research instruments and their suitability, determining whether the sampling frame is adequate; estimating the level of response; and, providing an opportunity for studies to become familiar with the research environment in which the main study is to be conducted. The pilot sampling allowed the study to evaluate the questions and see if it was asked correctly and if the questions were correctly formulated and easily understood by the participants.

The pilot participants included Nigerian social media users, including WhatsApp, LinkedIn, Facebook, and Instagram, identified through purposive selection. Purposive sampling is a non-probability sampling technique used to choose a small number of participants who will, hopefully, be particularly informative (Saunders & Townsend, 2018). The samples for the pilot study were chosen based on the study's judgment and were used to highlight the shortcomings of the questionnaire.

A total of 40 people were targeted, and 31 were returned and used as a pilot study of the final sample. They were emailed a link to an online survey. Prior to filling out the survey, the prospective participants had to answer yes or no to consent to completing the survey. Thirty responses were acquired, and the study decided that the marital status asked had no use in the study. It was noticed that the first questionnaire did not ask about the location of the participants by state, so that was changed.

4.14.5 Pilot sampling

Among others, Oppenheim (2005) and Zikmund (2000) have highlighted the significance of conducting a pilot study, which includes estimating the costs and duration of the main study; testing research methods and research instruments and their suitability, determining whether the sampling frame is adequate; estimating the level of response; and, providing an opportunity for studies to become familiar with the research environment in which the main study is to be conducted. The pilot sampling allowed the study to evaluate the questions and see if they were asked correctly and understood by the participants. A total of 40 questionnaires were distributed 28 were returned and used as a pilot study of the final sample. They were emailed

a link to an online survey. Before filling out the survey, the prospective participants had to answer yes or no to consent to complete the study.

4.14.6 Pilot study feedback

Thirty responses were acquired. At first, a Word document was sent to be edited by respondents, After the responses, the survey paper seemed unorganised, and the study would have to take a manual approach, so the survey was created as a Microsoft Teams form. It was noticed that the marital status asked had no use in the study. It was seen that the first questionnaire did not ask about the location of the participants by state, so that was changed. Also, the respondents answered yes about knowing waste. However, there was no confirmation for that, so an open question was added for the respondents to write what they know about waste management. Overall the respondents quickly answered the questions as it was deliberately made less technical for a layman to understand. The study also changed the word occupation to employment status for the participants understanding.

4.14.7 The survey sample size.

The survey questionnaire was sent out on various platforms targeting individuals online, including WhatsApp, Instagram, LinkedIn, Twitter, and Facebook. For the survey sample size, it was reported by Almanac, a Computer Industry. It was speculated by Clickz (2004) that there would be 1.1 billion internet users globally in 2005. The latest compilation of global social media statistics shows that, as of January 2021, there were 4.66 billion internet users worldwide, with 4.2 billion on social media (Global Digital Growth, 2021). smart Insights (2021) reported that there was also a notable increase in social media users in 2020 at the early stages of COVID-19. The rise most likely occurred due to global movement restrictions from 2020. With the high number of social media users globally, 2021 approximately an estimated 109 million Nigerian users are registered on various platforms such as Facebook, Instagram, Twitter, Snapchat, and LinkedIn (Johnson, 2021).

The study was conducted across various platforms to get different views on municipal solid waste from Nigerian social media users. Participants are randomly selected, and the study collects representative data nationwide. Hence, the study takes a non-statistical sampling approach where the population sample size is not accurately known. It is addressed to a

population that can use the internet on any platform, has experience with municipal solid waste management, and can produce sufficient data for analysis. This selection is considered the most valid strategy for obtaining participants because each person in the population is equal to the selection (Salkind, 2010). The target was to get at least 100 – 150 responses which are sufficient for statistical analysis because Spicer (2005, p. 35) said, "For now, a very rough guide would be that an absolute minimum of 50 cases is needed for any single multivariate analysis whereas, for the survey, 208 responses were acquired. The number of respondents is sufficient for statistical analysis.

4.15 Statistical analysis

The survey data were analysed using statistical software (i.e. SPSS). Descriptive statistical analysis methods such as mean, median, and standard deviation will be adopted for preliminary comparisons of responses and ranking of the view of respondents (Arul, 1989). The results will help determine causal relationships between the respondents' issues and variables developed from the data. After that, the data was analysed using descriptive statistics methods, factor analysis and bivariate correlations. Tests of hypothesis, validity and reliability are concluded (i.e., regression analysis and analysis of correlation coefficients). These statistical analysis methods are further explained in this chapter.

4.15.1 Preliminary stages of survey data analysis

This section demonstrates the preparatory steps taken prior to analysing the survey results. To evaluate the validity of the survey data, the data's data normality has been tested, and Cronbach's alpha has been used to test the data's reliability. The study conducts descriptive analysis to give a general picture of the responses a cross-tabulation analysis showing the result from specifically defined subgroups. Also, a correlation coefficient analysis is utilised to understand the association between the variables by measuring two at a time, and finally a regression analysis to determine the relation between the dependent and independent variables and will also provide the statistical data on the independent variable that influences each dependent variables in the study.

4.15.2 Normality test

 Choosing the measures of central tendency and statistical methods for data analysis requires doing a normality test, a crucial step and prerequisite to many statistical analyses (Mishra et al., 2017). According to these authors, there are two ways of assessing the normality of data: graphical and statistical tests. However, given their reputation as being more dependable and accurate, statistical tests are utilised in this investigation (Ghasemi & Zahediasl, 2012). The normality tests conducted in this study informed the research on what type of analysis to conduct. The study conducts non-parametric analysis, such as Spearman's correlation analysis, due to the abnormality of the data's distribution.

4.15.3 Reliability test

The reliability analysis aims to evaluate the consistency of the data obtained from the survey items. According to Pallant (2013), the reliability test examines the internal consistency of the scale or items in a questionnaire. The dependability of each item under each question was tested. This allowed studies to assess the degree of consistency and reliability of survey data for each variable.

The alpha Cronbach's coefficient was first developed by Cronbach (1951) to determine the internal consistency of the questionnaire items during the study's reliability test in SPSS. It is one of the most popular methods for determining whether items or scales are internally consistent (Dunn, Baguley & Brunsden, 2014; Pallant, 2013). Alpha coefficient scores should ideally be over 0.7 (Pallant, 2013), and higher scores indicate more reliability (Flynn, 2016; Rodeghier, 1996). This study conducts a reliability test to evaluate and ensure questionnaire items' consistency.

4.15.4 Descriptive statistics

This shows that the basic characteristics of the survey data, such as respondents' background and demographic data, were described using frequency and percentage scores. As most of the variables are nominal data, the descriptive analysis in this study illustrates the response outcomes using pie charts as Grey explained (2004 p.293). The application of this approach is covered in depth in the sections ahead.

4.15.5 Cross-tabulations analyses

Data that may be used to assess respondents' level of awareness, participation and payment was analysed using cross-tabulations. This makes it possible for the study to display frequency and percentage statistics on data Tables that reflected the outcomes of the entire respondents based on their demographic grouping (Schwarz et al.,2017). For example, if respondents are asked to respond "Yes" or "No" to a question asking if they were aware of the negative impacts of waste. By calculating the percentage of all respondents who responded "Yes" or "No," the level of awareness is established based on their demography, including age, gender, education level, occupation, and location.

4.15.6 Correlation coefficient

The correlation coefficient analysis is conducted in this study. This aids the evaluation of factors that are correlated with each other (Vieira & Matheus 2018). The correlation coefficient is a technique for determining the possibility of a two-way linear relationship between two continuous variables. Spearman correlation coefficients were utilised in this study because the data is not normally distributed (Mukaka, 2012). Spearman correlation was used in the correlation analysis except for age, where the Pearson correlation is used because the age variable is interval data. However, the correlation does not imply causation (Aldrich, 1995); hence, a regression analysis was further conducted.

4.15.7 Regression analysis

The regression analysis was conducted in this study to understand the causal effect between the dependent and independent variables. Regression analysis is a statistical tool for the investigation of relationships between variables. Usually, to ascertain the causal effect of one variable upon another (Sykes, 1993). This study utilised a simple linear regression and a multinomial logistic regression. The multinomial logit regression was used because the dependent variables are nominal in nature and also categorical (Hausman & McFadden 1984; Kwak 2002; Hedeker 2003). The results from the regression analysis provide a final output of the statistical analysis showing the dependent variables that are predictors and are influential to each dependent variable.

4.16 Chapter Summary

In this chapter, the study has outlined the chosen methodology, research methods and the justifications for choosing them. Figure 4.2 demonstrates a summary of the study's methodological approach to its research methods. The research philosophy for the study is an interpretivist approach due to the need for stakeholders' perceptions. It is inductive research because the study uses the information acquired from the data collection to determine the study's outcomes. Also, the data is a mixed method approach utilising both qualitative and quantitative data collection methods. The qualitative methodology used in-depth online interviews among expert participants. The reason is to acquire rich and detailed information from experts to determine challenges affecting municipal solid waste management in Nigeria. At the same time, the quantitative data utilised a survey questionnaire for data collection among public participants online. The mixed method approach is a sequential exploratory design where the qualitative data has priority over the quantitative data, and the quantitative data emerges because of the qualitative data.

The questionnaire was used due to the vast public population, and the survey is best for more prominent people. The experts were asked questions to determine what opportunities could be utilised to resolve the challenges in the Nigerian context. The online platform is used for this study due to Covid-19 limitations. Figure 4.3 illustrates the methodology chapter and their relationship summarised in the next section.

Figure 4.3: shows a summary of the study's methodological approaches and research methods.
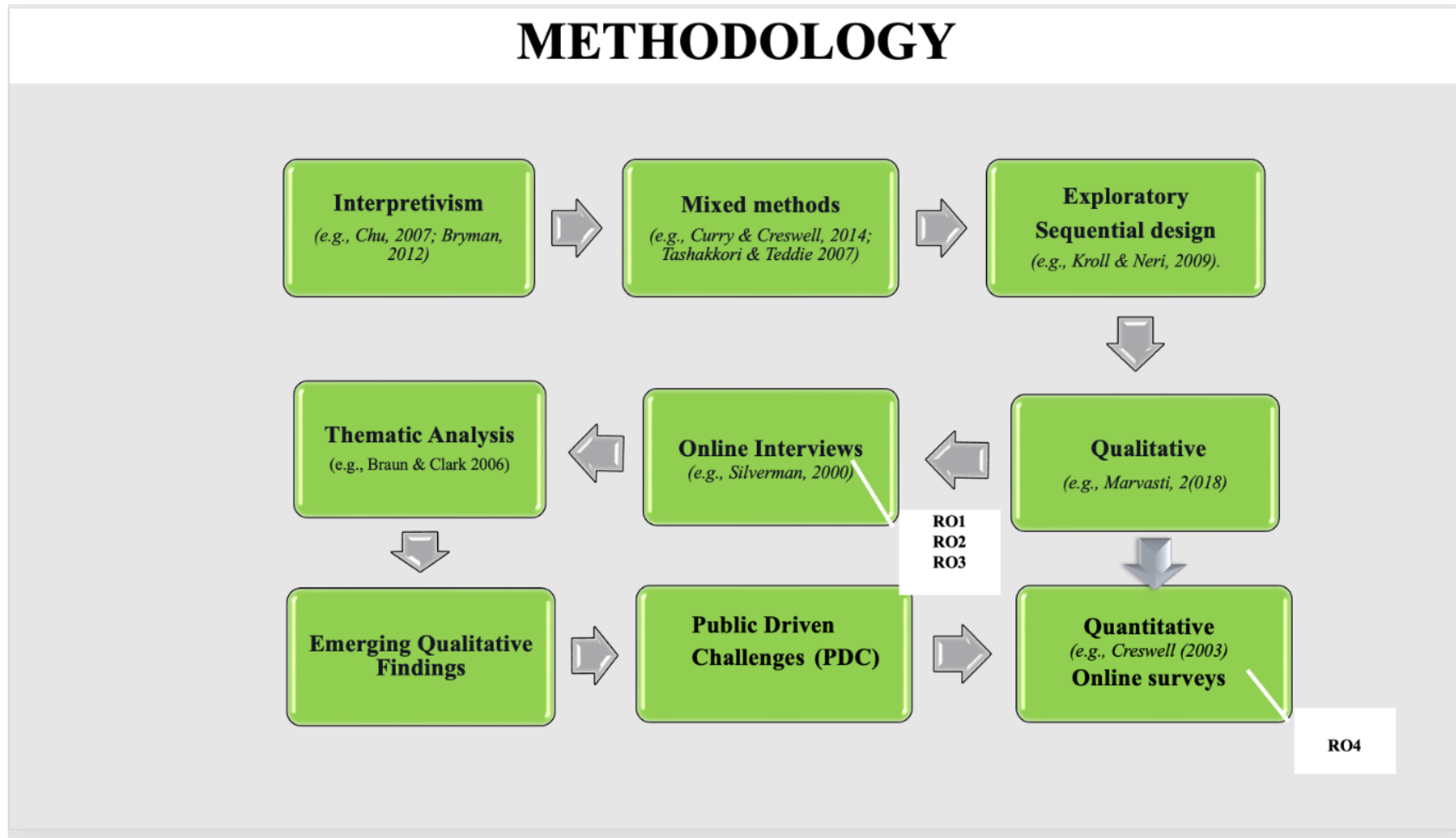
The diagram shows how the study's research method was designed as a mixed-method approach in an exploratory sequential manner. The research begins with data collection via interviews, thematic analysis and themes generated. The interview outcome requires a deeper understanding and validation about the public's perception; therefore, qualitative data is collected from the public via an online survey to validate those claims. In conclusion, this study is a mixed method approach, but the qualitative data carries more weight and higher priority than the quantitative data. The qualitative data is primarily collected in this study and analysed in the following chapter.

Chapter 5: Qualitative Data Results

5.1 Introduction

The qualitative data was collected to give in-depth and robust information on Nigeria's current state of municipal solid waste using interviews as a data collection tool. The chapter satisfied the study's objectives 1, the challenges affecting municipal solid waste management; objective 2, the criticality of the challenges affecting municipal solid waste management; and objective 3, the opportunities that can be utilised to resolve the identified challenges affecting municipal solid waste management in Nigeria. The interviews comprised fifteen experts from various waste management sectors, including academia, private business, consultants, managers from the federal Ministry of Environment, and staff from the state Ministry of Environment and local government areas. Table 5.1 shows a list of the expert participants in the study's interviews, including their areas of Interest, places of work, and years of experience. The interviews were conducted on different dates based on the availability of the experts. Interviews were conducted online via Zoom meetings as it was Nigeria's most used video calling platform. The average time for the interviews was about 60 minutes. All discussions were recorded with the participants' and the study's consent for future reference.

No.	Profession	Designation	Experience
1.	Academic	Senior lecturer environmental management, Bayero university.	10 years
2.	Climate activist	Natural resource manager, climate activist.	9 years
3.	Waste consultant, business	Chairperson recyclers association of Nigeria. Executive director of recycle points ltd Nigeria.	20 years
4.	lecturer	Faculty of art and environmental sciences.	8 years
5.	Civil servant	Permanent secretary ministry for environment and forestry Nigeria.	25 years
7.	Senior academic lecturer	Federal University of Dutse.	7 years
8.	Non-governmental organisation	Founder eyes on the environment Initiative	11 years
9.	Academic lecturer/solid waste consultant.	Bayero university, Capegate ltd, DFID	15 years

10.	Environmantal scientist	local government Officer	10 years
11.	Recycling business owner	Private sector	20 years
12.	waste consultant	Lagos state waste agency	
13.	Civil servant	Federal ministry of environment department of pollution control	12 years
14.	Environmental activist	Campaigns on waste and pollution awareness	5 years
15.	Business owner	Private sector	6 years

Table 5.1: shows a list of expert participants in the interview.

The Table above shows the experts that participated in the interview, the study sampled them using a snowballing technique where some experts were introduced through their network. Experts from various industries were different reasons regarding expertise and experience, for instance academics are found relevant in this study because Many lecturers specialize in waste management or related fields, making them well-versed in the latest research, trends, and best practices. Their academic backgrounds and teaching experience provide them with a deep understanding of the subject matter. They also play a role in educating future professionals in the field of waste management. Their perspectives can reflect the evolving educational priorities and curriculum developments, which are vital for shaping the future of waste management research.

Furthermore, individuals holding managerial positions within the Ministry of Environment can offer valuable insights stemming from their involvement in the decision-making aspects of waste management. They bring with them a wealth of experience gained through the execution of numerous national waste management initiatives and their interactions with local communities.

Additionally, it is worth noting that a significant portion of the interview participants are drawn from Lagos, primarily due to the employment of the snowballing technique. These participants willingly volunteered to take part in the interviews and bring with them a unique perspective derived from their experiences within Lagos state. Lagos is renowned for its effective waste management systems, making these participants well-equipped to propose practical solutions that have proven successful in Lagos and are likely to be applicable to the other 35 states.

Moreover, some of these participants also serve as consultants who have not only worked extensively within Lagos state but have also provided their expertise to other state governments. This wealth of experience positions them as valuable sources from which to extract comprehensive and robust information.

The interview emerged from the stakeholder theory that encouraged the consultation of multiple stakeholders in the waste management value chain. The qualitative data was meant to inform the study on the current state of municipal waste management in Nigeria through multiple lenses, experiences and perspectives using formulated semi-structured interview questions. Based on the interview questions found in the appendix, the first section, section A discussed the background information of the experts, the second section, section B, discussed the expert's general opinion on the current state of municipal solid waste management in Nigeria including the progress that has been made in the sector. The following sections discussed the challenges affecting municipal solid waste management in Nigeria and the recommended opportunities that can be potentially utilised. The interviews were analysed through thematic analysis using the NVivo software for coding and relevant themes emerged. The next section discussed the expert's opinions based on the interview questions, including direct quotes from the experts.

The interview questions in this study were formulated meticulously and drew extensively from the existing literature. It was designed to align with the research objectives and draw from the rich knowledge base from the literature review. They were crafted to ensure that the study effectively captures the participants' insights, experiences, and perspectives, enabling a comprehensive exploration of municipal solid waste management in Nigeria.

Introduction (Section B): This section of the interview was an introduction of the researcher, thanking them for their agreed participation, the duration and the terms of the interview, including consent for recording the session.

Participant's Profile (Section B): Questions in this section aimed to comprehensively understand the participants' backgrounds and roles in municipal solid waste management. The questions were designed to elicit information about their positions, roles, experiences, and training, all of which are relevant factors in the waste management domain. It is important to

showcase the eligibility of participants and the qualification of the experts to justifying their partaking in the interview process to provide their expert opinions. For example the participant's position in their organisation and years of experience in the industry was asked:

- Please Sir/Ma what is your position in your organisation?
- Please tell me about your role in the organisation as regards to municipal solid waste management.
- How long have you been working in the organisation?

Challenges to MSWM (Section C): This section delved into the challenges faced in municipal solid waste management. The questions were developed by synthesising findings from the literature review regarding common challenges in the waste management sector in Nigeria. The aim was to gather participants' perspectives on these issues and explore their opinions on government policies, stakeholder involvement, policy implementation, funding, technological systems, and public attitudes. These questions were crafted to align with themes and insights uncovered in the literature. However, the participants were first asked general questions like their opinion on the current state of MSWM and the achievements so far in the sector. The first questions mostly reverted to stating challenges in the sector. The section included questions like:

1. What can you say about the Management of municipal solid waste in Nigeria?
2. Who are the stakeholders involved in the waste management process?
3. What do you feel has been achieved so far in the waste management sector?

Opportunities for Improvement in MSWM Policy Implementation (Section D): The questions in this section were derived from the literature review's identification of opportunities for enhancing municipal solid waste management in developed countries. Insights from the literature regarding strategies, areas needing attention, and potential agents of change were used to formulate these questions. The objective was to explore the participant's views on existing plans, practical and contextual strategies that can be opportunities utilised for improvement and to identify key areas requiring urgent attention based on their experiences and perceptions. Questions Included:

- Are there plans in place to improve Municipal solid Waste Management?

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- What are the strategies to implement the plan?

- Based on your experience, can you suggest what opportunities can be utilised to achieve effective municipal solid waste management, and who should then be responsible for making these changes?

The interview questions led to the successful result analysis and compilation of the interviews through transcription and thematic analysis as shown in the next section.

5.2 The Current State of Municipal solid waste management in Nigeria.

Based on the interview questions, the fifteen participating experts were asked their opinion on Nigeria's municipal solid waste management. All interviews were conducted online on social media platforms, including LinkedIn, WhatsApp, Twitter, and Instagram a general agreement among participants that there is a need for improvement in the current state of things in the sector. Various explanations were provided for the negative feedback offered by the participants, such as the lack of proper collection and disposal mechanism, and the poverty level in the country was mentioned as another reason. One of the participants opined that:

> *"Waste management in Nigeria is abysmal". (Expert 10).*

The lack of effective law for regulating municipal solid waste management practices was also identified as an issue requiring urgent attention, as other participants described:

> *"Waste management in Nigeria is poor, we have fantastic laws and policies written but are not implemented and enforced" (Expert 3).*

> *"Municipal Solid Waste Management is still very poor in the country; It is not a sector operating as it is supposed to because mostly it is not that coordinated."(Expert 5).*

However, a few confirmed that the management of solid waste management in a poor state was more optimistic about the round's progress. The optimism was evident in the response of one of the participants, who argued that:

> *"Waste management in Nigeria is on an average because we have started improving, and gradually, we will reach some growth in the future". Additionally (Expert 5).*

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"I can say in the state where I am that it is partially working because, even though we are getting better, there is still waste everywhere in Nigeria, including the urban areas and capital territory".(Expert 7)

"In some places, you can find it better than others; however, generally, the desired form of solid waste management is yet to be implemented properly" (Expert 5

"The state of waste management in Nigeria cannot be specific because some states have their policy while others lag and are not strict on waste management enforcement". (Expert 1)

"There is not much to say about it because it has not largely been improved; it is still in a mess though we can still give credit to some state like Lagos" (Expert 14).

The statement by expert seven above was confirmed by several others, indicating that Nigeria's waste management is in a poor state. Still, a few exceptions, like Lagos state with advanced waste management systems and other conditions like Kano. This could be because Lagos and Kano are the most populous states in Nigeria; both are known to be the country's biggest economic hubs and business powerhouses. However, it must be stated that in terms of advancement and technology, Lagos state is the most advanced state in Nigeria; from what has been understood now, in Lagos state, there is political will and intentional leadership. According to the experts above, the Lagos state government have been very immersed in the state's environmental development, especially waste management. Nonetheless, according to the experts, Nigeria's general waste management atmosphere is in a poor state currently.

When describing the state of solid waste in Nigeria, the experts used words such as "poor" and "terrible"—providing reasons such as a lack of awareness regarding waste, financial limitations, and policy implementation challenges, among others. Before describing why they considered Nigeria's solid waste management insufficient, the experts were asked if they had witnessed any industry-wide improvements that would suggest progress. Their responses are discussed in the following section.

5.3   Accomplishments in the Nigerian solid waste management sector to date.

Experts were questioned about notable accomplishments in the waste management sector. Most specialists agreed that some improvement had been made over time, with federal ministry managers having the most to say; some experts emphasised that the federal ministry of environment had accomplished a great deal on a national level, stating:

> *"Our accomplishments have been enormous. Numerous projects have been undertaken to alleviate the issue of solid waste".(Expert1)*

> *Additionally, I am focusing on converting animal and food waste into biogas. I am currently the project manager for this initiative, which attempts to produce alternative, sustainable energy. (Expert 1).*

> *"There is much progress . I will tell you; the low-income areas want to participate more now, especially recycling because they know they can get something back from what we normally call our rubbish" (Expert 2).*

Additionally, some experts added that new policies were developed by the federal government specifically to solid waste management in 2020, saying:

> *"The federal government have successfully created a national policy on solid waste management and plastic waste policy" (Expert 4).*

> *"Those two policies have been launched. Usually, the policies have been approved by the Federal Executive Council, and the bill is presented to the public for implementation. It was presented to the public that it is what we have done in intervention projects" (Expert 5).*

> *"We are beginning to achieve some things because, I attended a conference in Calabar concerning open deification and stuff like that. That is an achievement, and we are trying to relate to other states and see how we can extend that, especially the issue of cholera and maria" (expert 7).*

All experts with these quotes have admitted that new policies are now launched and available but that more than the two approaches might be needed to resolve the range of challenges.

However, some experts asserted that they had not observed any growth in the area.

> *"I believe they don't both make necessary efforts. Even if large organisations sort their waste at the source, government workers collect it and mix it later. (Expert 8).*

Several experts mentioned advancements in their respective states where they had personally experienced progress. These experts noted how much progress has been made, particularly in Lagos.

> *"Little or no concrete achievement has been made except in a few states such as Lagos and Kano attempting to curb the menace, but the problem is still evidently prevalent"* *(Expert 14).*

> *"Tiny achievement has been made except in Lagos state, attempting to curb the menace through public-private partnerships and circular economy" (expert 15).*

> *"In terms of achievement, there have been numerous advancements. Sensitisation or making individuals aware that garbage is not waste but an asset (Expert 3).*

Another expert said Kano state had made some progress in their management sector; Kano, the experts, have also mentioned Kano Staten emerging leader in Nigeria's waste management industry. This could be because Kano state had recently handed over waste management operations to a new company via a public-private partnership. The experts seem optimistic that this move can promote well-balanced operations by taking responsibility off the government so they can regulate and monitor the process adequately. Some experts stated as follows:

> *"There is little improvement, particularly recently here in Kano state".(Expert 6).*

Furthermore, some experts believe that there has been some progress but very slow, not at the pace that matches the urgency of the current waste management situation stating as follows:

"There are certain accomplishments; for example, in Lagos and Kano state, Lagos has long been at the forefront." (Expert 13).

"There could be little progress in some other states the waste management system though is slow and they can do better" (Expert 11).

"It cannot be said that there is no achievement since now the government has realised that there is a need to involve the private sector in waste" (Expert 12).

The above experts have alluded to the government's poor progress. Implementation challenges can cause problems, and before implementation, specific measures must be in place, including appropriate finance, technology, expertise, and political will. Experts were questioned about what they believe contributes to the aggregate lack of effect and sluggish growth. The following section (4.1.3) discusses the expert's responses.

5.4   Challenges affecting municipal solid waste in Nigeria.

This section presents and examines the online interview findings from the qualitative data collected on challenges and opportunities affecting municipal solid waste management in Nigeria. Experts were questioned about why they believed waste management was in such disrepair in the previous sections. Numerous causes were cited, including the absence of explicit waste management policies until recently, ineffective policy implementation, a lack of political will on the part of the government, insufficient funding, and people's attitude toward waste. Expert comments reflected a common theme of elements, and dialogues revealed patterns indicating connections between the highlighted challenges. Before being asked to describe the problems, some experts provided the following explanations for why they believed waste management was in such a lousy state, followed by discussions on the challenges affecting waste management in Nigeria:

"If you look at it, the institutions need substantial budgets to cover waste activities. The funding is not enough, so we cannot achieve a good waste management system without adequate funding" (Experts 13).

"The big issue is in the implementation because I believe waste management or environment issues should be tackled from the grassroots, the local government." (Expert 2).

"You have a population of over 200 hundred million. About 10 million are doing it right; it is so little that it is still non-existent in Nigeria and most African countries except Ghana and a few more" (Expert 10).

The interview results were transcribed and analysed through thematic analysis using NVivo software to identify emerging themes and patterns in the qualitative data. The interview discussions begin by asking experts about the current state of municipal solid waste management, accomplishments so far, and the challenges and opportunities affecting municipal solid waste in Nigeria. Figure 5.1 illustrates a visual diagram of the challenges identified from the interviews, highlighting prominent themes based on their frequency of mention.

Figure 5.1: shows emerging sub-themes from expert interviews.

Challenges

Funding

Mention: 41 times
Experts : 15

awareness & sensitization

Mention: 41
Experts: 14

enforcement

Mention: 33
Experts: 14

Funds

Mention: 20
Experts: 11

inclusion

Mention: 16
Experts: 10

political ...

Mention: 13
Experts: 8

Policy

Mention: 40
Experts: 15

Implementation

Mention: 33
Experts: 14

infrastructure

Mention: 11
Experts: 8

corruption

Mention: 9
Experts: 8

public ...

Mention: 7
Experts: 5

communication

Mention: 10
Experts: 7

waste e...

expertise

Mention: 2
Experts: 2

Attitude to waste

Mention: 33
Experts: 15

technology

Mention: 23
Experts: 13

human capacity

Mention: 9
Experts: 5

resera...

Mention: 4
Experts: 2

compli...

ser...

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NVivo software was used to create the Figure above. Thirty-one themes emerged from previous interviews and were displayed in order of prominence based on the frequency of mention. Some of the themes mentioned mean the same but were discussed differently. Hence so, some themes were merged to form one challenge. For example, funding is the same as funds and has been merged together; therefore, instead of funding having 51 mentions since it has been merged with funds, funding now has 71 mentions, making it the most cited challenge in the interview. The above outcome shows that funding is likely to be the most challenging factor affecting municipal solid waste management in Nigeria. On the other hand, awareness and sensitisation were also highlighted 41 times by all 15 experts.

Furthermore, the experts cited a lack of awareness as a challenge but also acknowledged inadequate sensitisation as the reason for the lack of awareness, for every statement made regarding awareness, the issue of ineffective sensitisation arises. Therefore, sensitisation will be treated as a separate factor in this study. After some common themes were merged, eighteen themes emerged and are used in the study as the challenges affecting municipal solid waste management in Nigeria. The themes were classified into a taxonomy for easier reference during the study consisting of behavioural, financial, institutional, legal, Elaborations on these categories are explained further in this chapter. These classifications were previously conducted in waste management studies by Ezeah (2012). In his analysis of challenges and success factors affecting the adoption of sustainable management of municipal solid waste in Nigeria. It was also recommended by Ogwueleka (2009) in his study on municipal solid waste characteristics and management in Nigeria where he suggested that the institutional, political, social, financial, economic, and technical aspects of municipal solid waste management be further studied in order to achieve sustainable and effective solid waste management in Niger

Figure 5.2: shows a taxonomic classification of the interviews presenting identified challenges affecting municipal solid waste management in Nigeria.
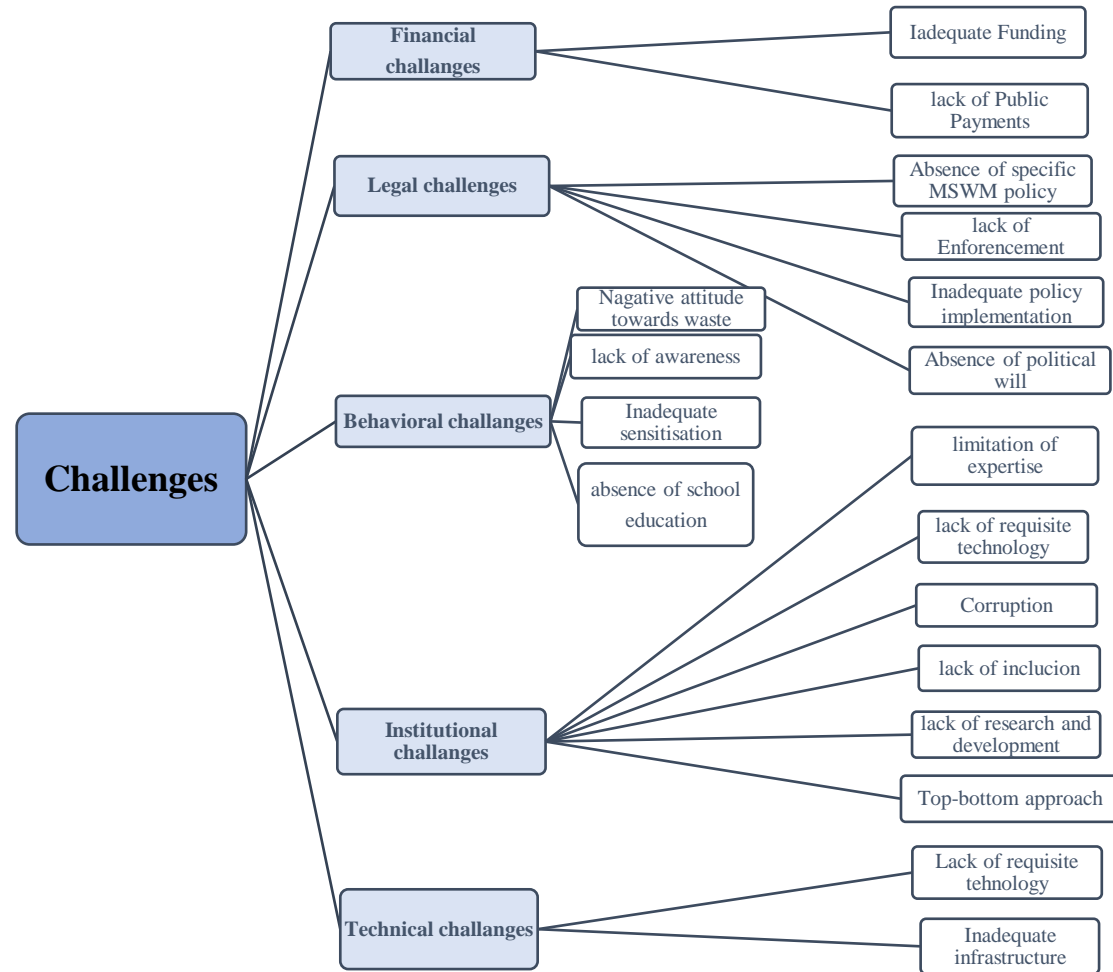
Figure 5.2 is a preview of the outcome of challenges identified from the interview. The classification will give a clearer picture of the challenges of the different government sectors and indicate each sector's responsibilities. It will also allow more structure and a better understanding of the analysis and interpretation of results. The main difference between figure 5.1 and 5.2 is that the latter is the final version of the former. From the earlier diagram, the experts mentioned all the challenges affecting municipal solid waste in Nigeria, however, some of the word used were similar to for example, some experts said there was the issue of inadequate funding and some said there were insufficient funds which all fall in the same category as scarcity of funds. Therefore, the words were merged together and made into inadequate funds. The same was done for the other factors mentioned by the experts, similar words fused together to make one in figure 5.1 from thirty-one sub themes finalised into eighteen themes shown in figure 5.2.

5.5   Behavioural challenges

This behavioural challenge includes four challenges. The experts mentioned that the negative attitude of the public is due to a lack of awareness, and this is because there is inadequate sensitisation; some experts also believe that this is all because of the absence of waste education in schools at all levels that is why people have a negative attitude towards waste because they lack the foundation to do so. Interview outcomes are shown as follows:

5.5.1   Public's Attitude towards waste

On the topic of obstacles impacting municipal solid waste management, all experts stated that people's attitudes toward waste were highly negative. Without a favourable attitude from the public, waste management will never be effective, as is the case in Nigeria, according to the experts, even if all the necessary procedures are implemented well. Regarding the public's attitude toward waste, the following topics were discussed:

> *"The people's attitude is deplorable; they have no idea about the impacts of waste, which explains their attitude towards solid waste. The key thing about solid waste is*

when they can sensitise their people to reduce the amount of waste generated"(Expert 1).

"Behavioural attitude is our biggest challenge; it is not how much funds government puts into waste management; it is the people's attitude that is key to solving waste issues." (Expert 10).

"Most people see waste management as a government responsibility. So, they do not at all participate. Instead, they fold their arms and wait for the government to manage it" (Expert 11).

"The public attitude is disheartening and uncalled for, as people's attitude is about the number one cause of deterioration of the environment in terms of solid waste management". (Expert 14).

The remark by the experts demonstrates how serious the situation is regarding people's behaviour towards waste in Nigeria. This could be due to a lack of public awareness and insufficient sensitisation to convey the word regarding waste's effects. Experts were then asked about their opinions on negative attitudes towards waste. Experts said it was due to a lack of awareness issue; responses are shown below:

The public is unaware of the impacts of waste, so it is difficult to control them" (Expert 15).

"People have little awareness about the impact negative impacts of waste. And they look at waste as something that is a social responsibility of government hence the attitude" (Expert 4).

According to all experts, the public's attitude stems from a lack of or insufficient awareness. The following section will elaborate on the expert's perspective on the public's awareness of waste management.

5.5.2 Awareness

As discussed in section (4.1.1.1), experts believe that the public's attitude is due to a lack of awareness. When asked about the public's understanding of waste management, some experts stated that it was non-existent, while others said it varies depending on the urban or rural area. Some even argued that people's waste management awareness has increased in recent years. Responses were as follows:

> *"I believe the greatest obstacle we face in waste management is a lack of awareness and political will to educate the public" (Expert 12).*

> *" Many are unaware of the harmful effects of garbage" (Expert 4).*

> *"I believe people are unaware of the dangers of the wrong disposal of garbage and plastics, as well as cholera and infections associated with incorrect disposal, and how it might impact the ecosystem" (Expert 8).*

This demonstrates that there is an awareness gap in this industry. If the populace had been adequately enlightened, their awareness levels would have been higher, leading to a more optimistic view of waste management. As indicated earlier in the first paragraph, some experts stated that the public's awareness level varies depending on the area of discussion and that people in urban areas are more educated and, therefore, more aware of waste management than those in rural areas, saying:

> *"The attitude and perception of waste of the people in urban areas who are more aware differ from those in rural areas who are less aware." What you will discover in the state capital, where people are more exposed and have a more modern manner of doing things, is different from what you would find in rural places" (Expert 5).*

> *"It is not properly implemented in certain regions, such as Lagos state. However, there are places where the rules are effective, such as in low-income areas with a high poverty level and poor awareness. They do not respect or listen to the government" (Expert 12).*

5.5.3   Sensitisation

The experts were then questioned whether the government was conducting the necessary sensitisation to raise awareness about the impact of waste management. Few experts agreed that there is appropriate awareness, whereas most experts acknowledged awareness, but it was insufficient. Responses were as follows:

> *"There is public awareness, especially to issues linked with cholera and other disease outbreaks, about the waste that only goes in as dramas I have seen advertised on television. There is awareness, yes" (Expert 7).*

> *"Yes, we do, basically with waste management community projects, we carry along with the communities so that they can have a buy-in on the project and own it" (Expert 5).*

> *"Not much is done; it is not enough. I know that we do radio jingles". (Expert 3)*

While others claimed that no efforts are being made to increase public awareness and sensitivity, the majority believe that awareness and sensitisation campaigns are carried out but are inadequate and insufficient. Experts with this opinion responded as follows:

> *"There is awareness in Nigeria because government makes effort to sensitise people is very limited to radio jingles and television shows; but not but not everyone watches television or listens to the radio; there are people and traditional leaders in rural areas who need to be reached out to, and other experts agree that the awareness is not adequate" (Expert 13).*

> *"In all honesty, the government is not doing enough sensitisation to educate the people about proper waste management and its consequences" (Expert 6).*

> *"Not much is done, sensitisation channels are not enough. I know that we do radio jingles." (Expert 1).*

> *"They conduct awareness campaigns, but waste management sensitisation is season for only election season when they require people's votes"" (Expert 6).*

The quotes above indicate that more effort should be put into educating the public about the effects of waste management. This could be due to a lack of sufficient funding, as sensitisation requires regular financing of logistics and other operations, or it could be due to a lack of political will to stress raising awareness about the repercussions and how to combat them through channels like the introduction of waste education in the Nigerian education curriculum.

5.5.4 Waste Education

Some experts stated that waste education needs to be communicated more effectively. This is because people have different ways of acquiring information. Some experts believe the absence of waste education is a crucial factor affecting Nigeria's lack of awareness of municipal solid waste. They think that even among educated people, waste awareness is absent because they have no foundation in school. Children need more than ever to be educated on environmental issues, especially in primary and secondary schools and universities. Some discussions were as follows:

> *"however, I believe we do not catch them young; waste management It could be incorporated into our curriculum, waste management" (Expert 1).*

> *"There are jingles on TV and radio, sometimes town hometown homes not enough, and we need to communicate how waste can provide jobs and business opportunities also, we are not teaching it in schools" (Experts 10).*

> *"The key challenges that affect the implementation of waste management are lack of political will from the side of government, inadequate policy, legal and regulatory framework, insufficient funds dedicated to recycling, lack of adequate and affordable recycling technologies and absence of expertise and education at all levels" (Expert 4).*

As the experts have discussed previously in this section, the lack of waste management education in schools plays a significant role in waste management since, if it is not implemented, kids and adolescents will not be adequately educated. These individuals are the leaders of tomorrow; if they are aware of waste management and environmental challenges, as the next generation of leaders, they will give such priority, and the country will have a more sustainable future than it does currently. It would also help promote awareness since children

will educate their parents and surrounding communities about the necessity of waste management and separation, even if they have not been sensitised.

The challenges analysed above are categorised under behavioural factors, and these all have to do with the public's behaviour and attitude towards waste. According to experts, ineffective sensitisation contributes to a lack of awareness, affects people's behaviour, and sparks a negative attitude towards waste. The experts have said that in Nigeria, generally, people lack awareness of the concept of waste management. Therefore, an online survey was conducted among some public members to confirm if these statements are valid and to understand what influences them. Two hundred and eight responses were acquired, and a general descriptive analysis was conducted showing the demography of the respondents based on location, gender, age, education level and employment status. Then the results for level awareness were analysed, as shown in the next section.

This section examines the quantitative data results from the survey conducted as part of this study. According to the third part of the methodology, the survey was done among Nigerians utilising social media platforms such as WhatsApp, LinkedIn, Instagram, and Twitter. The survey meets the third purpose of this research, as stated in the first chapter of this thesis, which is the public's perception, awareness, and participation in waste management in Nigeria.

The survey questions were created using team forms. The survey received 208 responses within a four-month term. The was first analysed using the team's responses, and data was analysed in a general descriptive manner. The data were then exported to SPSS, and a cross-tabulation analysis was conducted. The quantitative data was then analysed using a multinomial logistic regression to determine its relationship with the independent variables and how they can predict their occurrence.

5.6   Financial challenges

The financial comprises inadequate funding and the public's refusal to pay for waste services, as illustrated in Figure 4.2. During the interview, the experts mentioned that the finding is inadequate in the waste management sector and is caused because the funds are insufficient. They explained this insufficiency because the waste management sector relies solely on government budgetary allocations and foreign grants to conduct daily waste operations,

establish facilities, and complete projects. The experts believe a waste management system cannot operate that way successfully, and every successful waste management requires money from generated revenue. Waste management is mainly payment for waste services or tax generation, and the sector is in that financial state because the public does pay for waste services or taxes. Some experts have said it is due to poverty, others have said it is likely because the public is not getting sufficient awareness on the issue, or the government has no political will to implement and enforce follow-through, which is why compliance is lacking. The following section below explains the financial challenges as expressed by the experts.

5.6.1   Inadequate Funding

All the experts agreed that finance is a crucial aspect of a waste management system. When asked how waste management in Nigeria was funded, the experts responded that the government supported it. However, some experts added that there were occasionally grants from organisations such as the Japanese government, the United Nations Industrial Development Organisation (UNIDO), and some non-governmental organisations. This inquiry aims to determine whether the system generates revenue through waste management. Responses are as follows:

> *"Budgetary allocations finance the sector; every ministry in Nigeria, every project, and every industry awaits budgetary allocations from the federal government. In addition, some specialists linked the issue of limited funding to the public's failure to pay collection or tax fees" (Expert 1).*

> *"Funding comes from the federal government, so the ministry collaborates with UNIDO-supported organisations. The Japanese, Korean, and Chinese governments provide worldwide environmental facility access monies. They receive support from numerous overseas donors" (Expert 10).*

> *"Waste management is typically sponsored by the government or by grants or donations from outside organisations or donor agencies" (Expert11).*

According to the comments, this sector depends entirely on annual financial allocation. This is a significant worry because a country's waste management system cannot rely exclusively on

budgetary allocations; they will never be sufficient. This suggests that no income is made from waste management. If no funds are granted to the Ministry of the Environment, there would be no waste management activities that year due to the lack of funds. With sufficient money, waste management can be effective in any scenario. Suppose Nigeria's waste management relies solely on budgetary allocations. In that case, taxes are not collected, and the public is not charged waste collection fees, which implies that waste management barely generates any revenue.

This is due to a lack of public awareness resulting from inadequate sensitisation, as mentioned by the experts in section 5.5.3. Also, this indicates a deficiency in law enforcement since if laws are enforced, and others are made an example, individuals will typically cooperate and pay what is due. This indicates a fault in law enforcement since if rules are enforced, and others are made an example, individuals will typically cooperate and deliver what is expected. In addition, if the policy is not readily available to aid law enforcement, the legislation cannot be executed, which could lead to the absence of specialised policies for solid waste management. Now, we are to address the need for more guidelines for waste management, notably solid waste. In that case, it is possible that even the most recent governments did not have regulations on public waste service payments or harsh tax collection laws. However, several experts noticed that Lagos state was collecting cash from garbage through specialised rules and activities, including waste collection fees, taxes, and extended producer responsibility (EPR).

"Through these laws, Lagos State was collecting money from waste. Lagos state has been enforcing laws and collecting taxes and service fees from the public, boosting and advancing waste management systems".

When asked if the allocated funds are sufficient for waste management operations and project completion, experts unanimously responded that they are not. In addition to insufficient funding, several respondents indicated that the delay of funds hampers the implementation of projects. Noting the following:

> *"Government funding is inadequate, which is one of the problems impeding good waste management, and the people who implement it are underpaid, so they lack the drive to perform properly" (Expert 6).*

"No, there is insufficient funding for waste management" (Expert 3).

"When looking at the allocation for the environment or waste management, it is insufficient, severely insufficient" (Expert2).

"If we examine the situation, we can conclude that waste management is inadequate because institutions require considerable funds to cover waste operations, but the financing is insufficient; therefore, a good waste management system cannot be achieved without proper funding" (expert 13).

The remark of experts regarding inadequate funding refers to the debate in the preceding paragraph regarding poor funding and reliance solely on budgetary allocations, which indicated that no revenue is collected from the public other than grants and fiscal budgets.

Also, as noted in the first statement of this section, some experts say that money needs to be increased and frequently delayed, preventing planned projects from being finished or even initiated.

"Not only is the amount of funding an issue, but before we can access these monies, we must wait and make proper preparations, and prompt release is essential. You must utilise these funds promptly" (Expert 1).

It is inadequate because a project meant to be completed in six months or one year typically takes two or three years. Therefore, the actual cause is a lack of finances and payment delays " (Expert 5).

"The issue is unquestionably inadequate funding. The budgeted finances for waste management are grossly inadequate. And sometimes they are not released, the funds are unavailable, and sometimes they are not even made available in time for the project's implementation, or there is no money for the project" (Expert 4).

As stated in the opening paragraph of this section, the waste management business depends primarily on budgetary allotments and grants. Waste management operations demand consistency, making it impossible for any waste management system to operate on allocations

alone; no revenue is being earned to be reinvested in the system to maintain operations. If funds are delayed, as advised by the experts, or allotted funds are spent, no waste management operations will be initiated or completed on time. This could accelerate some of the most feared adverse effects of waste. For instance, if a project to clear gutters or sewers has been approved but funding has been delayed, the longer it takes, the greater the likelihood that malaria or cholera will spread. Suppose finances are postponed for a project to construct well-engineered landfills. In that case, there will likely be an increase in the dispersion of greenhouse gases and the accumulation of toxic gases in the atmosphere, resulting in more climate damage.

5.6.2 Public refusal of payments

According to several experts, Nigerians do not contribute to waste collection costs. As indicated in the preceding section, experts were requested to provide more information about inadequate public payments, discussed in the next section. In this section, the experts explain how the Nigerian public does not pay for waste collection or taxes required to fund an effective waste management system. When asked how waste was supported, the expert replied as follows:

> *"It is supposed to be taxpayers' money, which implies the federal and state governments subsidise waste management because the people do not pay taxes and cannot generate revenue." (Expert 10).*

> *"The populace is unwilling to pay for trash removal. People only desire free services. There are several issues with money, there needs to be a budget, and every local government should have recycling centres. However, this relates to funding. Therefore, a financing shortage inhibits the policy's implementation and enforcement (Expert 3).*

Only a few states enforced these regulations, and according to all the experts, there was no cash generated from waste management. This could be one of the most significant elements impeding the efficiency of waste management operations. Before this section, experts highlighted inadequate funding in this sector; nonetheless, refusing to pay for trash services is the primary reason for poor finance, delay, and political will. If only a few people in specific places pay for garbage services, financing will never be sufficient for Nigeria's population of almost 200 million people. This challenge may be due to a lack of awareness, as the experts

noted insufficient and ineffective sensitisation. Inadequate funding, a lack of understanding, inefficient sensitisation, and a lack of political will, amongst others, could influence the non-payment of waste services.

In addition to non-payment, some experts say that the public does not participate in paying taxes and fees because of poverty. One expert indicated that in an effort by the government to build a public-private partnership in Kano state, the corporation had established a fee collection system that, due to poverty in the region, particularly in the rural areas, may not operate. Quoting as follows:

> *"The company intends to tax the people 200 naira per week for waste collection, but I don't it will work because poverty is a major issue in the country, and people will not agree to pay 200naira per week for waste collection, they don't even know the effects of waste on their health and the environment" (Expert 6).*

> *"I feel that poverty and illiteracy are some of the greatest challenges we have because people struggling to meet their fundamental requirements would not care about their garbage, much less pay for it" (Expert 7).*

According to experts, poverty is one of the most significant impediments to waste management. The government cannot create sufficient revenue if the public does not pay taxes or collection fees. Given that Nigeria is one of the poorest countries in the world, this is acceptable. In a report published in 2021, the world bank forecasted that by 2022, 95.1 million Nigerians would fall into poverty, equating to 6.1 million individuals living below the poverty line, according to Oyedeji (2022). This explains why paying taxes and collection fees is burdensome and too demanding for people more concerned with meeting their survival needs, such as food, water, clothing, and shelter.

Nonetheless, this non-payment significantly impacts waste management performance, resulting in a revenue shortage and inadequate money to carry out waste management operations. From a different perspective, non-payment could be attributed to the absence of defined regulations for solid waste management with instructions on payments since several

experts emphasised the lack of waste management policy till 2020 during the interview. There may be no specific plan instructing the public to pay for collecting services in such a scenario.

As the experts have discussed earlier, the public refuses to pay for waste services; for that reason, the study consulted the public about this issue to validate the expert's statements and understand what constitutes payment for waste services. This will let the decision-makers know where to begin persuading people to pay for waste services. For instance, if it is discovered that the location of the public plays a role, then it will be easier to determine the areas that do not pay. If employed people pay for waste services, it is easy to confirm that the unemployed and low-income earners do not pay for them. They will be a target for stricter enforcement and efficient sensitisation. Like the survey analysis on behavioural challenges, a general descriptive study was conducted to understand the level of payments, if any, then a cross-tabulation to determine the link between the demography and their ability to pay for waste services, and a regression analysis to see which demography most influences the payment for waste services.

5.7 Institutional challenges

The institutional challenges include the absence of a political will, lack of inclusion, incorrect implementation approach, corruption, and inadequate infrastructure, as indicated in Table 5.1. it shows how the institutions are being run ineffectively, and if the institutional foundation of a sector is weak, then challenges are expected. This is especially true when there is little or no inclusion and proper communication among key stakeholders and when the government lacks the solid political will to resolve issues. The institution will be weak and lose its practical functionality. Experts have discussed these challenges and have been quoted in the following sections.

5.7.1 Political will

The experts believe that lack of implementation, inadequate funding, enforcement, and other challenging factors are primarily due to the government's lack of political will to conduct waste management diligently. Some experts discussed as follows:

"Government does not have the will to collect waste constantly" (Expert 12).

This statement by expert 12 shows the inconsistency between the government's waste services and people's attitudes towards waste. Because the government lacks political will, waste operations are poor, hence the people's non-challans and lack trust in the government's ability. This inconsistency in waste collection has led to health and environmental impacts currently suffered in Nigeria.

> *"Also, some government waste management services are seasonal because they will do things when they need them for campaign purposes, so they don't have the political will unless it serves them". (Expert 11).*

This also tackles the issue of government inconsistencies in waste management; expert 11 refers to elected decision-makers. They only take waste issues seriously if elections are imminent or the topic favours them in some way with the public. It has severely harmed the people and their environment. This demonstrates that even some decision-makers lack comprehension of waste's effects. It could also be ascribed to inadequate funding since agents are not adequately compensated and lack the drive to work correctly. The government may need to have the will to remedy funding concerns. Other experts also responded as expert 11 on the issue of political will, responding as follows:

> *"We need the government to adequate funding and proper implementation waste management policies, but the government lacks the political will to do so" (Expert 6).*

Earlier talks in section (4.1.3.5) about policy reinforced the point made by expert 6; until recently, there were no solid waste management policies. If the government had the will, it would have been worthwhile to resolve it earlier than it did. Some of the experts explained that specific government agencies are unwilling to collaborate. This can be validated because Expert 8 holds a managerial position inside the federal environment ministry. Described as follows:

> *"The government has plans, but I don't think they have the political will to implement them. The state government also all have obligations towards the projects. However, the. Most of these states have no political will for environmental projects. Only one is ongoing out of the nine states" (Expert 8).*

This indicates that, even though other government branches may be willing to be careful in waste issues, it tends to impede operations of any size if one component is unwilling. In this instance, expert 8 addresses how most state governments have violated their federal and investor agreements. This can be linked to a lack of political will and concern for waste issues, as all preparations were made before the project's launch. Furthermore, some experts believe that, in addition to state governments lacking political will, municipal governments are no exception:

> *"There is a lack of political will, especially on the part of local authorities charged with their responsibility" (Expert 1).*

This statement from expert 1 demonstrates that the lack of political will is a problem that affects all government departments. This involves all federal, state, and municipal government levels, effectively suggesting a problem with ignorance and indifference. It might be a case of non-challans where all consequences are overlooked, or it could be a case of ignorance because those in this position may be unaware of the effects of waste on humanity. However, it is also possible that all factors need to converge to produce beneficial results. However, some experts believe there is a lack of inclusion, hence why the local governments underperform due to a lack of inclusion and adequate communication of Information. This is discussed in the next section.

5.7.2   Implementation approach

Some of the experts highlighted how the implementation strategy is handled in Nigeria via federalism and stated that the waste management system in Nigeria should be a bottom-up approach, as opposed to the current top-down approach, to promote inclusive communication. Some experts believe that the local government should provide the federal government with information since it directly deals with the people and facilities. Noting the following:

> "*Waste management or environmental issues should be addressed at the local level; the local government plays a crucial role in policy development and implementation since location and proximity are the core principles of waste management*. (Expert 2).

"A top-to-bottom approach is necessary to generate positive results for sensitisation at the grassroots level" (Expert 10).

As noted in the Chapter 1 introduction, municipal solid waste should ideally be controlled primarily by the local government. This is because they handle all waste-related activities, collection facilities are in each municipality, and, most importantly, local government officers are more aware of the state of their people and their environment. The federal government needs to be present to understand how things operate. For example, DEFRA is responsible for making decisions in the United Kingdom, but municipalities are the primary implementers of waste activity. Thus, decisions based on their recommendations and experiences allow for more efficient and continually improved operations.

If the Nigerian government continues to function on a decentralised approach, waste management will remain problematic due to the lack of inclusion and information. In addition, a significant disparity between levels of government indicates that neither the state nor the federal government conducts sufficient monitoring and evaluation. If there were, it would be simple to communicate more effectively and identify waste management procedures with room for improvement. Without systematic monitoring and assessment, people are not executing their duties properly, and there is a lack of political will to move these agendas ahead. Moreover, according to some experts, the local government level, where waste management facilities should be located, lacks the requisite technology and people resources to perform waste management properly. This is addressed in the following section.

5.7.3   Lack of Inclusion

Experts blame the federal government for being at the Apex of decision-making, believing that the local governments are not included in waste management activities. Hence, the overall system lacks the inclusion of essential parts of government in waste management, which is the local government. Discussed as follows:

"There's a disconnect between the federal government, the state governments and the local governments; they lack proper communication channels" (Experts 3).

> *"Waste management is funded using government budgetary allocations and interventions from other international organisations intervention which is mostly at the federal government level, and those funds hardly reach the local government". (Expert 15).*

> *"The local government is still fighting for its autonomy, so when that allocation comes, it domiciles with the state ministry of environment, then the funds can get disbursed then shared to the local governments. So sometimes the local governments claim they don't even receive the money for sanitation" (expert 2).*

Some experts further explained that other layers of government are because the federal government does not communicate properly.

It has been argued that a lack of proper communication and information transfer between government levels leads to a lack of inclusivity in waste management decision-making. Experts discussed as follows:

> *"There is a gap between the federal, state, and municipal administrations; they lack effective communication routes (Expert 11).*

> *"The system is devoid of harmony and synergy" (expert 14).*

Some experts said it is also due to a lack of proper communication that the public lacks enough awareness of waste segregation issues. Elaborating, the government does not use appropriate and diverse communication channels to reach out to people.

> *"You know, people are unaware of the consequences. I think when people are aware of the consequences, some will act but haven't communicated well to help people comply with regulations" (Expert 8).*

Experts feel that generally, there is poor communication within the system, especially with the local governments, as waste responsibilities are burdened on them. In addition to inclusion and communication challenges, some experts believe that the approach to implementation needs to be made the right way. The Nigerian government operates on federalism, a top-bottom

approach to implementing waste management activities and decision-making. This means all decisions are made by the federal government and passed to the local governments without input. That is why the local government should be involved.

5.7.4 Research and Development

Experts have also mentioned the issue of not harmonising research and development with decision-making. They believe a lack of data and accurate information causes makers to act accordingly. Statements are as follows:

> *"I think there is a disconnect. there is no harmony and synergy in the system. In academia, we do independent work. Those in the government responsible for the policymaking are working as an entity on their own" (Expert 14).*

> *"There is a lack of data and information amongst others" (Expert 4).*

According to the experts above, academia works independently from the government, which means the government does not utilise informed and updated data to make decisions in waste management operations. This could influence the need for more requisite technology, new ways of establishing public-private partnerships, innovations in technology and infrastructure etc.

All challenges affecting municipal solid waste management above have been summarised below in Table 4.1, showing a taxonomic classification based on their category. Sorts include behavioural, legal, financial, technological, and institutional challenges. This will give a well-explained picture of the situation and make it easier to understand as grouped challenges. It will also be used as a reference for result discussions in chapter 6 of this thesis. The same taxonomic classification is also represented in Figure 4.2, showing a more visual representation of the classified identified factors.

5.7.5 Inadequate Infrastructure

The experts mentioned infrastructure during the interview; experts feel this is an essential factor that, because it is missing, the country cannot have an effective waste management system, not to mention the health and environmental impacts. This was discussed as follows:

"We have inadequate infrastructures; we need capacity development along and then matched with adequate infrastructure" (Expert 2).

"Our infrastructure is so poor that, for instance, the rainy season is here, any drainages you go to now are blocked with waste, and anywhere you have stagnant water, there will issue of malaria and so on. If you have a clean environment, there's no way the mosquito wants to breed in there, but once the environment is dirty, there's waste, so the drainages become breeding sites for the mosquitos that lead to malaria" (Experts 3).

"We have poor drainage systems causing horrible health impacts due to limited infrastructure" (Expert 6).

"There are no waste separation bins available to enable people to segregate their waste, even if they are aware of it they cannot participate in it" (expert 5)

"waste separation is not encouraged for people to organise their solid waste"(expert 8)

Some experts cited poor infrastructure as a major cause of massive effects. This is most likely due to a need for more requisite technology and adequate facilities to waste participation and promote participation. For example, for public participation, bins must be provided to encourage source separation to avoid constant litter of plastic waste. Another example is that dumping plastic water bags, polythene bags, and general debris on the streets and washed into the sewers has severe health consequences and is the primary breeding ground for mosquito parasites (WHO). To begin with, the sewers (infrastructure) might have needed to be built correctly to contain proper transportation channels.

Poor infrastructure could also occur because of a lack of well-engineered landfills and waste facilities to treat garbage, resulting in waste being dumped in the open air and generating massive environmental damage. Suppose these infrastructures are not provided as claimed by the experts. In that case, it means that Nigeria does have a source separation policy or is yet to implement it; it also means that the public does not participate in waste activities. So, that means a waste hierarchy policy in the country is non-existent. Other factors can also be linked to causing inadequate infrastructures, such as insufficient funding, a lack of political will to

build proper infrastructure or expertise to follow through with operations and maintenance, and the public's lack of awareness of the negative impacts of waste.

The American Society of civil engineers ASCE (2021) reported on the ideal process of solid waste management Infrastructure. It began with waste generation, source separation (recycling), transportation etc.

The solid waste management infrastructural process begins from its source with the public, where waste is generated from their respective locations, be it homes or businesses and how they separate waste to be later handled by the experts thoroughly and appropriately. However, according to the experts, it is not so in Nigeria because waste is not separated from the source, and collection needs to be more adequate and consistent. Separate bins are not provided to facilitate source separation, no efficient sensitisation to make people aware of its importance. In fact, as of 2020, there was no specific policy for solid waste management that could have emphasised waste separation.

Although the guidelines have recently been launched in early 2021, their impacts are yet to be seen. For that reason, the experts argued that there lacks adequate infrastructure, so the public cannot participate in waste separation. Therefore, the study analysed the public's responses on the topic to understand the level at which source separation exists in Nigeria, the demography that participates the most, and what factor influences participation in source separation the most.

5.8 Legal challenges

Experts have established a gap in the legal system concerning waste management mainly because up until 2020, there were no specific solid waste and plastic policies, which caused confusion and inadequacy in policy implementation; hence, nonpractical results were attained. The legal factors include the absence of policy, inadequate policy implementation, and lack of enforcement, leading to non-compliance.

5.8.1 Absence of policy

When discussing policy, most experts stated that policies were ineffective because municipal solid waste management policies were absent and non-existent until recently. In contrast, others noted that the procedures to be used were on the ground and well-written but needed to be implemented effectively. Experts stated:

"It has not been easy, especially because we had no policy. " (Expert 1).

"We have the policies on the ground but were just burrowed from public health sector". (Expert 13).

"There is no provision for specific municipal solid waste and waste hierarchy policies for waste management in Nigeria; that's a huge indicator" (Expert 8).

"Some policies that are supposed to be relevant to municipal solid waste management are absent " (Expert 12).

During this investigation, it was determined that there have never been specific municipal solid waste management guidelines to be followed; instead, environmental and health regulations related to solid waste management have been implemented over time. The absence of adequate policies customised to solid waste management based on the area's nature could have resulted in the build-up of numerous obstacles impeding the effectiveness of waste management operations. It can also be linked to a lack of political will on the government's side, which could indicate that the lack of political will has contributed to the decision-makers reluctance to adopt municipal solid waste management policies. The lack of competence could also influence the absence of waste policy decision-making. This is because an environmental agency can only operate effectively with a straightforward approach to guide its operations. This would have been resolved sooner if the decision-makers had sufficient knowledge or capacity.

Nonetheless, many experts said the available policies on the ground could have been effective if implemented correctly, while some said it was effective in some states.

"The government policies are in place but ineffective" (Expert 6).

"The first fundamental difficulty I perceive is establishing and implementing policies" *(Expert 2).*

"We have laws in place that deal with the issue of municipal solid waste. It is called the national environmental sanitation and waste control regulation 2009. They have about ten sections about municipal solid waste and why you must segregate it from hazardous waste but has not been implemented " *(Expert 3).*

During this study, it was observed that there have never been explicit municipal solid waste management regulations to be followed; instead, other environmental and health regulations were implemented over the years. This must have caused a massive waste management development and the ecological development gap that has been partially implemented in other states. According to the consensus mentioned above by experts, the available policies would have been effective if they had been implemented effectively. In the next section, we will discuss the comments made by experts regarding the absence of policy implementation.

5.8.2 Inadequate Policy Implementation

In the discussion about policy implementation, all experts argued that there was improper policy implementation due to the absence of the policies or multiple factors mentioned above by the experts. Responses were as follows:

"Policies are partially effective since the policies are beautifully written on paper, but implementation and enforcement are low" *(Expert 7).*

"There is no clear delineation of roles because they are amazing on paper when you look at Nigeria's waste policies. There is no evidence of implementation and enforcement when you arrive in the cities". *(Expert 14)*

"It is a huge problem. Implementation is a huge problem. We have all these laws and policies now; even before the new policy came, we had laws and regulations, but our ability to implement it is a challenge" *(Expert 1).*

"There are so many policies, but they are just on paper. they are not implemented. They have only been implemented a little of those policies and don't make any impacts" (Expert 12).

"You might have lovely documents and policies, but they are not properly implemented; implementation is always an issue for the Nigerian government" (Expert 8).

If there is no implementation, nothing is intended to work in the first place, and it is common knowledge that there will be no beneficial outcomes if there is no implementation. Numerous causes can contribute to poor execution, which implies that the accumulation of all problems might result in a lack of performance. First, the lack of proper legislation, inadequate and delayed funding, lack of knowledge, lack of experience, lack of needed technology, the public's attitude toward waste, insufficient sensitisation, and a lack of political will are cited as obstacles. Implementation will be impacted if any of these factors are not handled.

Also, some experts added that even the laws and regulations needed to be adequately enforced, and the problem is not just the implementation of policies but also laws and regulations enforcement. Experts' discussions on enforcement are discussed next in the section below.

5.8.3   Lack of enforcement

When discussing enforcement, experts believed there was enforcement among the issues affecting municipal solid waste management's development and ecological development. Some experts argued that laws were not enforced properly and there could not be compliance without strict enforcement experts responded as follows:

"Laws and regulations were not being enforced properly also; there was an issue of compliance" (Expert 12).

"As I said, the problem is with the implementation and enforcement. Nobody wants to have waste in their house, so they dump it indiscriminately because there is no law enforcement" (Expert 3).

"Lack of policy implementation is number one, and there's no enforcement" (Expert 4).

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"The laws for waste management are fairly enforced, most of the states don't have any waste management policy because it has not been sent down from the federal government so we cannot even discuss enforcement of laws now without the right policies and guidelines". (Expert 13)

"Policies are ineffective because there is no enforcement of such laws in most cities in Nigeria. This is another issue of concern as most are not involved in drafting and designing these policies". (Expert 15)

"Laws have been in place since 1988 when there was a toxic waste issue in the south; there was FEPA, so, the obvious issue is that of enforcement, we have all these agencies, but we lack proper enforcement and compliance". (Expert 6).

The National Environmental and Sanitation Regulatory Enforcement Agency (NESREA) controls the enforcement of environmental regulations, particularly municipal solid waste management rules. Experts feel that enforcement is ineffective if individuals have not obeyed. However, experts believe enforcement is only helpful if people cooperate with the law. There may be several reasons enforcement needs to be handled adequately, including a lack of political will. If the government lacks political will, it may not question NESREA's performance by monitoring or regulating them. More funding could also be needed; many operations can only be carried out if funds are sufficient for monitoring and evaluation. Occasionally, the staff can be apathetic due to poor budget and thus low pay; they lack the drive to function well. Nonetheless, according to some experts, the government does its best to enforce laws, but people do not comply. Therefore, compliance is also an issue.

5.8.3   Compliance

During the interview, experts added that compliance is a problem affecting municipal solid waste management. This was brought up as they were asked how environmental laws are enforced; some experts said there is a lack of compliance as much as inadequate enforcement. This means that the public does not obey the rules and regulations for waste management. Experts responded as follows:

"The government haven't made provisions that will help people comply, for instance, waste bins for segregation; they have not made people aware of the rules or given guidelines to follow because, in the absence of guidelines, people cannot comply with law and regulations" (Expert 8).

"In Kano, there is a program once a month about awareness of the environment, and there is sanitation every last Saturday of the month, but people don't do it; they just stay at home until the lock is up so they can go out, so we have an issue of lack of compliance, and that has to do with strict enforcement" (Expert 6).

According to these experts, compliance and enforcement go together; one cannot exist without the other. People will be forced to comply if they are aware of the impact of waste and the consequences of disobeying the law. This indicates that there needs to be more waste awareness education for the public. Also, going back to a lack of enforcement, if the public sees others prosecuted adequately for violating environmental laws, they will have no choice but to comply, indicating that agencies may not have been assertive in enforcing rules and regulations.

In addition, the government in Kano imposed a sanitation ordinance in Kano state, but people still do not clean up; instead, they wait at home for the curfew to end, indicating inadequate enforcement. This suggests that, to some extent, the law is being enforced but lived if the government needs to be followed up to ensure compliance. Environmental authorities are absent in this circumstance, particularly in rural areas. This would have been a fantastic way to assure compliance by monitoring and regulating actions to ensure that persons have complied with the law. This could be due to a lack of political will to adequately enforce laws or a lack of funds to inspire agents to fulfil their responsibilities. Some experts have stated that implementation, enforcement, and awareness can only occur with political will. Many complex elements, including enforcement and compliance, can only be political will. In the following section, more issues of political will are examined.

5.9   Technological challenges

Technological constraints were discussed with the experts, and most answered that technology was inadequate and poorly maintained. They also mention that the expertise and funds to

operate it could have been more abundant. The following section shows the comments and quotes from the experts about the inadequacy of technology.

5.9.1 Inadequate requisite Technology

When discussing technology in waste management, most specialists stated that there needed to be cutting-edge technology in operation. This is discussed as follows:

"No, we do not have appropriate technology; looking at what occurs for waste management in other nations, they have continual upgrades and new technology, while we do not" (Expert 11).

"Not; we are far from it, as we still employ old equipment in our facilities." When comparing garbage removal and operations in the United Kingdom, you will notice how organised they are; Kano still lacks a single waste separation plant" (Expert 14).

"No, there are no modern technologies; perhaps in the state capital and trash-aware states such as Lagos, but in our local governments, we utilise outdated machinery and equipment, we rarely employ technology, everything is manually run, and we dispose of waste in open dumps" (Expert 15).

"We don't have good technology for waste management in Nigeria; we utilise local ways for waste collection and disposal. " (Expert 6).

With the absence of adequate technology, there is no room for precautions to prevent greenhouse gas pollution. This can have negative environmental consequences and contribute to the current climate crisis. The provision of adequate technologies may result from sufficient funding. Another reason is the government's lack of political will. Some progress would have been made if the government had sponsored technological breakthroughs.

Two experts argued that the technology is occasionally acquired but needs to be better maintained. Experts quoted as follows:

"Yes, there are technological systems, even advanced ones in some locations, which were bought during the previous administration, but they are poorly maintained" (Expert 7).

"The situation is dire. There were numerous amenities and collection points. Ten years later, the condition of the waste management system has worsened because of the absence of any maintenance" (Expert 12).

Experts feel that good technology is occasionally implemented in facilities, but owing to a lack of sufficient infrastructure and maintenance. These technologies become outmoded and less productive. This may result in multiple steps backwards. It implies that all operations may be halted or slowed down. This may be because there need to be more funds to administer these facilities or because the operators need more knowledge and workforce to operate and maintain them effectively. In addition to a lack of technology and maintenance, workers lack the expertise and skills to sustain equipment facilities, according to some experts.

Based on the outcomes in Figure 4.1, the initial 32 challenges identified had a frequency of mention by the experts and as they were merged together, became 18 making some even more mentioned. The next x]section will explain the hierarchy based on the challenges frequency of mention.

5.10 Hierarchy of the challenges affecting municipal solid waste management in Nigeria.

The study's results have indicated a hierarchy among the challenges affecting municipal solid waste management in Nigeria. The frequency of mention of these challenges by experts in the field signifies their level of criticality and influence on the waste management system. The most frequently mentioned challenge is financial constraints, as shown by the study's outcomes. This is because funding is crucial for the successful operation of any waste management system, and Nigeria's financial issues are pervasive across all sectors, including the environmental sector. The low priority given to the sector in budgetary allocations, corruption and mismanagement of funds, and lack of effective leadership all contribute to the financial challenge in waste management.

The second most frequently mentioned challenge is awareness and sensitisation. Experts assert that public action is necessary for the success of any waste management system, and awareness is a prerequisite for such action. However, the high poverty rate in Nigeria means that awareness does not always translate to payment for waste services. To achieve awareness, effective sensitisation is required, which necessitates funding.

The third most frequently mentioned challenge is policy and policy implementation. The absence of specific waste management policies has caused confusion in the sector, as policies from other sectors have been used as a guide. Although recent policies have been launched, proper implementation requires adequate funding.

In conclusion, financial challenges are the most critical and influential challenges affecting municipal solid waste management in Nigeria. The low priority given to the sector in budgetary allocations, corruption and mismanagement of funds, and lack of effective leadership all contribute to this challenge. Awareness and policy implementation are also crucial, but funding is a prerequisite for success. Our study emphasizes the need for increased funding and effective policies to address the challenges facing waste management in Nigeria. Other policies will be explained in Figure 5.3, illustrating the challenges based on their criticality.

Figure 5.3: shows the hierarchy of criticality among the challenges affecting municipal solid waste management in Nigeria.

As explained earlier in this section, Figure 5.3 clearly illustrates the criticality ranking of these challenges according to the expert's responses. Based on the Figure, in the last column, lack of

compliance ranks the least mentioned among the group. This is because compliance does not happen on its own without enforcement. If there is strict enforcement of a law, then compliance follows naturally. Therefore, compliance will be a problem when the law is effectively enforced. Thus, enforcement will influence the occurrence of compliance. Also, research and development are relevant to any sector. However, this can be utilised more effectively when a proper system is in place, and then research and development can help improve the system. In Nigeria, the fundamentals of a working waste management system are yet to be achieved. The arrows show the most influential challenge: inadequate funding was mentioned 71 times by the 15 experts, and inadequate sensitisation was mentioned 41 times by all 15 experts. Although this is a compiled version of the subthemes and a finalised list of the themes, Figure 5.3 illustrates the hierarchy and influence levels of the identified challenges, but the details on the frequency of mention are discussed in Figure 5.1 earlier in this chapter.

Furthermore, The eighteen Challenges have been identified and classified into five categories from the previous sectors. They have also been categorised into two, identifying them as public and government-driven challenges, meaning some challenges involve the public's responsibility, and others are the government's responsibility, as shown in Table 5.16.

Public driven challenges	Government driven challenges
Lack of awareness Negative attitude towards waste participation Public's refusal to pay for waste services. Lack of compliance	Absence of political will Inadequate funding Top-bottom approach Absence of solid waste policy Lack of enforcement Inadequate policy implementation Lack of inclusion Corruption Ineffective sensitisation Inadequate utilisation of R & D Scarcity of expertise Absence of waste education Deficient infrastructure Inadequate technology

Table 5.2: shows the classification of challenges according to public and government involvement.

The challenges related to waste management in Nigeria can be categorized into two main types: government-driven challenges (GDC) and public-driven challenges (PDC). GDC are

challenges that involve the responsibilities of the government at different levels, such as the Federal, state, and local governments, as well as public environmental agencies.

On the other hand, PDC is the challenge that involves the responsibility of the public to achieve an effective, sustainable waste management system. This includes the public's participation in waste-related activities such as source separation, paying taxes and waste services, and acting responsibly based on their awareness after being sensitised by the government. However, it's important to note that PDC also involves the government's actions, as they are often a result of the government's ineffective efforts.

For example, if the public lacks awareness about waste management practices, it may be because the government's sensitisation efforts have been inadequate. Experts have discussed this issue in detail, pointing out that sensitisation is a part of the government's responsibility, and it requires the proper disbursement of funds and effective implementation to create awareness among the public. Without adequate funds for effective sensitisation, the necessary awareness among the public may not be generated, and they may not actively participate in waste management practices.

Therefore, PDC is often a direct result of the government's inaction. The government lays the foundation for the public to effectively carry out waste management practices. This interrelationship between GDC and PDC indicates that the challenges are interconnected, and one can directly influence the occurrence of the other. For instance, the lack of public awareness can be traced back to inadequate sensitisation efforts by the government.

To resolve the awareness issue and address PDC, the government must conduct effective sensitisation programs and allocate sufficient funds. Properly utilising identified opportunities can also prevent the factors directly related to them. This indicates that there is a strong interrelationship among the challenges affecting municipal solid waste management in Nigeria, and addressing one challenge can potentially prevent or mitigate the occurrence of other challenges.

Opportunities were also discussed with the experts to investigate in the Nigerian context what opportunities can be used to resolve waste management challenges. These were analysed the

same as the challenges using thematic analysis. This will be utilised as recommendations empirically identified as opposed to the recommendation that is inapplicable and practical.

5.11 Opportunities for addressing municipal solid waste management challenges in Nigeria.

This section evaluates opportunities to resolve the existing municipal solid waste management challenges. Just like the challenges discussed with experts, they were asked about options in section C of the interview questions to explain opportunities that can be utilised for waste management in the Nigerian context. These opportunities satisfy research objective one of this study, which is important because these are informed solutions and acquired empirical data from qualified experts based on their knowledge and experiences in the Nigerian context. Among those opportunities are sensitisation, waste education, public-private partnerships, a circular economy improving human capacity, adequate funding, etc. Figure 5.4 illustrates the opportunities highlighted by the experts in the interview and illustrates the prominence of the themes according to the frequency of mention.

Opportunities

sensitization Mentions: 32 Experts: 11	**Business** Mentions: 15 Experts: 7	**collaborations** Mentions: 13 Experts: 7	**expertise d...** Mentions: 6 Experts: 2	**community ...** Mentions: 6 Experts: 4	**circular eco...** Mentions: 6 Experts: 4

public private partnerships
Mentions: 14
Experts: 8

waste education
Mentions: 12
Experts: 6

Policy
Mentions: 6
Experts: 4

political ...
Mentions: 5
Experts: 4

commu...
Mentions:5
Experts: 3

Financ...
Mentions: 5
Experts: 4

Inclusion
Mentions:14
Experts: 8

incentives
Mentions: 8
Experts: 5

technological a...
Mentions: 4
Experts: 3

source se...
Mentions:3
Experts: 2

adequate f...
Mentions: 3
Experts: 3

stakeholder engagement
Mentions: 7
Experts: 6

human capacity
Mentions: 4
Experts: 2

law enfor...
Mentions: 3
Experts: 3

advo...
Mentions:2
Experts: 2

Figure 5.4 shows the highlighted opportunities from the expert's interviews.

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The experts provided suggestions in the Figure above to potentially tackle Nigeria's waste management concerns. Based on the frequency of mention, the Figure depicts the prominence of these opportunities based on the frequency of mention and size of boxes. It demonstrates that sensitisation was the most frequently referenced by experts, with 32 references from 11 experts demonstrating the criticality of ineffective sensitisation in the Nigerian waste sector. However, in order for sensitisation to be successful, finance is essential. While sensitisation is the most significant opportunity to disseminate waste awareness, financial challenges must be addressed first.

Moreover, the proposals based on financial opportunities are essentially approaches to create more revenue to compensate for the sector's financial issues. For example, public-private partnerships are a potential method for increasing funds for revenue generation; collaborations with small businesses are another approach to produce revenue, and the suggestion encourages people to develop waste management businesses. If the financial possibilities provided by the expert's problems are combined, the financial opportunities will receive the greatest emphasis because they are aimed at the same goal. As a result, as stated in Chapter 5, Section 5.4.2, financial opportunities must first be utilised before effective sensitisation can take place. The opportunities discussed by the experts are further explained in the next sections, including quotes from the experts.

5.11.1 Sensitisation

As the issue of awareness is one of the biggest challenges mentioned, sensitisation and waste education were among the most mentioned opportunities to be utilised.

> *"First and foremost, awareness and sensitisation must be utilised critically awareness is very crucial to the waste management sector". (Expert 1).*

> *" Nothing will change in Nigeria's waste management until we change our attitude. If we get it right, that's the first approach to achieving positive outcomes of sensitisation from the grassroots level". (Expert 10)*

> *"source separation is key because, with that, much money can be saved, and we are a step closer to the circular economy, so if there is awareness sensitisation on, people will begin to comply and practice it". (Expert 14)*

"If people know the negative impact of waste, they will work with the government, particularly on the issue of waste segregation and disposal. They will dispose of their waste in an environmentally sound manner or places designated for waste" (Expert 4).

" There needs to be more awareness, especially on the circular economy so that people can be aware of the value of waste. Sensitisation on circular economy is the only way people will be interested in waste, this is the only way that people will turn their negative perception of waste in the society".(Expert 6).

"The greatest infrastructure is the mindset of the people. Because if you don't affect the behaviour on the mindset of the people, you can put so many millions and billions of dollars to build the infrastructure it is as if it does not exist". (Expert 2).

Expert two linked awareness to infrastructure, explaining that no infrastructure will be as adequate without people being aware of the importance of waste management. He recommended this, saying,

"If the government can advertise waste management as they did Covid-19, it would be very impactful". (Expert 8).

Some experts also suggested that sensitisation can be adequate but introducing waste education and catching kids young could be a very effective way of spreading awareness on waste. This is discussed in the next section.

5.11.2 Waste Education

Experts believe it is essential that waste education is introduced into the school curriculum to teach children the importance of their environment and handling waste from a young age.

"If we teach children. Even at the elementary stage, it will help because kids are the best advocate for change". (Expert 1)

"Then our educational curriculum also needs to be looked at on how to include sustainable environmental management is critical. So, from infancy, people are taught

how to manage their waste; we minimise waste now and in the future. Hence, it needs to be a part of our curriculum" (Expert 2).

"Also, waste education in schools from primary to university level is significant when the kids are aware from a young age it grows with them". (Expert 8).

 As seen above in this section, some of these experts added that sensitisation, people should be aware of the benefits of a circular economy and how to utilise their waste to benefit from it. This is further discussed below.

5.11.3 Circular economy

The experts suggested the introduction of a circular economy to make the people aware of the economic and environmental impacts of a circular economy where they can turn waste into wealth and benefit from it. For instance, expert six said,

"There needs to be more awareness, especially on the circular economy, so people can be aware of the value of waste so they have to start finding innovative ways that can waste can be used to make money and benefit themselves and the environment to generate something profitable" (Expert 6)

Some experts believe not only using circular economy for awareness purposes, but it also needs to be introduced into our waste management systems by the government.

"I think the current issue of a circular economy, we have to be thinking towards that direction" (Expert 4).

"Everyone should take responsibility and work closely with inclusion and collaborations to achieve a sound waste system in the country and even move into the circular economy" (Expert 6).

"Then when you have that structure, you can utilise it in so many ways like this waste to energy, recycling all as a circular economy" (Expert 13).

These experts also added the financial benefits that can be yielded from having a circular economy. The economic benefits of waste management are discussed in the next section.

5.11.4 Financial benefits

Out of the opportunities to be utilised, some experts mentioned that people must be aware of the financial benefits of participating in the waste management sector. This can include job opportunities, incentives, and business opportunities, especially with the introduction of a circular economy, which will benefit both the government in increased revenues and the targeting of several sustainable development goals as well as serving as a generator for people. Therefore, the experts explained as follows:

> "*There's need for more awareness, especially on the circular economy, so people can be aware of the value of waste so they must start finding innovative ways that can waste can be used to make money and benefit themselves and the environment to generate something profitable and useful" (Expert 6).*

> "*There's much progress in the low-income areas want to participate more now, especially around recycling because they know they can get something back from what we usually call our rubbish (Expert 2)*

> "*There's much money in the waste business. So, is it the responsibility of the government to invite private investors or invest in small businesses" (Expert 12).*

> "*It is contributing to the economic growth and is contributing to raw material for Local industry instead of importing sourcing for dollar to import; now they look inward locally to get their raw materials from recyclers." (Expert 3)*

> "*We lack ease of doing business for the private sector in Nigeria and easy access to government loans or grants they will need to work alongside the government to resolve the waste issues we face" (Expert 8).*

> "*We need to communicate how waste can provide jobs and business opportunities and also, teach it in schools" (Expert 10).*

Suppose the financial benefits of waste management participation are successfully presented to individuals. In that case, this can foster inclusion with many people and diverse stakeholders contributing to the waste management value chain.

5.11.5 Inclusion

These experts believe that inclusion is crucial for achieving a successful waste management system.

"*Surrendering the waste management system into the hands of the private sector if they can". (Expert 11).*

"The country should harness the possibility of waste to wealth opportunities. The government and the public should be at the forefront of making the changes" (Expert 15).

Expert 2 added that all stakeholders must be included in any waste decision since it involves everyone to achieve seamless results.

"We cannot do it in secret. We must do its very form of transparency and all-inclusiveness of everyone from the generation to the collection process". (Expert 2).

"There are informal sectors that can process or manage the waste if they are fully included" (Expert 4).

"As mentioned earlier, everyone should take responsibility and work closely with inclusion and collaborations to achieve a good waste system in the country and even move into the circular economy" (Expert 6).

Some experts explained that stakeholders must be included in any waste decision since it involves everyone to achieve seamless results. Additionally, expert seven believes that to achieve proper waste management, there must be inclusion, and the government must have the political will to include everyone on the value chain to come together as a unit, saying,

"The government needs to be serious; we need the political will to achieve inclusion. All stakeholders engaged in the solid waste management cycle should be responsible." *(Expert 7).*

Inclusion in this context means including every stakeholder in the waste management value chain. This can also involve private businesses which are more preferred to operate waste management than the government itself; rather, delegation is critical. This will strike a good balance where private business and the government fund and monitor operations.

5.11.6 Collaborations

Some experts brought up the utilisation of collaborations between the public and private sectors.

"There's much money in the waste business. So, it is the responsibility of the government to invite private investors or invest in small businesses and collaborate with the private sector". (Expert 12).

"Helping with capital investment for entrepreneurs, if they see can do a business out of it they will always make profits which will indirectly contribute to government revenue" (Expert 11).

The experts have also mentioned that the private sector has better technology than the public sector; if more public-private partnerships are established, private companies are primarily to technology. Expert 2 gave an example of an app developed by a private company making waste collection and recycling more accessible; he said,

" A private business developed an app where people can be in their houses and on gathering their recyclables request for collection, and then the nearest recyclers or recyclers in charge of that area will pick it then go and pick up" (Expert 2).

As experts have mentioned above, collaborations can bring about a successful private partnership between the government and the private sector and will improve waste management operations as the weight of the responsibility will reduce on the government. So,

they delegate to the private sector and then regulate them as well as develop policies and monitor activities to ensure businesses follow the guidelines and procedures.

5.11.7 Public-private partnerships

The experts have discussed severally the importance of collaboration to form public-private partnerships. Experts discussed as follows:

> *"Empower youth and encourage them to start a business in waste management, give them loans to kick start their business and include studies and invest in research and development of managing waste" (Expert 12).*

> *"The state government has brought another company to manage waste through a public-private partnership. They have started operating, so we look forward to seeing how this move can likely improve the state of waste" (Expert 6).*

> *"It is all about business development there and investment opportunities as well for investors and then pull young Nigerians" (Expert 2)*

> *"Foreign investments may not work right now because they must have been given travel advisory not to travel to Nigeria due to insecurity, so we need to look inwards for collaborations, youth, and women empowerment, create a conducive business environment for waste management entrepreneurs and so on". (Expert 10).*

> *"There must be synergy between government and people in the private sector would be that same energy. Okay. Let me just try and right. Creating the enabling environments for them to do business" (Expert 1).*

According to the quotes above, the experts emphasised how crucial this factor is to establish public-private partnerships between the government and the private sector. As waste management is a daily service based on the population and space size, the government cannot take responsibility consistently. They must liaise with the private sector and provide financial assistance for capital, such as grants and loans, to encourage and attract people into the waste management business, such as recycling, waste collection, etc. This will reduce the burden of responsibility on the government and increase revenue and job creation, thus influencing economic growth and desired outcomes. For this to happen, there needs to be the political will

to give this sector importance to establish relationships and spend such amounts of money in the environmental sector.

5.11.8 Political will

Experts have mentioned in section 5.3.11 that the Nigerian government lacks the political will to indulge in waste management activities fully. This could be due to a lack of awareness and education on the issue. Also, the environmental sector is not of the utmost priority in the country, as discussed in chapter 1 of this thesis. When asked about beneficial opportunities, experts said if the government have the political will, they can resolve waste issues if necessary efforts are put into it. They discussed as follows:

> *"For you to implement these laws and these policies, you need that strategy, you need political will, the mindset must be there. You need adequacy" (Expert 1).*

> *"Just as the government needs to be more serious, we need political will. They need to be serious. All stakeholders engaged in the solid waste management cycle need to be more responsible. We need to remove issues of funds that are supposed to take care of that aspect into our pocket" (Expert 7)*

According to the experts, if the government is serious about implementing waste management, they can, but they do not have the will to do so. It is believed that the presence of a political will, can resolve any challenge because the government will put in all required resources to achieve desired outcomes. The fact of political will also mean enforcement is done effectively to make sure that people comply with the rules and, if not will be dealt with accordingly with no exceptions.

5.11.9 Enforcement

Experts earlier discussed the enforcement issue in section 5.3 above, where they mentioned that the waste midsegment sector was facing a challenge where the law is not adequately enforced, and people also do not exercise compliance. Therefore, it is expected that when asked about opportunities, some experts mention enforcement as an important opportunity that can be utilised for the law to be abided by.

" There should be enforcement after engagement. We must enforce these laws"(Expert 2).

"Certainly yes, the challenge we have now is about those policies that were not in place earlier. Now that they're in place, we need the state government to domesticate these policies in their states, so that people cannot be ignorant of what is happening then enforcement can now take place" (Expert 4).

Some of the experts quoted above say that law enforcement is crucial; however, before that, there must be engagement. That is engagement by enlightening people, and educating them on rules to follow; this will encourage compliance of waste laws, especially if incentives are involved. This once again shows the importance of sensitisation to educated people because they cannot abide by the law that they are not aware of.

5.11.10 Incentives

As discussed above in section, incentives are a great way of promoting compliance and awareness of waste laws, which is why the experts mentioned it as a crucial opportunity that can be utilised to sway people into complying to waste laws. This was said as follows:

"People participated more in managing their waste because when given incentives" (Expert 11).

"There also needs to be incentives to be given to prompt them more additionally; they should be engaged in all the activities included in community projects and so on" (Expert 14).

"Awareness and incentives should come first before enforcement" (Expert 2).

'To get attention, to get people, to manage waste properly. We often introduce incentives". (Expert 3).

This section shows how sensitisation, awareness and incentives are connected, which will thus promote compliance. Incentives can be used to attract people to attend sensitisation as well as encourage people to participate in waste management activities. It is also important that after utilising incentives, communication with people must be done effectively to be fully aware of the impacts, processes, and guidelines. It is also crucial that there is effective communication

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among relevant agencies to know their responsibilities and planned waste management as mentioned by the experts. Discussed in the next section.

5.11.11 Effective communication

Experts mentioned effective communication as an opportunity to be utilised. Discussed as follows:

> *There needs to be synergy and proper communication with relevant agencies because some of these agencies have overlapping functions (Expert 1)*

> *The government and the policymakers, the regulators, and we, as well as the professionals, need to come up with a formula to communicate to the people, to let them know that we all have a responsibility in the space (Expert 2).*

According to the experts, it is important to make sure there is effective communication among relevant agencies in other for implementation to go smoothly. This also means that proper training serves a big role in communicating roles and responsibilities to staff as well as their role in the value chain; if Information is not passed correctly, it will affect implementation, thus, the natural outcome of waste management services.

Based on the opportunities identified from the qualitative data, similar to the challenges, the opportunities have been classified into their respective categories for easier reference through the study in Table 5.3 below.

TAXONOMY	FACTORS
Behavioural opportunities	Introduction of waste education
	Effective sensitisation
	Political will
Financial opportunities	Public private partnerships
	Incentives
	Financial benefits
Institutional opportunities	Inclusion
	Collaborations
	Introduction of circular economy
	Effective communication
Legal opportunities	Adequate law enforcement

Table.5.3: shows a taxonomic classification of the interview outcomes for opportunities that can be utilised in tackling challenges affecting municipal solid waste management in Nigeria.

5.12 Chapter Summary

The qualitative data gathered from experts was analysed in this chapter. The data was gathered through semi-structured interviews with 15 waste management experts with knowledge and experience from various branches of the waste sector. Data was efficiently saved and managed. In the NVivo software, data were transcribed and thematically analysed, yielding themes that informed the study. When questioned about the present state of municipal solid waste management in Nigeria and what progress has been made, experts stated that the current state is poor, with little improvement made over the years. The problems affecting this progress were discussed, and 32 challenges were presented; however, some of them were similar, and thus they were merged to form one component.

The highlighted challenges were also identified based on their prominence through the frequency of reference by experts, which revealed their criticality or level of impact in the waste sector. Inadequate funding was highlighted as the most critical challenge influencing municipal solid waste management in Nigeria, followed by awareness, sensitisation, and the dearth of a specific solid waste policy. Eventually, eighteen challenges were formed and divided into five taxonomic categories, including behavioural, financial, legal, institutional, and technological factors. During the analysis, it was also noticed that there was a relationship among the challenges mentioned, and some could influence the occurrence of others. For

instance, it was seen that lack of enforcement yielded a lack of compliance, and lack of funding yielded ineffective sensitisation, which caused a lack of awareness among the public.

Furthermore, the study solicited expert recommendations on potential opportunities for resolving the challenges. The findings revealed several opportunities, including effective sensitisation, financial solutions such as public-private partnerships, collaboration with small businesses, and encouraging waste management-related business start-ups. These opportunities were identified as potential avenues for revenue generation. In addition, suggestions were made for the inclusion and communication among all three tiers of government.

The study concluded that although sensitisation was identified as a crucial solution, the financial challenges posed the most significant obstacle to effective waste management in Nigeria. If all three financial solutions are combined, then the study will have financial challenges as the most prominent factor. This is because even sensitisation cannot take place without the necessary funds. Therefore, the study recommends that all the financial opportunities be utilised first to address the most pressing challenge facing the Nigerian waste management sector.

Furthermore, the eighteen challenges identified were classified into two categories: public and government driven. The public-driven challenges gave rise to the collection of quantitative data because the public-driven challenges are problems that involve the public and based on the size of the public, survey data was utilised. The quantitative data is analysed in the chapter.

Chapter 6:   The Public's Perception and Experiences on Nigeria's municipal solid waste management.

6.1   Introduction

The current chapter satisfies objective four of the PhD research by exploring the public's perception and experience of Nigeria's municipal solid waste management. The study satisfied the objective by collecting quantitative data via online surveys using a questionnaire. The quantitative data was employed based on the previously employed qualitative data outcomes, which produced emerging themes that included quantitative data gathered in response to the emergent themes as the challenges affecting municipal solid waste management in Nigeria. The themes from the qualitative data were labelled into two categories: government-driven challenges (GDC) and public-driven challenges (PDC). The quantitative data were collected as a result of the public-driven challenges in which the challenges involved include the public's action or inaction considered as part of the factors impeding the waste management efficiency in Nigeria. Thus, the public-driven challenges are a part of the qualitative data results. The PDC investigations include elements such as the public's level of awareness, participation in waste activities, and payments for waste services, which emerged from the interview outcomes. The mentioned themes are a significant aspect of waste management operations, and public participation is required in any waste management system. The study employed quantitative methods to validate the claims by the experts about the public-driven challenges.

A pilot study was carried out to evaluate the correctness and the level of the participant's understandability of the questionnaire. The initial questions were sent out, and responses were collected. The questionnaire was reviewed, revised, and resend for the main survey. Nigerian social media users from Facebook, LinkedIn, WhatsApp, and Instagram participated in the online poll. Two hundred and eight people responded. After that, the survey was analysed using the statistical software SPSS for descriptive statistics, cross-tabulation, correlation coefficient, and regression analysis. Figure 6.1 depicts a flowchart of the research technique utilised to achieve the results.

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┌─────────────────────────────────────┐
│     Questionnaire administration     │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│        Online survey via LinkedIn,   │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│        Responses inputted in SPSS.   │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│         Test for normality and       │
└─────────────────────────────────────┘
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┌───────────────────────┐   ┌───────────────────────┐
│ Descriptive statistics │   │ Inferential statistics │
└───────────────────────┘   └───────────────────────┘

┌──────────────────────────┐ ┌──────────────────────┐   ┌──────────────────────────┐
│ Frequency outcome for each │ │   Crosstabulation of │   │ The   correlation   coefficient, │
└──────────────────────────┘ └──────────────────────┘   └──────────────────────────┘
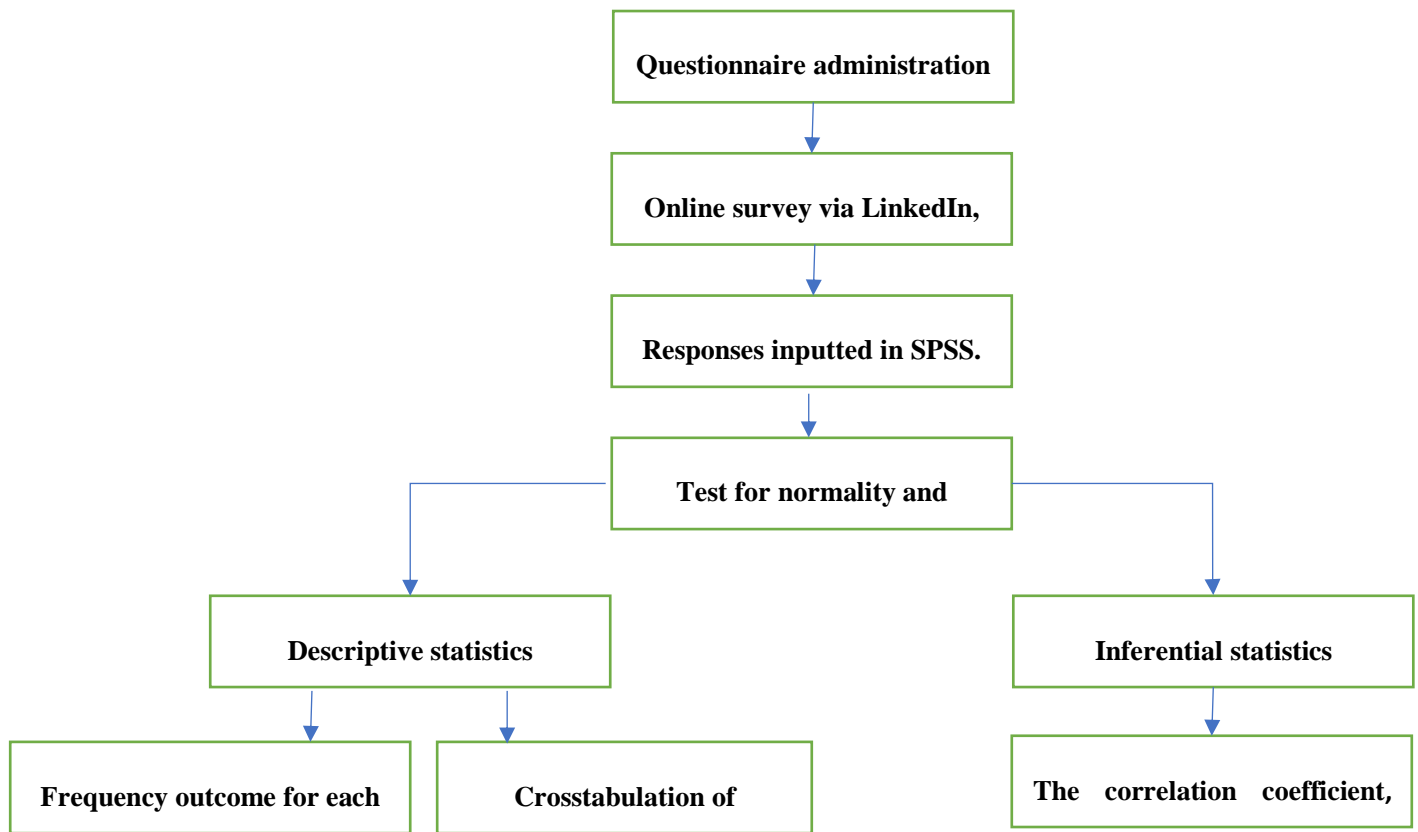
Figure 6.1: shows the flowchart for implementing the survey.

The above figure illustrates the sequence in which the survey was conducted and analysed in this study using various forms of analysis to arrive at a rigorous result from the questionnaire administration to participants to the analysis in the preliminary stages, including normality tests, reliability tests and descriptive analysis. Also, the study included cross-tabulations and types of analysis conducted, including correlation coefficient and regression analysis based on the non-parametric data type.

6.2   Preliminary stages of survey data analysis

This section demonstrates the preparatory steps taken before analysing the survey results. To evaluate the validity of the survey data, Cronbach's alpha has been used. The following sections present more details of the study undertaken.

6.2.1   Normality test

The normality test for this study was conducted using the Statistical Package for the Social Sciences (SPSS). According to Mishra et al. (2017), The two most frequently used techniques

to check the normality of the data are the Shapiro-Wilk test and the Kolmogorov-Smirnov test. The Shapiro–Wilk test is the more suitable method when testing small samples (<50 samples), and the Kolmogorov-Smirnov is more suitable for handling larger samples (n ≥50). Therefore, the study reported in this chapter employs the Kolmogorov-Smirnov test since this study has 208 responses.

The results for normality of data depend on the outcome as follows:

- When P > 0.05, then the data is normal.
- When p < 0.05, then data normal is not normal.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
payment for waste services	.414	208	<.001	.628	208	<.001
awareness	.503	208	<.001	.458	208	<.001
waste separation	.320	208	<.001	.829	208	<.001

a. Lilliefors Significance Correction

Table 6.1 shows normality test results

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We reject the null hypothesis that the data follow a normal distribution since the test findings shown in Table 6. 1 suggest that the data for this study are not normally distributed because the p-value is less than 0.05. It is reasonable to apply non-parametric statistics, often known as distribution-free tests, because the assumptions of normality are not met (Sprent & Smeeton, 2000; Altman & Bland, 2009). Additionally, non-parametric tests are appropriate when all 208 variables are measured using nominal or ordinal scales, as was done in this study, to assess participants' awareness levels and participation in waste activities (McHugh, 2013).

6.2.2 Non-parametric tests

Non-parametric tests provide a practical tool to use when the previous assumption of normality is not satisfied, that is, when data is not normally distributed and thus does not require parametric data, especially in multi-problem analysis (Derrac, et al., 2011). The non-parametric tests come in various shapes and sizes, including the Chi-square, Mann-Whitney, and Kruskal-Wallis (Ali et al., 2015). These tests make specific assumptions about how the independent and

dependent variables are measured on nominal, ordinal, interval, or ratio scales. This study comprises mostly nominal data. For instance, the independent variables of location, gender, education level, and employment status are nominal data, age is a quantifiable variable on an interval scale and gender. On the other hand, the dependent variables in this study have categorical data.

6.2.3   Reliability test

The alpha Cronbach test was conducted to evaluate the consistency of the survey items. Table 6.2 shows that the alpha coefficient ratings for all the items assessing the awareness, payment and participation levels were higher than 0.7. This implies that the survey items were reliable and consistent enough to serve as a scale for evaluating the research questions.

Case Processing Summary

		N	%
Cases	Valid	208	100.0
	Excluded	0	.0
	Total	208	100.0

a. Listwise deletion based on all variables in the procedure.

Table 6.2: shows the alpha coefficient ratings for all the questions.

Reliability Statistics

Cronbach's Alpha	N of Items
.843	23

6.3   Survey descriptive analysis

The first section of the survey was the demography of the respondents who are present online and use social media, as explained previously in the chapter. The demography will give basic information on the respondents and provide a deeper insight into the behaviour or perception of a particular group about waste management. In section 2.10 in the literature review,

Connelly (2013) explained that it is essential for a study to understand the demographic data of a group of participants to understand the reasons for certain behaviours.

In the survey, participants were asked for their consent and willingness to participate in the research with an option of yes or no. They all answered "Yes" except one respondent, who also participated in the survey, as shown in Figure 6.3 below.
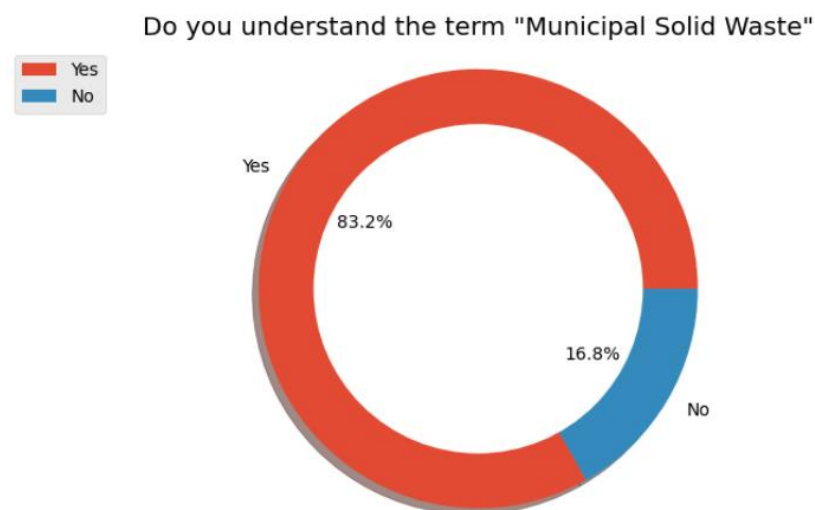
Figure 6.2: shows results for descriptive analysis of respondents' knowledge of municipal solid waste.

According to Figure 6.3, 83.2% of respondents know the meaning of municipal solid waste management. This positive response indicates that the respondents know what municipal solid waste is.

Furthermore, results show the descriptive analysis for respondent's locations. The study needed to know about the respondents' localities within Nigeria. To give an idea of the states they live in, provide some information on Nigeria's concentration of waste activities. The distribution is depicted in the map in Figure 6.3 below. The Table shows the distribution of

locations in several Nigerian states. The survey collected responses from 25 of Nigeria's 36 states.

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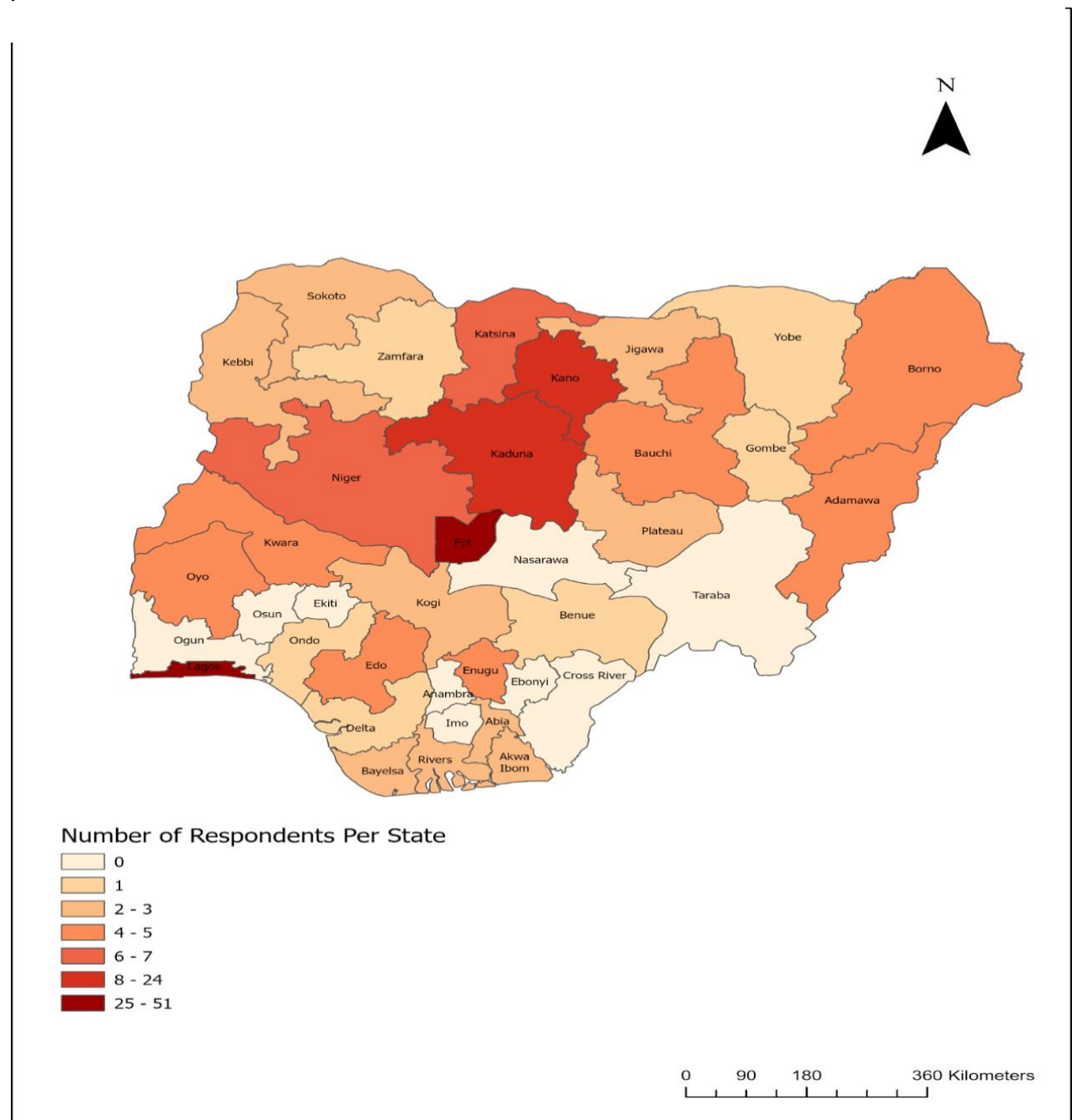
Figure 6.3: shows the distribution of respondents' locations in Nigeria

Results show that the respondent distribution is most concentrated in Abuja. Because it is Nigeria's capital and is occupied by highly educated, working-class residents who have high access to the internet and mostly use at least one social media platform making them more active on social media. The second highest distribution is in Lagos state. Lagos state is the most populated state in Nigeria and the country's largest modern economic hub, with the largest GDP, followed by Kano state. According to the National Bureau of Statistics NBS (2022), Lagos, Abuja, and Kano are some of the states with the highest number of internet users in Nigeria. The tallying results explains why the respondents are concentrated mostly in these states. The location of the respondents critical because it provides some understanding to the study based their responses.

Additionally, The gender of respondents was investigated in the study reveals that most respondents were male; this has no bearing on the waste management responses, but it provides information on the gender distribution of those who responded.
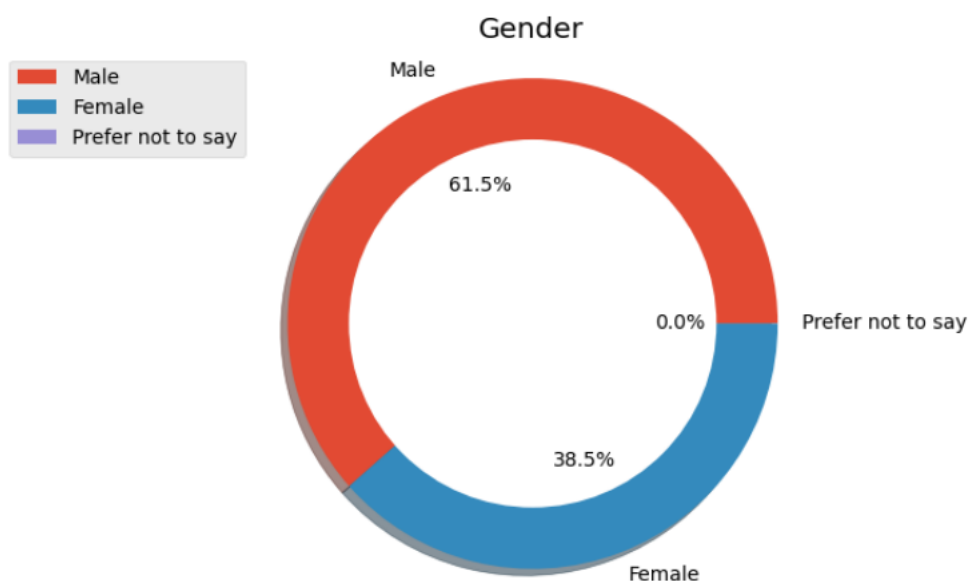
Figure 6.4: shows a diagram illustrating the gender distribution of respondents.

This section provides gender distribution demographic questions. This information provides a quick understanding of which gender participated in the poll more significantly. 62% of males and 38% of females participated in the study. This is due to the presence of men on social media more than women. Statista (2022) shared a report on the gender distribution of social

media users in Nigeria, showing 58.7% of men and 41.7% of women. Naturally, based on the statistics by Doris (2022), overall, 41% of users in Nigeria were women, and 57.7% were men. That means more men are expected to participate in the survey due to their dominant presence on social media.

This respondent's age was also investigated. Results showed that the highest distribution of the respondents was within the 30-39 age bracket in Table 6.5 below.
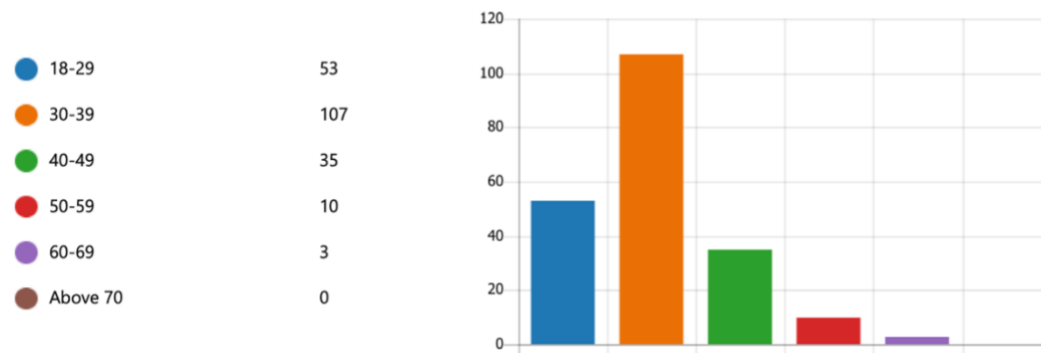
Figure 6.5: shows the age range of respondents.

The highest age bracket of respondents is (30-39) 52%, and the smallest age category is (60-69) The age group result tallies with the general statistics by Doris D.S (2022) that as of July 2022, there were over ten million Instagram users in Nigeria. About 37% of users were between 25 and 34 years, and 32% were aged 18 to 24. On the other hand, Just three per cent of the users belonged to the 55 to 64 years category.

The respondent's level of education was also investigated. This is essential to understand how it relates to the awareness level, participation, and payment for waste services. Results are shown in Figure 6.6.
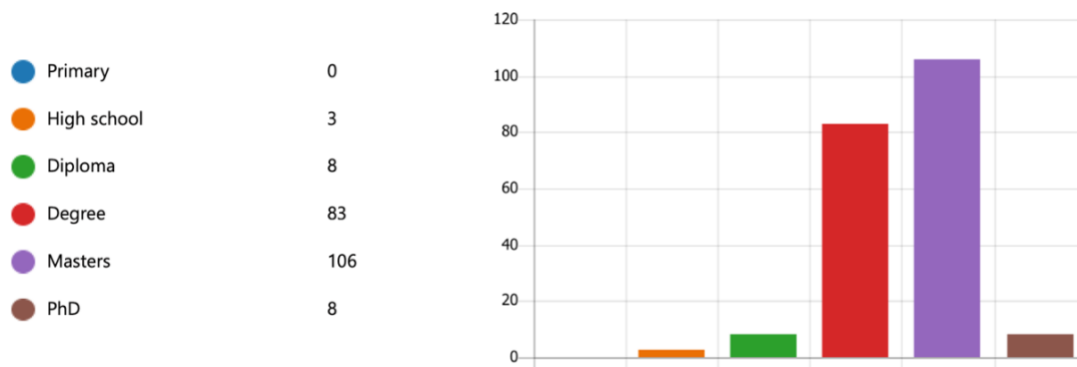
Figure 6.6: shows the respondent's level of education.

Figure 6.6 indicates that most respondents hold a master's degree 106 (51%), a bachelor's degree 83, a doctorate, and a diploma with eight individuals each, and no one stopped at primary education, indicating that all respondents have a higher education, which may increase their knowledge of waste management and waste participation levels. It is assumed that the level of education correlates with waste management awareness. Later in the study, a correlation analysis will be carried out to empirically confirm if there is a relationship between awareness and level of education. In a society where most of the population is educated and has fewer fundamental cultural assumptions or biases, it may be easier to impart waste management information, and the compliance rate may rise. Although a PhD candidate or master's degree holder may obtain more information than a bachelor's degree or associate degree holder, the level of education may not be significant if sensitisation is done correctly at all levels. Some experts say Nigeria's waste management issues result from a lack of education and awareness. However, based on the respondent's level of education, they likely have some familiarity with the topic.

Occupation or employment status is investigated to allow the study to understand the occurrence of certain variables, especially the affordability for waste services payment. This is depicted in Figure 6.7 about their occupation.

Occupation

- Employed
- Not employed
- Self employed
- Retired

Employed
66.8%

1.0%   Retired

24.0%

8.2%   Self employed
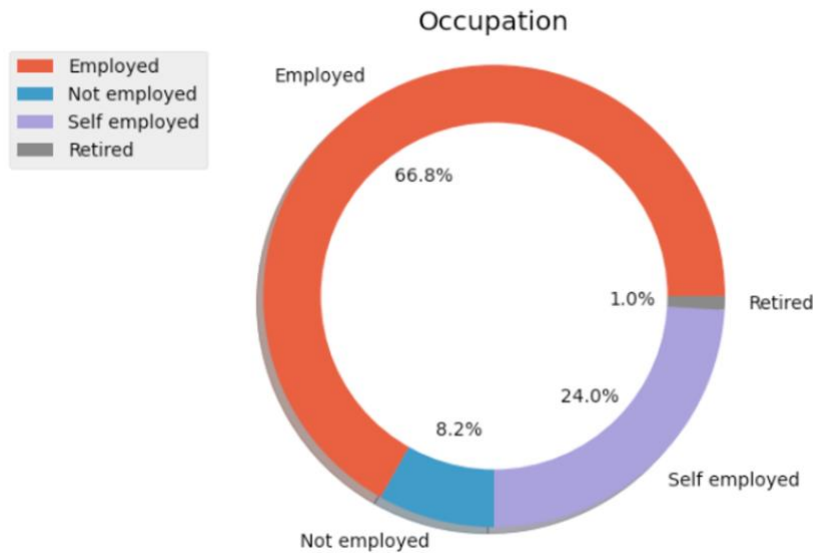
Not employed

Figure 6.7: Pie chart showing the employment status of respondents.

According to Figure 5.7, 67% of respondents are employed; the majority are used, only 1% are retired, and only 24% are unemployed. This again demonstrates the distribution of the respondents in the sense that they are not in their retirement years, indicating that this is a younger generation, like Figure 6.3. This data reveals crucial waste management information regarding waste generation. It is often assumed that any individual with a job generates waste in multiple locations. As of 2022, approximately 60 million people in Nigeria were employed, according to estimates by Statista (2022). Both employed and self-employed individuals are likely to generate waste at their homes and workplaces, so waste generation is greatly affected due to population and rate of waste generation, and significant challenges are likely to arise.

However, in this study, rather than waste generation, waste disposal is essential to the research, though the demography helps determine the level at which the respondents operate. The experts in section (5.1) have discussed the difference between high-income/ urban areas and low-income/ rural areas, which means that high-income earners are mostly educated and working class and that demography mostly pays for waste services, which will be seen in section C of the survey regarding the public's payment of waste services.

The demographic representation of this study will play an essential role in understanding the respondents. It will also identify which predicts or influences the general themes as the dependent variables. Now that we know the respondents' background, it is essential to determine the correlation between the demographic (independent variables) and the general themes for the survey (dependent variables). As discussed earlier in this section, all quantitative data will be analysed under its grouped category; for example, referring to behavioural factors which we began discussing, the level of public awareness will be analysed using a general descriptive analysis to understand how many respondents are aware of the concept of municipal solid waste.

Respondents were asked if they understood the concept of municipal solid waste on a yes or no scale, as depicted in Figure 6.8.

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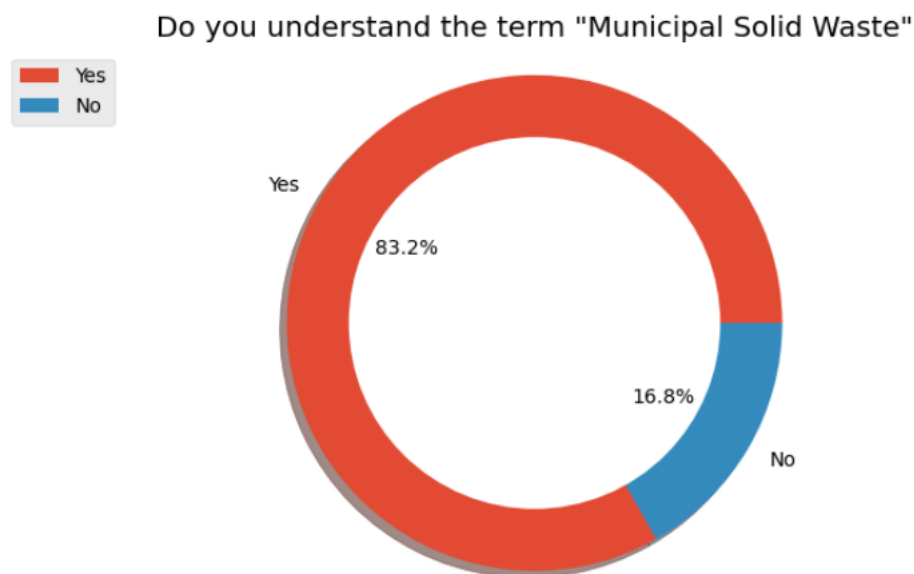
Figure 6.8:shows the responses on understanding municipal solid waste management.

173 out of 208 respondents said they understood municipal solid waste management. This suggests that most respondents understand the issue. These results contradict the statements made by experts and the literature regarding a lack of awareness of municipal solid waste

management. Fewer individuals responded with "NO", given this result. As the experts have suggested, the positive responses and participation in high-income areas may indicate that high-income earners are better educated and can access waste management information, likely through the Internet.

Respondents who answered yes to understanding the concept of municipal solid waste were asked to briefly explain what municipal solid waste management meant to them; responses included "domestic waste, waste from households, domestic waste, and everyday waste, but some respondents said liquid waste fig. 6.9.

Figure 6.9: shows responses on what municipal solid waste management means to respondents.

The respondents were asked to give their own meanings of municipal solid waste to validate their understanding of municipal solid waste management, as some had previously responded affirmatively to Question 7's inquiry on whether they understood municipal solid waste management. The replies revealed that 177 people answered the question, but only 173 responded positively to Q7. If only 173 are aware of municipal solid waste management, it is possible that the remaining four respondents answered incorrectly since some of them selected "liquid waste."

This is evidence that contrary to what the experts have claimed, individuals are informed about waste management, but the educated populace is most likely to have such knowledge. This knowledge may be obtained through reading, television, formal education, or the Internet. However, after carefully reviewing the responses, most of the respondents answered: "daily waste" (3%), "waste in the trash" (2%), "home waste" (3%), "waste and garbage" (3%), and "solid waste" (25%) and "domestic waste" (2%) while others answered incorrectly with "liquid waste" (1%) and "industrial waste" (2%). This could mean that respondents could be sounder on waste knowledge but do have an idea about it.

After responding positively to the concept of waste, respondents were asked if they were aware of the negative impacts of municipal waste to answer either yes or no; the results are shown below in Figure 6.10.
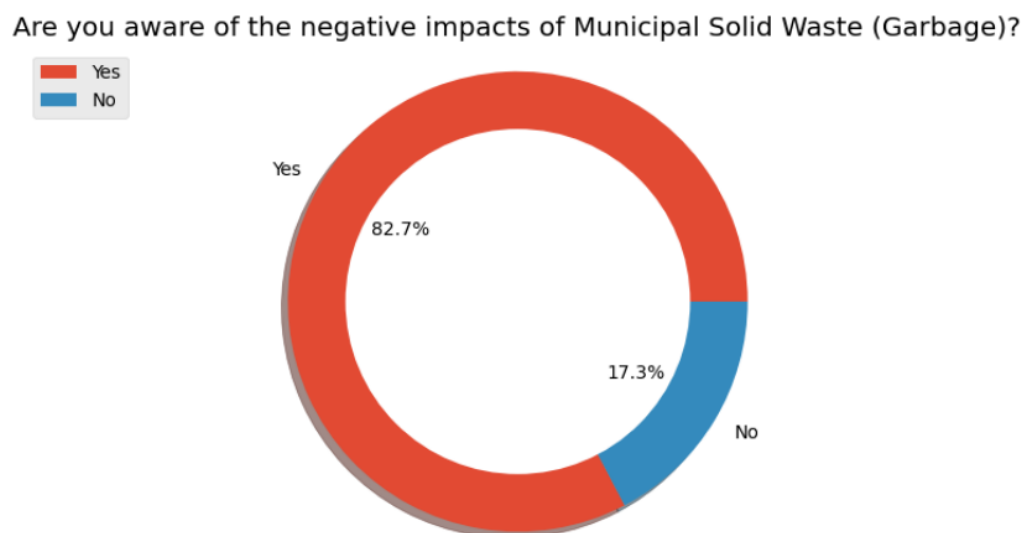
Figure 6.10: shows respondents' awareness of the negative impacts of municipal solid waste management.

The question above is to get in-depth information on the respondent's understanding of the impacts of waste management. 83% answered "yes," and 17% answered "no". This does not differ much from the previous question of understanding the municipal solid waste concept. This means that the respondents have been consistent with their responses, and one more respondent did not know about the impacts of waste management.

Furthermore, the respondents were asked to give a few examples of their opinion of the negative impacts of municipal solid waste; however, in this case, all 208 respondents answered, responses shown in Figure 6.11 below.

78 respondents (**38**%) answered **pollution** for this question.

Land pollution pests and disease pollution to land
environmental pollution Spreading of diseases
pollution risks water pollution **pollution** **disease** Disease outbreak
pollution to air Health hazard Cause infectious diseases
Cause disease Air pollution environment
Blockage of drainage land and water blocking drainage

Figure 6.11: shows participants' responses on examples of negative impacts of municipal solid waste.

According to Figure 6.11, 58% of respondents named pollution, 35% identified disease, and 14% answered environmental problems. The results demonstrate that respondents are fundamentally aware of the impact of municipal solid waste management. This also shows the level of municipal solid waste management knowledge these respondents possess. This results from their education level and exposure, as 100% are educated at different levels.

The respondents were then asked on a Likert scale ranging from "extremely disagree, disagree, not sure, agree and extremely agree" about their knowledge of waste separation. This will give an entire picture of the public's understanding of general waste activities and will lead us to discover the potential of waste separation in the country if there is awareness. The results are presented as follows:

A: "I have been taught about recycling and garbage separation", Respondents answered as follows, shown below in Fig 6.12.

B: "I know how to recycle and separate garbage" results are shown in Fig 6.12 below
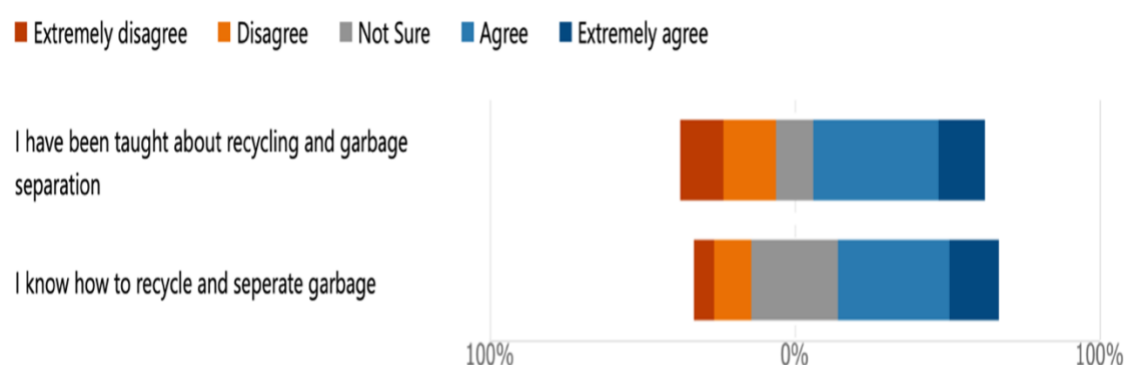
Figure 6.12: shows the extent to which respondents were taught about municipal solid waste.

The highest positive response was 53.6% of respondents agreeing they had been taught about recycling and source separation. With 30% disagreeing that they were taught, this provides an overview of waste awareness in Nigeria. According to the experts, the Nigerian education curriculum has no waste management education. Also, based on the education level provided in question 5, it is possible that waste management is taught in higher education institutes, for instance, in environmental departments, and some even get their degrees from the environmental management department. In this study, about three academics were interviewed from the environmental management department in their various universities. That means since most of the respondents are educated up to master's degrees, they most likely have been taught either as a course of study or awareness through university school activists, as many respondents hold master's degrees, degrees, and doctorates. According to a website study in Naija (2022), about nine universities currently offer environmental science courses in Nigeria. Some Nigerians also study abroad, meaning some respondents may have learned in foreign countries where the waste management is taught and practised.

As many respondents are working or self-employed, some could have been taught during training. It has also shown that even among the educated respondents, 31% of them disagreed that they had been taught about recycling and waste separation. This supports the expert's views regarding waste education, although it is not the most responses. However, as noted above, there are many circumstances in which people may learn about recycling and waste separation outside the Nigerian school system. The second section of the survey questionnaire discusses the public's participation and knowledge.

According to the descriptive analysis, it is now seen that contrary to the statements made by the experts in section (5.4.1.2), many of the respondents claim to understand the concept of municipal solid waste. However, it must also be considered that the experts mentioned some demographic variances such as location, income level, etc. These varying factors influence the awareness of the public and the success of waste management systems in general. Therefore, this study conducted a cross-tabulation and regression analysis to analyse the correlation between the demographic backgrounds of the respondents and their awareness level to determine the correlation between the variables.

6.4   Responses on the public's awareness level of waste management.

The interview responses show that one of the biggest challenges affecting municipal solid waste management in Nigeria is the public's lack of awareness, but this does not mean the entire population needs an understanding of waste management. As the experts have mentioned, the level of awareness can differ based on the respondent's demographic status, such as education, employment status, age, location, or gender influencing awareness level. Therefore, a cross-tabulation analysis was conducted on the survey data to understand further the relationship between the respondent's characteristics and their level of awareness.

The question "Are you aware of the impacts of waste" was linked to the demographic variables, including age, education level and occupation. It has shown that there are relationships between these variables and the level of awareness. However, further investigations will be made to evaluate the level at which they are related. For instance, Table 6.3 assesses the understanding of waste's impacts and respondents' education level.

Aware_of_negative_impacts	No	Yes
Education		
Degree	15(18%)	68(81%)
Diploma	4 (50%)	4(50%)
High school	0(()%)	3(100%)
Master's	16(15%)	90(84%)
PhD	1(12%)	7(87%)

Table 6.3 shows responses to awareness of the impacts of waste by education level.

The cross-tabulation results provided show the percentage distribution of respondents based on their level of education (Degree, Diploma, High School, Master's, and PhD) and their awareness of negative impacts (No and Yes). (100%) of high schoolers and (87.5%) of the

respondents with a PhD are aware of the negative impacts of waste, as well as (84.9%) and (81.9%) of master's degrees and degree holders, respectively, have awareness. The respondents with the slightest understanding are diploma holders, with a 50% awareness level. The high schoolers have the highest percentage of yes responses with a 100% awareness, then the PhD holders with 87.5% and 84.9%, 81.9% for masters and degree holders, respectively.

It appears that awareness of negative impacts varies across different levels of education. Respondents with higher levels of education, such as master's and PhD, tend to have higher awareness of negative impacts compared to those with lower levels of education, such as diploma or high school. However, it's important to note that the sample size for some education levels (e.g., high school and PhD) is relatively small due to random sampling and the level of education. The level of education among Nigerian social media users could range from high school graduates to individuals with advanced degrees, and it may not be limited to any specific educational level. The education level of social media users in Nigeria is likely to be diverse and could vary across different platforms and user segments. For instance, this study distributed survey questionnaires on LinkedIn, this study and is more of a professional platform therefore, there is high usage by bachelor's degree owned and master's degree owners. As for PhD owners, there is only 1.6% of them globally, according to OECD (2021). Therefore, a population based on education cannot have a random distribution.

This shows that in Nigeria, the higher the level of education, the more awareness people have of waste management, but those in high school also seem to have awareness; since there is no waste management education in the Nigerian curriculum, it could be that they acquired the knowledge through exposure to the internet and social media. It could also be that the students were enlightened about waste management through activists going to schools and teaching them about waste management. Waste management activities go to primary and secondary schools to sensitise students on waste management activities. For instance, in 2022, Nestle Nigeria trained over 1000 primary school students across Lagos, Ogun state, and the Federal Capital Territory, Environ news (2023).

It is shown that education affects the level of awareness of waste management. It means those educated are likely to be aware of waste management impacts through formal or informal ways, e.g., school, the internet, and social media.

Aware_of_negative_impacts	No	Yes
Occupation		
Employed	25(18%)	114(82%)
Not employed	4(24%)	13(76%)
Retired	0(()%)	2(100%)
Self-employed	7(14%)	43(86%)

Table 6.4 shows a visual representation of responses to awareness by occupation.

Notably, most respondents across different occupations are aware of the negative impacts of waste management. However, there are some variations in awareness levels among different occupation categories. Employed individuals have the highest percentage of awareness at 82%, followed by self-employed individuals at 86%, those who are not employed at 76%, and retired individuals at 100%.

The highest number of positive responses comes from the employed respondents, then the self-employed category and the lowest category are the unemployed respondents. However, being unemployed does not mean a lack of education. In the previous sections, all respondents are educated, unemployed, self-employed, or retired, but this does not necessarily mean respondents are uneducated. This means that any employed person most likely has an education and internet access, hence the highly positive responses.

The results suggest that occupation may shape awareness levels, with variations observed among different employment statuses. Further analysis of contextual information is needed to understand the underlying factors contributing to these differences in awareness levels among various occupation categories.

Awareness linked to age.
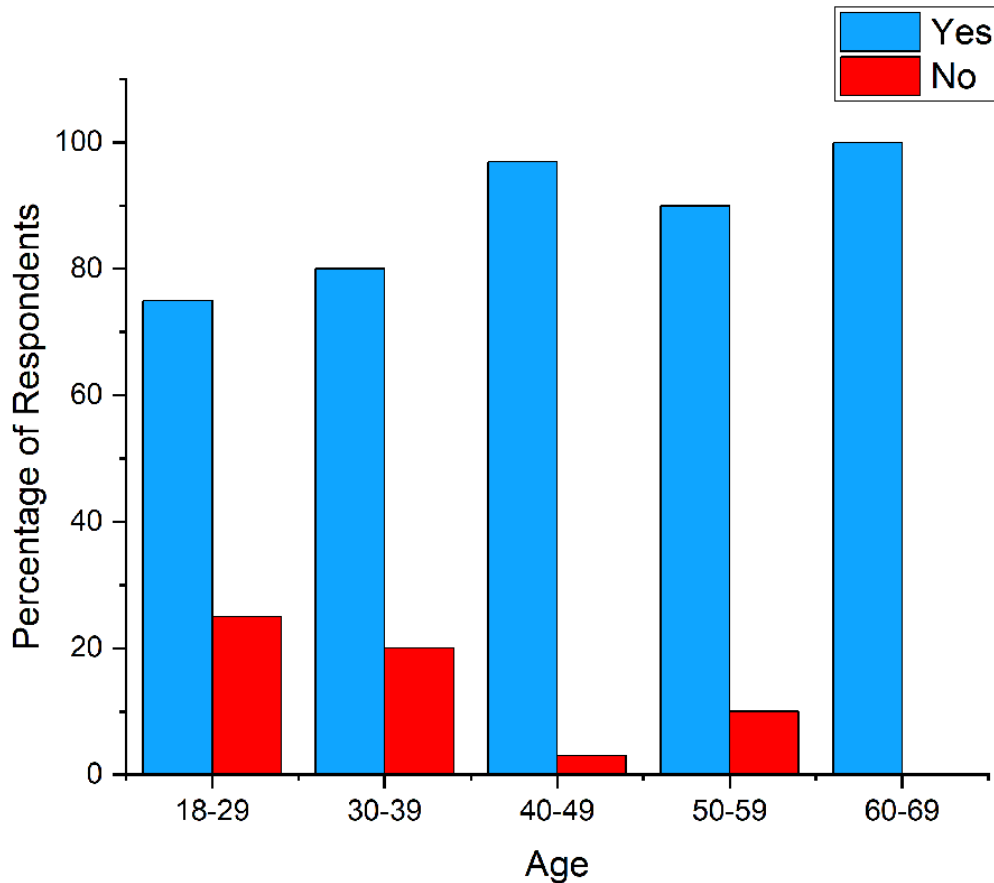
Figure 6.13: shows a visual representation of the responses to awareness by age.

In this analysis, the age of the respondents is essential for determining which age group is most aware of the impact of municipal solid waste management in Nigeria. 50-59 age group at 90% and the 60-69 age group at 100%. Despite minimal participation in the survey, both age groups had a high proportion of favourable comments. This means that this group is educated and has gathered knowledge on waste issues through the internet, university, workplace or formal or informal experiences. As previously noted, the two age groups are not mostly on social media, yet results show that they are aware of waste impacts.

The results suggest that awareness of the negative impacts of waste management tends to increase with age, with higher percentages of awareness observed in older age groups. The highest awareness levels are seen in the age groups of 40-49 years, 50-59 years, and 60-69 years, with 97%, 90%, and 100% awareness, respectively. The lowest awareness level is observed in the age group of 18-29 years, with 75% awareness. The age-based differences in

awareness levels could be attributed to a variety of factors, such as education, life experiences, and exposure to environmental issues, which may vary across different age groups. Further analysis or contextual information is needed to understand better the reasons behind these age-based differences in awareness levels related to waste management impacts.

6.5   Correlation coefficient analysis between respondents' awareness level and their demography

In the above paragraph, the respondents' answers have been seen based on their demographics; however, even though they have responded positively to some questions, it cannot be concluded that there is a relationship between the respondent's demographics to awareness. It must be investigated to determine if these variables are related to confirm that. Therefore, a correlation coefficient analysis was conducted as the most suitable way to verify if there is a relationship between the study's dependent and independent variables (age, education, location, occupation, and gender). Because the variables are categorical with nominal, ordinal, and interval variables, Spearman's and Pearson's correlation coefficients are utilised in this study. Spearman's correlation is a non-parametric measure of the correlation between two or more variables Makowski, Ben-Shachar, Patil, and Lüdecke (2020).

 In contrast to Pearson's correlation coefficient, which measures the linear link between two random variables, Spearman's correlation coefficient assesses a monotonic association and is thus significantly less limiting Yu and Hutson (2022). Pearson's correlation is also used in this study to measure the correlation between dependent variables and age, which is an interval variable where x and y are the X and Y sample averages, respectively; SX and SY are the X and Y sample standard deviations, respectively; The value of r X Y fluctuates between -1 and 1, with the closer it is to 1, the variables is said to be strongly correlated with each other, and once near to 0 (zero), the variables being said to be uncorrelated with each other Marcondes dos Santos and Perrella Balestieri (2018). The Spearman correlation was used to measure the correlation. The nominal variables, including gender, level of education, employment status, location and Pearson's correlation, were used to calculate the correlation with age as interval data. Results are shown below in Table 6.5.

The formula for calculating Spearman correlation is as follows:

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$\rho = 1 - (6 * \Sigma d^2) / (n * (n^2 - 1))$

where:

- ρ: Spearman correlation coefficient
- Σd^2: The sum of squared differences between the ranks of the paired data points
- n: The total number of paired data points

Correlations

			awareness	Level of Education
Spearman's rho	awareness	Correlation Coefficient	1.000	.051
		Sig. (2-tailed)	.	.461
		N	208	208
	Level of Education	Correlation Coefficient	.051	1.000
		Sig. (2-tailed)	.461	.
		N	208	208

Table 6.5: shows Spearman's correlation between awareness and level of education.

Correlations

			Gender	awareness
Spearman's rh o	Gender	Correlation Coefficient	1.000	.056
		Sig. (2-tailed)	.	.420
		N	208	208
	awareness	Correlation Coefficient	.056	1.000
		Sig. (2-tailed)	.420	.
		N	208	208

Table 6.6: shows spearman's correlation between awareness and gender.

Correlations

			awareness	employment status
Spearman's rho	awareness	Correlation Coefficient	1.000	.035
		Sig. (2-tailed)	.	.620
		N	208	208
	employment status	Correlation Coefficient	.035	1.000
		Sig. (2-tailed)	.620	.
		N	208	208

Table 6.7: shows spearman's correlation between awareness and level and employment status.

Correlations

			awareness	Age
Spearman's rho	awareness	Correlation Coefficient	1.000	.181[**]
		Sig. (2-tailed)	.	.009
		N	208	208
	Age	Correlation Coefficient	.181[**]	1.000
		Sig. (2-tailed)	.009	.
		N	208	208

[**]. Correlation is significant at the 0.01 level (2-tailed).

Table 6.8: shows a correlation analysis between respondents' age and awareness level.

All variables were tested with the awareness level of the respondents, and results show that the correlation coefficient between the variables in Tables 6.6, 6.7,and 6.8 all indicate low positive correlations. Outcomes show that for location (r=.074), gender (r=.056), education (r=.051), and employment status (r=.035). The correlation analysis in Table 6.8 examines the relationship between respondents' age and their awareness level of waste management impacts. The results show a statistically significant positive correlation between awareness level and age, as indicated by Spearman's rho correlation coefficient of(r=.181), (p = .009). This positive correlation coefficient of .181 suggests that as respondents' age increases, their awareness level of waste management impacts also tends to increase. In other words, older respondents are more likely to be aware of waste management's negative impacts than younger respondents.

The significance level (p-value) of .009 indicates that the correlation between age and awareness level is statistically significant at the 0.01 level (2-tailed). This means that the likelihood of obtaining a correlation as strong as or stronger than .181 due to chance alone is

less than 1%, supporting the notion that the observed correlation is not likely to result from random variation but rather a true relationship between age and awareness level. The sample size (N) of 208 for both age and awareness level indicate the number of respondents included in the analysis, providing a sufficient sample size for the statistical analysis. Therefore, the null hypothesis (H0) has been rejected and the alternative hypothesis) (H1) has been accepted that all the independent variables are correlated with awareness.

Overall, the correlation analysis suggests that there is a positive relationship between age and awareness level of waste management impacts, with older respondents being more likely to be aware of these impacts compared to younger respondents. However, it is important to note that correlation does not imply causation and other factors could influence the observed relationship between age and awareness level. Therefore, further analysis is needed to understand this correlation's underlying mechanisms.

6.6   Regression analysis between awareness and demographic variables

This section investigates which variables influence the occurrence of awareness of waste. The study identifies which independent variables (age, gender, education, occupation, and location) affect awareness the most. The null hypothesis (H0) states that age does not affect waste management awareness, and the alternative null hypothesis (H1) states that age affects waste management awareness. This analysis is conducted using multiple linear regression. It will provide a deeper understanding of what variable public awareness of waste management among the demographic variables. The regression analysis is conducted using the formula:

$Y = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta nXn + \varepsilon$

where:

- Y is the dependent variable that we want to predict.
- X1, X2, ..., Xn are the independent variables that we believe may influence Y.
- β0 is the intercept term, which represents the expected value of Y when all the independent variables are set to zero.
- β1, β2, ..., βn are the coefficients or parameters associated with the independent variables X1, X2, ..., Xn, respectively. These coefficients represent the change in Y for

a unit change in the corresponding independent variable, holding all other variables constant.

- ε is the error term, which represents the random variation in Y that the linear relationship with the independent variables cannot explain. It is assumed to be normally distributed with a mean of zero and constant variance.

Source	SS	df	MS	Number of obs	=	208
				F(5, 202)	=	1.53
Model	1.08935783	5	0.217871565	Prob > F	=	0.1806
Residual	28.6798729	202	0.141979569	R-squared	=	0.0366
				Adj R-squared	=	0.0127
Total	29.7692308	207	0.143812709	Root MSE	=	0.3

Awareness	Coefficient	Std. errs.	t	P>t	[95% conf.	interval]
Age	0.072174	0.0315109	2.29	0.023	0.0100416	0.134306
Gender	0.0295099	0.0547338	0.54	0.59	-0.078413	0.137433
Education	0.0063206	0.0183187	0.35	0.73	-0.0297998	0.042441
Occupation	0.0145707	0.0210896	0.69	0.49	-0.0270133	0.056155
Location	0.0014214	0.0024586	0.58	0.564	-0.0034263	0.006269
_cons	1.561216	0.1255499	12.44	0	1.313659	1.808772

Table 6.9: shows the independent variable's statistical significance on awareness using regression analysis.

Table 6.9 shows that all independent variables indicate a low positive correlation coefficient. Overall, the table provides information on the coefficients, standard errors, t-values, p-values, and confidence intervals for the predictor variables to the awareness of the dependent variable. Age appears to have a statistically significant positive relationship with awareness, as indicated by its coefficient, standard error, t-value, and p-value. However, the other predictor variables (Gender, Education, Occupation, and Location) do not appear to be statistically significant predictors of awareness, as their coefficients have larger standard errors and higher p-values. However, age indicates a statistical significance to awareness and a low positive correlation,

meaning it has the strongest relationship with awareness than other independent variables (b=-.07217, s.e.= .278, P= 0.023). These results tally with the correlation analysis; however, the p-value differs. This result rejects the null hypothesis (H0) stating that age does not affect awareness of waste management and accepts the alternative hypothesis that age is affects the awareness of waste management.

Individuals' age significantly influences their awareness of waste impacts in Nigeria, as indicated in Table 6.9. The crosstabulation between awareness of waste impacts and age revealed that higher age groups tended to have more positive responses. This aligns with Shaw's (2017) explanation that growing older and gaining experience during the ageing process can increase knowledge and positive attitudes towards waste and its impacts. In Table 6.9, the youngest age group had the lowest percentage of positive responses, while the highest age range had the highest percentage. This is likely because older individuals have acquired knowledge through formal or informal means, as well as experiences and greater exposure to waste management issues.

Notably, Nigerian schools have no formal waste education curriculum from nursery to secondary levels, which may explain the low awareness among younger age groups who may rely on informal means of information. However, as individuals age and gain more experiences and exposure, particularly with the internet and social media availability, they become more aware of waste management issues. Some individuals may also study environmental courses in higher institutions, as some universities in Nigeria offer environmental management and environmental engineering courses.

The findings highlight the importance of considering age as a relevant factor in waste management sensitisation efforts in Nigeria. It provides insights into which age groups may require more focus and attention in sensitisation campaigns. For example, since the younger generation shows lower awareness of waste management, efforts should be directed towards introducing waste education in school curriculums to promote a sustainable future. On the other hand, since older individuals tend to have more favourable attitudes towards waste management, they may be more receptive to educational efforts. Overall, understanding the influence of age on awareness of waste impacts can guide effective strategies for waste management sensitisation in Nigeria.

6.7 Responses for the public's waste services payments.

This section examines the financial aspect of municipal solid waste management regarding the public's role in the funding issues previously discussed by experts and in the literature. The responses will provide a comprehensive overview of the Nigerian waste management system's funding difficulties because payments for waste services are crucial to achieving sufficient funding. For example, in section 5.4.2.1, the experts explain inadequate funding and how insufficient funds are; some experts explain that funds are wrong because the public does not contribute to the waste system by not paying taxes and fees for waste collection services.

In addition, some experts have argued that poverty also contributes to the problem; nonetheless, some residents in high-income areas, particularly in Lagos state and the federal capital territory, often pay for waste services. Similarly, Elebiju (2020) argued in the literature that in developed countries, municipalities earn money via fixed taxes, environmental taxes, fine enforcement, and promoting the polluter-pay concept, while most developing countries, especially Nigeria, do not. Therefore, this section will explain from the public's perspective and corroborate the claims' validity.

Respondents were asked about waste management's financial aspects to determine the payment status for waste management services. Experts mentioned this topic in the interview as impacting waste management's finance and revenue generation. Figure 6.14 displays responses as follows:
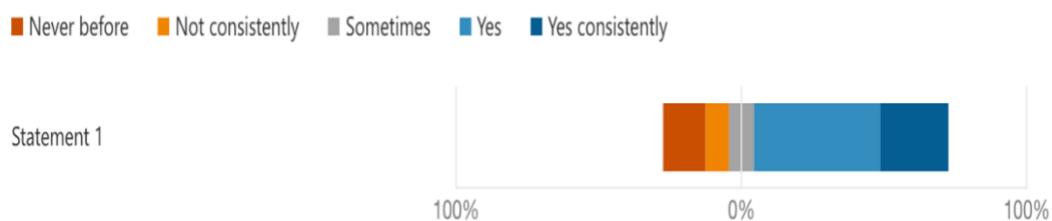
Figure 6.14: shows responses to payments for waste service.

68.2% answered, 'Yes' suggesting they pay for waste services without fail, and 23.1% don't pay for waste. This result contradicts the general claims made by the literature and experts that,

generally, people do not pay for waste services. However, the experts mentioned that payment for waste services is vastly more effective in Lagos state and the federal capital territory, Abuja. Judging by the respondents' locations, most of them are in these areas. This suggests that the experts may be correct on the non-payment impact on funding, but it does not apply to these citizens since they live in high-income areas or in a state where waste services fees are adequately enforced and comply.

Furthermore, respondents were asked if they would be willing to pay more for waste services if necessary. This would determine the possibility of generating more revenue in the waste management industry. Since poverty has been cited as one of the primary reasons why many people cannot pay for waste services, Fig 6.15 will show whether the public is willing to pay more for waste services to generate more income and if those already paying will agree to pay more to try to close the revenue gap.
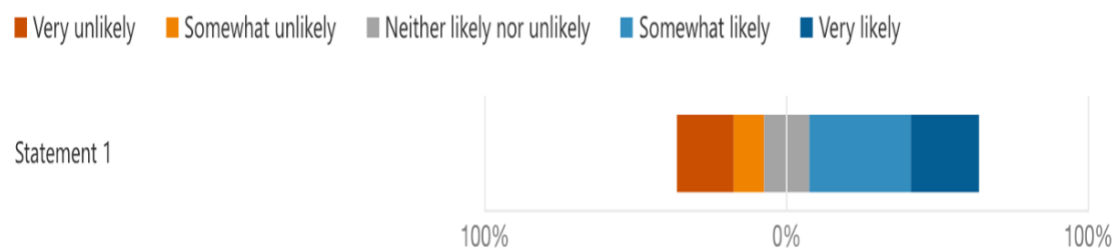
Figure 6.15: Shows responses to increased waste services fees.

56.3% agreed to incur higher waste service fees, while 43.8% responded negatively to the question. This means a high percentage of respondents are willing to increase their waste service fees, and a large portion is not willing to pay; nonetheless, according to the results above, it is a positive outcome. This is likely due to these respondents' awareness of municipal solid waste and its impacts, demonstrating their level of compliance if a law is enforced. It also gives an idea of their income level, meaning they can afford to pay higher. With proper sensitisation and enforcement, unwilling people may comply with the rules if implemented.

Experts said earlier in the interview chapter that the public does not pay for waste services and that government financial allocations alone cannot sustain waste management operations in the

country. This cross-tabulation analysis will validate the assertion by comparing multiple variables to determine if it is a general problem or if there are specific contributing factors. The study compares the statement I am currently paying for waste services linked to education, occupation and age of the respondents as follows:

currently_paying_for_waste_management	Never	not consistently	Sometimes	Yes	consistently
Education					
Degree	17(20%)	7(8%)	10(12%)	30(36%)	19(22%)
Diploma	3(37%)	1(12%)	0(0%)	3(38%)	1(13%)
High school	1(33%)	1(33%)	0(0%)	1(33%)	0(0%)
Master's	9(8%)	8(8%)	8(8%)	53(50%)	28(26%)
PhD	1(13%)	0(0%)	0(0%)	5(62%)	2(25%)

Table 6.10 shows responses to payment of waste services by education level.

The findings from this section highlight that individual with higher levels of education, specifically those with a PhD and master's degree, tend to pay more for waste management services. According to Table 6.10, out of the 142 respondents who reported paying for waste management services, 62.5% hold a PhD, 76% have a master's degree, and 58.8% have other educational backgrounds.

On the other hand, respondents with a high school diploma show the lowest participation rate in paying for waste services, with only 49% reporting payment. Similarly, respondents with a high school education pay for waste services at a rate of 33%. This suggests that individuals with lower levels of education tend to pay for waste services less frequently.

The results also indicate that higher levels of education are associated with a more positive response towards paying for waste services. This may be due to the respondents' greater awareness of the environmental impacts of waste or their higher likelihood of being employed or self-employed. Notably, the majority of respondents reported being employed or self-employed, and the highest age range of respondents were those with a master's degree, who are more likely to have jobs and the financial capacity to afford waste services in their areas.

This section demonstrates that those with the highest level of education, the Ph.D. holders, pay the most for waste management services, followed by those with a master's degree. According to Table 6.10, 142 respondents pay for waste management services, including 62.5% with a PhD, (76%) with a master's degree and (58.8%) respondents.

The groups that pay the least frequently are those with a high school diploma. Although they have a low participation rate, their responses show that the percentage of those who pay for waste services is considered low, with (49%) and (33%) for diplomas and high schoolers, respectively.

The results indicate that the higher the education, the more positively they responded to paying for waste services. This may be due to their knowledge of the impacts of waste or because they are mostly employed or self-employed as the majority of the respondents have answered to be either employed or self-employed, and the highest age range of the respondents are master's degree holders who mostly have jobs and can afford to pay for waste services in their areas.

The payment of waste management services was also linked with the participant's employment status to see if their employment status is related to the respondent's ability to pay for waste services. Table 6.11 shows the link between waste services payments to participants' occupations.

currently_paying_for_waste_management Occupation	Never	Not consistently	Sometimes	Yes	consistently.
Employed	20(14%)	11(8%)	9(6%)	64(46%)	35(25%)
Not employed	6(35%)	2(11%)	6(35%)	1(6%)	2(12%)
Retired	0(0%)	1(50%)	0(0%)	1(33%)	0(50%)
Self-employed	5(10%)	3(6%)	3(6%)	26(52%)	13(26%)

Table 6.11 shows responses for payment for waste services by employment status

The table provides insights into the relationship between occupation and the frequency of paying for waste management services. Employed individuals and self-employed individuals report higher rates of consistent payment for waste services, while those who are not employed or retired tend to report lower rates of consistent payment.

It indicates that employed and self-employed respondents pay for waste services. Employed respondents pay the most for waste services, with (71%) having affirmative responses and (13%) indicating they pay occasionally. The category of self-employed individuals has the most significant percentage of payment rates, at (78%). In contrast, only three unemployed individuals confirm payment for garbage services occasionally. Nonetheless, many respondents in these categories confirm paying for waste services.

The higher rates of consistent payment for waste services among employed and self-employed individuals may be attributed to their consistent income, which allows them to afford such services. While this does not necessarily indicate whether their incomes are high or low, it does highlight their ability to pay for waste services consistently. However, it's worth noting that not all employed and self-employed respondents reported paying for waste services, with approximately 21.9% of employed and 16% of self-employed respondents indicating that they never paid for waste services. This could be due to various reasons, such as weak enforcement in their location or lack of understanding of the impact of waste, suggesting a need for increased sensitisation efforts.

Furthermore, it is important to note that all employed and self-employed respondents are likely to be educated, as indicated in Table 6.11. Educated respondents correlate with awareness of waste impacts, which may make individuals more inclined to pay for waste services regardless of their employment status. The ability to pay for waste services may also be influenced by the stability of their employment status, as reflected in the higher payment rates among those with solid employment compared to the lower percentage among unemployed and retired respondents.

In conclusion, the affordability and income stability associated with employment or self-employment may contribute to higher payment rates for waste services, as reported by many employed and self-employed respondents. However, other factors such as location, enforcement, and awareness of waste impacts also play a role in determining payment behaviour among different occupational groups.

currently_paying_for_waste_management.

	Never	not consistently	Sometimes	Yes	consistently
Age					
18-29	11(20%)	5(9%)	7(13%)	17(32%)	13(24%)
30-39	15(14%)	6(6%)	8(7%)	52(49%)	26(24%)
40-49	5(14%)	4(11%)	2(6%)	15(43%)	9(26%)
50-59	0(0%)	1(10%)	1(10%)	6(60%)	2(20%)
60-69	0(0%)	1(33%)	0(0%)	2(67%)	0(0%)

Table 6.12 show responses to payment for waste services by age.

Based on Table 6.12, The older the age group, the fewer negative responses. The most senior age group, 50-59 and 60-69, have no adverse reactions. Only 31 of the 208 respondents

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answered, "never before" when asked if they paid for waste services, and 122 said "yes" and "yes consistently". Due to participation, the (30-39) age group had the most significant number of favourable responses at 72.5% due to their high involvement; however, the (50-59) age group had the highest percentage with no adverse reactions and 8 (80%) out of 10 with no negative responses and two respondents paying sometimes but not consistently.

These results suggest that as age increases, there is a trend of a higher percentage of respondents paying for waste services consistently, with the highest percentage observed in the age group of 30-39. It's worth noting that none of the respondents in the age groups 50-59 and 60-69 reported never paying for waste services, indicating a relatively higher tendency to pay consistently among older age groups. However, further analysis and interpretation is required to understand the underlying reasons for these payment behaviours and any potential influencing factors related to age.

More investigations were conducted to find out if there is a relationship between the independent and dependent variables using a correlation coefficient analysis to confirm. Tables in the appendix.

Results show that compared to other demography, only age, level of education, and occupation correlate with payment for waste services with coefficient values of (Education r=.102), age (r=.193), and occupation (r=.051), with education having the strongest r value and P= .003 meaning it has the most statistical significance among the independent variables. However, the results show that location and gender do not correlate with the payment of waste services. The tables below show the correlation between payment for waste services and demographic variables:

Correlations

			payment for waste services	Age
Spearman's rho	payment for waste services	Correlation Coefficient	1.000	.115
		Sig. (2-tailed)	.	.099
		N	208	208
	Age	Correlation Coefficient	.115	1.000
		Sig. (2-tailed)	.099	.
		N	208	208

Table 6.13: shows a correlation of age and waste payments.

Correlations

			payment for waste services	Gender
Spearman's rho	payment for waste services	Correlation Coefficient	1.000	-.215[**]
		Sig. (2-tailed)	.	.002
		N	208	208
	Gender	Correlation Coefficient	-.215[**]	1.000
		Sig. (2-tailed)	.002	.
		N	208	208

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6.14: shows a correlation of gender and waste payments.

Correlations

			payment for waste services	employment status
Spearman's rho	payment for waste services	Correlation Coefficient	1.000	-.021
		Sig. (2-tailed)	.	.766
		N	208	208
	employment status	Correlation Coefficient	-.021	1.000
		Sig. (2-tailed)	.766	.
		N	208	208

Table 6.15: shows a correlation of employment status and waste payments.

Correlations

			Level of Education	payment for waste services
Spearman's rho	Level of Education	Correlation Coefficient	1.000	.202[**]
		Sig. (2-tailed)	.	.003
		N	208	208
	payment for waste services	Correlation Coefficient	.202[**]	1.000
		Sig. (2-tailed)	.003	.
		N	208	208

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6.16: shows the correlation coefficient between the level of education and payment for waste services.

The correlation analysis above indicates that all other demographic variables show negative correlation with the payment for waste services and no statistical significance, and only the public's level of education is associated with the payment for waste services with a low positive correlation coefficient of (r=.202) and is also statistically significant to payment with a P value of (P= 0.003). This means that the level of education and the payment for waste services have a relationship. A correlation matrix is added to this study in the appendix section. However, the correlation coefficient does not show any causation among the two variables; therefore, the study is further analysed to understand how the independent variables influence the dependent variable the most.

The study utilised a multinomial logistic regression analysis because the question asked has multiple categories of answers. Therefore, MLR is the most suitable for analysis. Outcomes are shown in Table 6.16 below. In a waste management study, the logit model was also used by (Angeles et al. 2009) to test the influence of socio-demographic variables on the public's willingness to pay for waste services in Ibadan, Nigeria. Quraishi et al. (2022) used logistic regression to evaluate the Willingness To Pay For Improved Solid Waste Management And Associated Factors Among Households In Pakistan.

The multinomial logistic regression is calculated using the formula:

$$\Pr Y_{ik} = \Pr Y_i = k \mid x_i; \beta_1, \beta_2, \dots, \beta_m = \frac{\exp \beta_{0k} + x_i \beta_k'}{\sum_{j=1}^{m} \exp \beta_{0j} + x_i \beta_j} \text{ with } k = 1,2,\dots,m$$

Where:

- $P(Y = j \mid X1, X2, ..., Xn)$ is the probability of Y falling into the j-th category given the values of the independent variables.
- β0j, β1j, β2j, ..., βnj are the coefficients or parameters associated with the j-th category of the dependent variable for each independent variable X1, X2, ..., Xn.
- exp() is the exponential function.
- X1, X2, ..., Xn are the values of the independent variables.
- k is the total number of categories in the dependent variable Y.

Pseudo R-Square

Nagelkerke	.540

Likelihood Ratio Tests

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	362.519	622.847	206.519[a]	.000	0	.
Gender	366.440	616.755	216.440[b]	9.921	3	.019
Age	357.270	607.586	207.270[b]	.752	3	.861
location	380.438	480.564	320.438[b]	113.920	48	<.001
Level of Education	393.734	614.012	261.734[b]	55.216	12	<.001
employment status	365.263	595.554	227.263[b]	20.745	9	.014

Table 6.17: shows result for regression analysis between independent variables and waste service payments.

The results indicate that some of the predictor variables are statistically significant at certain significance levels. For example, the Gender variable has a Chi-Square statistic of 9.921 with 3 degrees of freedom (df), and a significance level (Sig.) of .019, suggesting that it is statistically significant at the .05 significance level. Similarly, the Employment Status variable has a Chi-Square statistic of 20.745 with 9 degrees of freedom (df), and a significance level (Sig.) of .014, indicating statistical significance at the .05 significance level. The results also show that the R square value indicates that the independent variables included in this model can explain 54% of the variance observed in the outcome. That means the two variables can predict the ability of the public to pay for waste services.

The outcome means that the null hypothesis (H0) that gender does not affect payment for waste services is rejected and the alternative hypothesis (H1) that gender affects payment for waste services has been accepted. It is also concluded that the null hypothesis (H0) that employment status does not affect the public's payment for waste services has been rejected and the alternative hypothesis (H1) has been accepted.

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The study findings suggest that employment status is a significant factor influencing the payment of waste services. This is supported by the notion that only individuals with incomes from jobs or self-employment can afford to pay such fees. It is assumed that unemployed individuals may not have the financial capacity to pay recurring waste service fees, and thus those with higher incomes are more likely to pay for these services. However, further empirical research is needed to identify the specific category of employment that contributes the most to waste service payment.

In addition, gender is also found to be a relevant factor in the payment of waste services or taxes in Nigeria. This is consistent with the traditional gender roles in African households, where men are typically responsible for financial affairs and women assist with household and caregiving responsibilities. Male breadwinning is a common norm in most African communities, as highlighted by Akanle and Nwaobiala (2020). While women in Nigeria may engage in trading and have independent incomes, they are often not considered as family breadwinners. Therefore, males are assumed to have a greater influence on waste service payment in Nigeria.

However, it is important to note that female breadwinners do exist in Nigeria, and women can also pay for waste services. There is a growing trend of female-led households, including single women, divorced or widowed single mothers, or even married women taking on the financial responsibility. This trend is observed in developed countries like the United Kingdom and developing countries like Nigeria and South Africa. As a result, gender roles in financial responsibility are expected to evolve, which may impact the dynamics of household waste management fee payment. Further research is needed to understand these dynamics better and identify which gender should be prioritized in public sensitisation efforts for waste service payment.

In conclusion, the study findings highlight the influence of employment status and gender on the payment of waste services in Nigeria. However, further empirical research is recommended to better understand the specific employment categories and evolving gender roles in waste service payment. This information would be valuable for informing public awareness campaigns and waste management fee collection strategies.

6.8 Responses for the Public's participation in waste activities

Respondents were asked about their waste separation practices. This will give an idea of participation in the waste hierarchy. Even though the experts have established the lack of provision for proper infrastructure, this question will give an idea of how far people's awareness has gone and if it has driven them to action in waste management activities since results have shown that they are willing to participate. It is also possible that some already act without the government's push. The question asks respondents, "Do you already segregate your waste into separate bins? "Never, occasionally, infrequently, constantly, and regularly for (plastic, bottles, paper, and food). This will help determine the level of public participation and source separation knowledge if any. This exemplifies the potential responses illustrated in Figure 6.16.
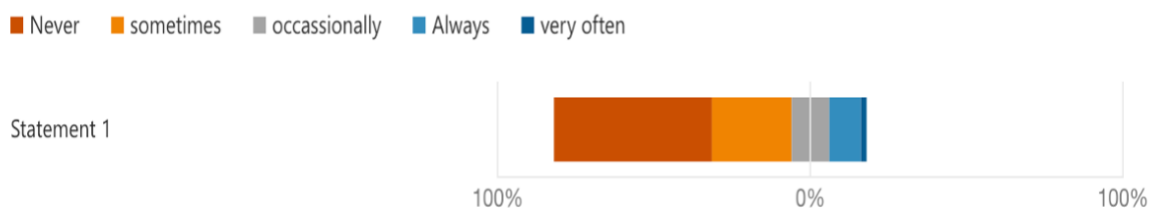
Figure 6.16 shows respondent's waste separation participation levels.

According to Figure 6.16, 50.5% of respondents never answered, indicating that they have never separated waste in their households, while 25.5% and 12% answered sometimes and occasionally, respectively. This former outcome may not be considered a positive response because for waste separation to be effective, it must become a daily habit performed at the source as waste is generated. In the meantime, 12.8% of respondents responded positively. This result indicates that there are low source separation activities in Nigeria, which is consistent with the expert's opinion regarding source separation and its absence from the policy. If a waste hierarchy had been included in the waste policies and implemented adequately, the results would have been very different. This could also be attributed to a lack of political will and a lack of sensitisation to educate the public in the literature review, according to Jamshid et al.

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(2011). Nasrabadi et al. (2008), despite the advantages of waste hierarchy in developing countries, its implementation confronts social opposition, such as public participation and waste management awareness.

Also, According to Ogwueleka (2003), there are no formal recycling or resource recovery policy programmes in Nigeria, nor are there any composting policies. This means the absence of policy and low public participation in waste separation activities shows a wide gap in Nigeria's reaching waste hierarchy. Now that there is a new national policy on plastic waste management, proper policy must be implemented to ensure that a functioning circular economy is reached.

The lack of source separation and, consequently, the waste hierarchy has been explored by experts in the interview and in the studied literature, and as confirmed by the survey respondents. The results demonstrate a need for more infrastructure for efficient waste management. This indicates that, unlike developed nations with distinct waste bins to facilitate source separation, Nigeria lacks the infrastructure required to implement source separation.

Following the previous question, to get a deeper understanding of the respondent's opinions regarding waste separation, the respondents were asked if they were likely to recycle if necessary and required. They were using a range of answers: Very unlikely, somewhat unlikely, neither probable nor unlikely, somewhat likely reasonable, and very possible. Responses were as follows.
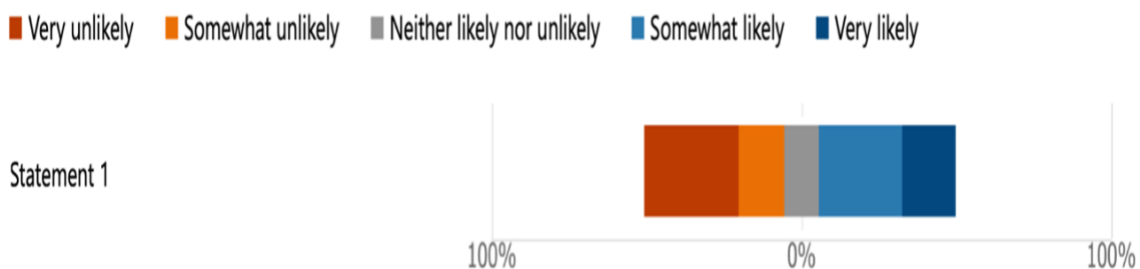
Figure 6.17: shows respondents' responses on how likely it is for them to separate waste.

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This result reveals that Most respondents appear uninterested in recycling 30.3% of respondents were very unlikely to recycle their waste, 14.4% were somewhat dubious, and 11.5% were indifferent. However, 43.8% were likely to recycle their waste. This outcome shows less than half of the respondents are willing to recycle. Nonetheless, 11.5% of those who are apathetic may be persuaded with sufficient education and enforcement.

People's unwillingness to participate in waste-related activities has been noted as an issue in interviews and published works. This can be due to a lack of motivation seen by the people in implementation and enforcement. If the people do not see consistency and strictness in government operations, they will not trust them to do the right thing in implementing waste policies.

The experts noted in section (5.3.2.1) that the general population has a negative and sometimes indifferent attitude toward waste and is either unaware of or unconcerned about the effects of their activities. Keramitsoglou and Tsagarakis (2013) and Krook et al. (2007) stated that public participation in source separation operations significantly impacts the implementation of recycling programmes. This survey's results confirm the point made by experts regarding the public's negative and indifferent attitude toward participation in waste management operations.

To understand why respondents were unwilling to participate, it has been said that a lack of trust in the government can demotivate people to participate in waste activities. The respondents' experience and perception of the government's waste collection performance were questioned. This will aid comprehension of the public's experience with waste collection and collection performance so far and give an idea of why people are so demotivated. Outcomes are shown in Figure 6.18.
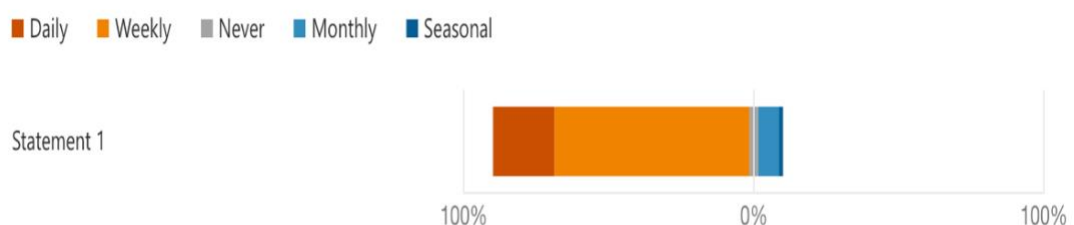
Figure 6.18: shows the frequency of waste collection.

The results have disclosed a pattern of garbage collecting that is largely effective. According to Figure 6.15, 67.3% of respondents said their waste was collected weekly, followed by 21.2% who said it was collected daily, only 2.9% said it had never been collected, and 7.2% and 1.4% who said that waste was collected monthly and seasonal, respectively. This shows a relatively positive outcome. However, as mentioned by the experts in section 4.3.6, waste collection has a lot to do with the location of the respondents. It determines the frequency and quality of operations. Experts mentioned that high-income areas experience better waste service than low-income or rural areas.

The findings contradict the consensus opinion of experts and relevant journals. Nonetheless, both parties have established that waste collection varies by location and that high-income and urban areas have better waste collection services than low-income and rural areas, just as Hoornweg (2012) noted in section 3.7 of the literature review that high-income countries have superior waste services to low-income countries, similarly, some experts indicated in section 5.1.1 that certain high-income, urban regions in Nigeria, such as Lagos and the federal capital area, offer superior waste collection services. These are also the locations most frequently identified by survey respondents. Based on the respondent's background, education, and employment position, it was also established early in this section that they reside in urban or high-income locations.

Participation in waste separation activities: The study evaluates the level of participation of respondents in waste activities. This relevant theme is linked to some demographic variables, including education, occupation/employment status and age. Additionally, further investigations will be conducted to discover which variable affects participation the most.

Waste separation is	Always	Never	occasionally.	sometimes	very often.
Degree	9(10%)	41(49%)	8(10%)	23(28%)	2(2%)
Diploma	3(38%)	3(38%)	0(0%)	2(67%)	0(0%)
High school	0(0%)	0(0%)	1(33%)	2(67%)	0(0%)
Master's	8(8%)	59(56%)	13(12%)	24 (23%)	2(2%)
PhD	1(13%)	2(25%)	3(38%)	2(25%)	0(0%)

Table 6.18 shows the link between participation in waste separation and education.

This result shows a low participation rate in waste management activities, even among educated people in Nigeria. The highest responses from all participants say they "never"

separate their waste, including (55.6%) of the master's degree holders with the most heightened awareness of waste. Then the degree holders at (49.3%) of them never separated waste. However, the remaining respondents fall under other categories, only 26 out of 208 separate scraps. This could be for personal reasons of passion for the environment but not in compliance or enforcement because infrastructure is not in place for waste separation.

This negative outcome is due to insufficient infrastructure, policy, and sensitisation provision to conduct waste separation. As the experts discussed, no specific waste management policies were in place. Thus, there is no infrastructure to facilitate processes like waste separation.

Overall, it appears that waste separation behaviour varies among individuals with different educational backgrounds. Degree holders tend to report higher frequencies of "Never" and "Sometimes" responses, while Diploma and High School holders report higher frequencies of "Always" and "Sometimes" responses. Master's and PhD holders show a similar trend to Degree holders, with higher frequencies of "Never" and "Sometimes" responses. However, it's important to note that the sample size for each educational category may not be equal, which could impact the percentage distributions. Further analysis and interpretation would require considering the sample size and other relevant factors to draw meaningful conclusions from the crosstabulation table.

Waste separation Occupation	Always	Never	Occasionally	sometimes	very often
employed	9(6%)	77(55%)	16(12%)	37(26%)	0(0%)
Unemployed	2(12%)	5(29%)	4(23%)	5(29%)	1(6%)
Retired	0(0%)	0(0%)	0(0%)	2(100%)	0(0%)
Self-employed	10(20%)	23(54%)	5(10%)	9(18%)	3(6%)

Table 6.19 shows responses to participation in waste separation by occupation.

The Table above displays low participation in waste-related activities in Nigeria, independent of employment status or income level. According to Table 6.19, 105 of 208 respondents said "never" when asked if they separated their waste, and only 25 responded positively. This means that even though people are aware of the impacts of waste management, the government has made no facilities for waste separation, and just having an education and employment or income cannot replace the required infrastructure to support waste separation.

This shows that employment status has little effect on engagement in waste separation since employed and self-employed respondents are predominantly negative about waste separation, indicating a low participation rate in waste activities.

Waste separation linked to age.

Waste separation Age	Always	Never	Occasionally	sometimes	very often
18-29	4(8%)	24(45%)	6(11%)	18(33%)	1(2%)
30-39	8(7%)	6(57%)	12(11%)	25(23%)	1(1%)
40-49	6(17%)	15(42%)	5(14%)	7(20%)	2(6%)
50-59	2(20%)	5(50%)	2(20%)	1(10%)	0(0%)
60-69	1(33%)	0(0%)	0(0%)	2(67%)	0(0%)

Table 6.20 shows responses to participation in waste separation by age.

The outcome in Table 6.20 shows a low participation rate in waste separation. As discussed earlier by experts, no infrastructure and policy were provided for separating waste until recently. As seen in the Table above, 105 respondents never separate waste; the rest claim to do it sometimes or occasionally. This indicates low participation in waste activities regardless of age, education, or income status. This is because there are no provisions to facilitate source separation. Nonetheless, it is crucial to understand if there is a relationship between the independent and dependent variables. The analysis was conducted using a correlation coefficient analysis. Table 6.21 below.

Correlations

			waste separation	location
Spearman's rho	waste separation	Correlation Coefficient	1.000	.146[*]
		Sig. (2-tailed)	.	.035
		N	208	208
	location	Correlation Coefficient	.146[*]	1.000
		Sig. (2-tailed)	.035	.
		N	208	208

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6.21: shows a relationship between location and participation in waste separation.

Results show that only location correlates with waste separation (r=.146, P=.035), which means the location has a low positive correlation and is statically significant at 0.01 level at 95% confidence intervals. However, the other demographics, including age, gender, education level and occupation, show a low positive correlation with participation in waste separation. This means that the variables have relationships, but only location has a statistical significance. Although the variables have correlations, the correlation coefficient has no causal effect. Therefore, a further regression analysis was conducted to understand the variables that influence participation in waste activities.

Further investigations were conducted to understand which independent variables predict participation in waste activities. This was conducted using a multinomial regression shown in Table 6.22 using the formula.

$$\Pr Y_{ik} = \Pr Y_i = k \mid x_i; \beta_1, \beta_2, \ldots, \beta_m = \frac{\exp \beta_{0k} + x_i \beta'_k}{\sum_{j=1}^{m} \exp \beta_{0j} + x_i \beta_j} \text{ with } k = 1,2,\ldots,m.$$

Log-likelihood = -247.47895   LR chi2(20) = 27.37

Prob > chi2 = 0.1251

Pseudo R2 Type equation here.

Participation	Coefficient	S Ltd. er r.	z	P>z	[95% conf.	interval]
Always						
Location	0.0091763	0.0235857	0.39	0.697	-0.0370509	0.0554034
Age	0.5114722	0.259773	1.97	0.049	0.0023264	1.020618
Gender	0.2808724	0.5371093	0.52	0.601	-0.7718425	1.333587
Education	-0.1656865	0.1722035	-0.96	0.336	-0.5031992	0.1718262
Employment status	0.4254641	0.1789861	2.38	0.017	0.0746577	0.7762704
_cons	-3.808598	1.230069	-3.1	0.002	-6.219488	-1.397707
Never	(base outcome)					
Occasionally						
Location	0.0256104	0.021164	1.21	0.226	-0.0158703	0.067091
Age	0.1171323	0.2789895	0.42	0.675	-0.429677	0.6639416
Gender	-0.3477858	0.4636674	-0.75	0.453	-1.256557	0.5609857
Education	0.1451772	0.1647256	0.88	0.378	-0.177679	0.4680333
Employment status	0.0461332	0.1851819	0.25	0.803	-0.3168167	0.409083
_cons	-2.097053	1.078726	-1.94	0.052	-4.211317	0.01721
Sometimes						
Location	0.0356186	0.0165042	2.16	0.031	0.003271	0.0679662
Age	-0.0570898	0.2201049	-0.26	0.795	-0.4884875	0.374308
Gender	-0.0773531	0.3597615	-0.22	0.83	-0.7824727	0.6277665
Education	-0.0766865	0.1201953	-0.64	0.523	-0.3122649	0.1588919
Employment status	-0.0475135	0.1476828	-0.32	0.748	-0.3369665	0.2419396
_cons	-0.8231869	0.8362348	-0.98	0.325	-2.462177	0.8158031
Very often						
Location	0.0530294	0.0549396	0.97	0.334	-0.0546502	0.160709
Age	0.3377192	0.5383099	0.63	0.53	-0.7173489	1.392787
Gender	-0.2994294	1.071335	-0.28	0.78	-2.399208	1.800349
Education	-0.1021203	0.3785989	-0.27	0.787	-0.8441606	0.63992
Employment status	0.9903298	0.4845371	2.04	0.041	0.0406545	1.940005
_cons	-6.900695	2.905469	-2.38	0.018	-12.59531	-1.206081

Table 6.22: shows dependent variable's statistical significance to public participation in waste activities.

The coefficient estimates for Age vary depending on the participation level. For the Always group, Age has a positive coefficient of 0.5114722 with a p-value of 0.049, indicating a statistically significant association between Age and higher participation. For the Occasionally and Very often groups, Age has a smaller positive coefficient of 0.117 and 0.337 respectively, but the p-values are not statistically significant ($p > 0.05$), suggesting that the association between Age and participation may not be statistically significant in these groups.

Employment status has a significant positive association with participation in the Always group, with a coefficient estimate of 0.4254641 and a p-value of 0.017 at a 95% confidence interval. This suggests that being employed may be positively correlated with higher participation in this group. Location, Gender, and Education do not appear to have statistically significant associations with participation levels in most of the groups, as the p-values are greater than 0.05. However, in the Sometimes group, Location has a positive coefficient estimate of 0.0356186 with a p-value of 0.031 at a 95% confidence interval, indicating a potential positive association between Location and participation in this group.

In addition, according to Table 6.22, most respondents are educated, indicating that education is also an indirect predictor of participation in waste activities, given that if employment plays a role in promoting waste activities, then education must also have an indirect effect, given that most of the work requires various levels of education.

While source separation of waste is not yet widely practiced in Nigeria, some environmentally conscious organisations and industries are taking the lead in implementing this waste management practice. Many workplaces in Nigeria still mix and dispose of waste together, making it challenging to recycle or reuse materials. However, in Lagos, some multinational companies such as Coca-Cola, Unilever, and Procter & Gamble have implemented waste segregation practices in their facilities. They encourage their employees to sort waste into different bins for recycling, composting, or disposal. Additionally, organisations such as We cyclers, Recycle Points, and Chanja Datti are involved in collecting waste from households and businesses in Lagos and have implemented waste separation at the source. Location has been seen to play a significant role in the promotion of source separation, as evidenced by the example of Lagos state and the industries located there. This indicates that for source separation

to become feasible in other states, policies and laws need to be enforced, and people can follow suit, following the example set by Lagos state and the industries operating there.

6.9   Chapter Summary

The summary of this section highlights several key findings from the statistical analysis. Firstly, the majority of respondents are aware of waste management and its consequences, which is consistent with the concentration of internet users in Lagos and Abuja where the study was conducted online. The education level of respondents is also noted, indicating that most are aware of the effects of municipal solid waste.

The regression analysis results suggest that age is statistically significant in influencing respondents' awareness of waste management. Older individuals are more likely to be aware of waste management practices, possibly due to their experience and exposure over time. It is also emphasized that age is a critical factor in waste management sensitisation efforts, as individuals need to be of an appropriate age to comprehend and assimilate the knowledge presented to them during sensitisation.

The findings also indicate that payment for waste services is influenced by gender and employment status. Employed or self-employed individuals, particularly males, are more likely to pay for waste services due to their higher income levels and traditional gender roles in Nigerian households. This is consistent with existing literature on gender-based roles in Nigerian households.

Furthermore, the study reveals that participation in waste source separation activities is low across all states in Nigeria, primarily due to the lack of policy support and infrastructure arrangements for waste reduction, reuse, and recycling. Age, employment status, and location are identified as factors that influence source separation participation, with employed and self-employed respondents showing more positive responses, possibly due to some organisations practising source separation or recycling. Lagos state, which has laws in place for waste management, shows slightly higher levels of source separation activities in some organisations.

The summary of outcomes for the demography that influences the public-driven challenges is illustrated in Figure 6.19 below.

Awareness	Payment	Participation
• Age	• Gender • Employment status	• Employment status • Location

Figure 6.19: summary of outcomes for the demography that influences the public-driven challenges.

The summary of this section suggests that age plays a significant role in influencing public awareness about waste management. As people grow older, they gain more experience, education, and likely employment, which can affect their understanding and awareness of waste management practices. The study also highlights the influence of gender and employment status in influencing people's ability to participate in waste management activities, as discussed in section 6.10. Employment status, in particular, is identified as a predictor of participation, as the availability of infrastructure for waste separation varies across Nigeria. For instance, respondents who work in recycling enterprises or organisations located in states with established waste management practices, such as Lagos state, may be more likely to participate in waste management activities.

Chapter 7:   Discussion

7.1   Introduction

This chapter presents an overall discussion of the findings from the data analysed in the interviews reported in chapter four and surveys reported in chapter five. The chapter shows how the objectives of the study have been addressed. It is designed to address each objective, starting from objective 1the challenges affecting municipal solid waste management in Nigeria. The data was gathered from interviews and surveys conducted in Nigeria to explore the expert's opinions on the current state of municipal solid waste management in Nigeria and the public's perception, experience, and attitude towards waste management in the country. The chapter highlights the themes that emerged from the interviews, such as the inadequate sensitisation of the public on waste management in Nigeria, the public's attitude towards waste, and their refusal to pay for waste services and linking the results to existing literature. It also indicates the relationship between these challenges where one is more influential and can cause or prevent the occurrence of the others.

7.2   Challenges affecting municipal solid waste management in Nigeria.

7.3   Behavioural challenges

These challenges were identified during the interviews with experts. Some significant challenges affecting municipal solid waste management were the people's negative attitude towards waste, lack of awareness, inadequate sensitisation, and the absence of school waste education. These were all classified under behavioural challenges because they ultimately translate into behaviour.

The study notes that while the findings in this study are similar to the literature, the interviews have provided more in-depth information and insight into the waste management situation in Nigeria. Similarly, common behavioural challenges such as lack of awareness and negative attitudes towards waste, including the absence of waste education in primary and secondary school from the education curriculum (Okoli et al. 2020; Abila and Kantola 2013; Ifegbesan 2010). The challenges also include less-discussed issues Nabegu and Mustapha (2014) mentioned regarding cultural and religious beliefs. Therefore, the study concludes that this is

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not a relevant challenge affecting municipal solid waste management in Nigeria based on the interview outcome and literature reviewed.

The study highlights certain shortcomings in the current body of literature, particularly the inability to explain the direct reason why there is a lack of awareness in Nigeria's waste management industry. It was discovered and highlighted that there is a lack of awareness due to inadequate sensitisation of the public on waste. This is a major challenge that whenever lack of awareness was discussed in the interview, the respondents would mention it was due to sensitisation issues, hence the lack of awareness. This highlights the importance of the stakeholder theory in conducting interviews and gathering first-hand information from multiple stakeholders to gain a more comprehensive understanding of the issue.

Sensitisation is inadequate because the government conducts it through specific limited channels such as TV and radio stations but only some people have access to these channels, which means that other communication routes are not utilised to reach a broader audience. For instance, Nigeria's diversity of over 250 ethnic groups and 500 languages means that sensitisation efforts need to be tailored to specific groups, including face-to-face communication in local languages. This has contributed to the challenges leading to the lack of awareness and therefore is listed as a challenge in this study.

It is seen that the issue of sensitisation was never added as a challenge in the literature. Examples of these studies are (Okoli et al, 2020; Abila and Kantola 2013) hence, this study has included it as a challenge affecting municipal solid waste management. As explained by experts in the interview, sensitisation was mentioned because it serves as a link between the government efforts conveyed to the public. For instance, for awareness to be successful among the public, the government's political will is required to place the necessary steps in place, then funding needs to be available for an effective sensitisation process, especially logistics to reach over 213 million citizens. If sensitisation is successful, then the challenge of lack of awareness is resolved. Although Abila and Kantola 2013; Ezeah (2012) discussed the need for the government to put more effort into creating awareness, sensitisation was explicitly added to the challenges faced in the Nigerian waste management sector. Therefore, sensitisation is essential to creating awareness and an effective waste management system. table 7.1 highlights the differences found in reviewed literature and the study's outcome.

Literature	Qualitative data
Lack of awareness	Lack of awareness
Absence of waste education	Absence of waste education
Cultural & religious beliefs	Negative attitude towards waste
	Inadequate sensitisation

Table 7.1 shows the distinction between identified challenges in literature and qualitative data.

The table above illustrates the study's findings which indicate that literature has been omitting the concept of sensitisation as the necessary link between funding and lack of awareness. For instance, The earlier section explains how sensitisation must be done to encourage the public to participate in the fight for effective waste management. Lack of awareness occurs due to inadequate sensitisation or the lack of it while sensitisation is inadequate because funds are insufficient to implement effective planning and sensitisation.

In addition, the study identified negative attitudes towards waste as a significant challenge in implementing waste management services. This implies that the lack of awareness contributes to the development of negative attitudes among the public. Furthermore, this indicates the interrelationship among the challenges, showing how a lack of awareness causes negative attitudes by the people, and the lack of awareness is due to inadequate sensitisation. |Inadequate sensitisation has been earlier to be caused as a result of inadequate funding which is also due to inadequacy of funding rising from total dependence on budgetary allocations and no revenue generation from the public.

Another interesting point to be highlighted in this chapter is the difference in perspectives between the literature and the experts interviewed. While some experts claimed that there was awareness among the communities due to the government's works and the people's participation in community projects, the literature did not confirm these claims (Amasuomo and Baird, 2016; Okoli et al., 2020; Ifegbasan, 2020) and all literature about challenges generally says the people lack awareness. Additionally, the literature generally agrees with the experts' claims that the waste sector has an awareness gap. Still, the interviews provided more detailed information on the reasons behind this gap. It has been discovered that this is due to

factors including education level, age, location, etc. The interviews highlighted the difference between high-income and low-income areas, where people in high-income areas are more likely to be aware of waste management than people in low-income areas due to access to information formally or informally through the Internet or in school.

The literature does not provide specific information on the public's awareness of waste management in Nigeria. Many have mentioned the public's lack of awareness (Okoli et al., 2020; Abila &Kantola 2013; Ifegbesan 2010). However, on the other hand, this study acknowledged the public's lack of awareness but further highlighted the variation among the public based on location. The experts have addressed the difference between those who live in rural areas and those who live in urban areas, noting that individuals in urban areas are more conscious of waste issues than those in rural areas due to higher levels of exposure and education based on this survey to understand the level of The study has confirmed this based on the survey results conducted to understand the public's level of awareness of waste management. Many people in Nigeria are aware of waste management and waste impacts, they even further spelt their own meanings of waste and its impacts.

The study findings in this study do not generalise that everyone in Nigeria is aware of waste impacts but, based on the survey responses, most of this study's respondents are aware of waste and its impacts. This is solely because the study has not reached other people in rural areas without internet access. Therefore, results might differ if that demography is consulted. As mentioned earlier in this section, various factors affect public awareness. Most significantly, results show that age plays the most influential role in the awareness of municipal solid waste and its impacts in Nigeria. This is other factors did show a particular pattern in the awareness of waste management except for age, correlation coefficient correlation results show the relationship between age and are new with a statistical significance.

Additionally, regression analysis confirms the causal effects that is the influence of age on the awareness of the public on waste management. The results show that, even at the target of sensitisation, age is an important factor to be considered in resolving awareness, therefore will be added as a recommendation for studies to into the specific age ranges that should be focused on while sensitising people to create awareness. These results have been discussed in the literature confirming that age has an influence and plays a vital role on awareness and

participation in waste activities, explaining that due to exposure and experience, people tend to acquire knowledge on waste management formally or informally (Shaw 2017; Olukanni, Pius-Imue 2020; Eagles & Demare, 2010).

In summary, this study provides valuable insights into the current state of behavioural challenges in municipal solid waste management in Nigeria, indicating that progress has been limited. Including sensitisation as a critical challenge and identifying factors that influence awareness levels contribute to a deeper understanding of the complexities involved. These findings can inform policymakers and stakeholders in designing more effective strategies to tackle the behavioural challenges and promote sustainable waste management practices in Nigeria. Further research and interventions are needed to address the identified challenges comprehensively and drive positive change in Nigeria's waste management sector.

7.4 Financial challenges

The findings from this study identified financial challenges that were consistent with the findings of previous studies. During the interviews, experts emphasised financial challenges as the most prominent challenges that affect municipal solid waste management in Nigeria, with 72 mentions. The financial challenges identified included inadequate funding, insufficient funds, and reliance on annual budgetary allocations due to a lack of public funds generation. Previous studies, including (Amasuomo and Baird 2016; Igbinomawanhia and Ideho 2014; Abila and Kantola 2019), similarly stressed the lack of funding for municipal solid waste management, citing low salaries and a lack of revenue generation as additional concerns.

However, while the literature review emphasised the lack of funding, the study revealed a different perspective. The study found that funding issues for municipal solid waste management existed but were explained in a deeper context. Specifically, the study indicated that the issue was primarily related to insufficient and delayed funding rather than a lack of funding. According to the experts, even though insufficient, the budget is generally available, but funding delays are common. This issue of delayed funding was not previously mentioned in the literature on Nigeria's financial challenges of waste management.

The study has also highlighted that Nigerian solid waste sector primarily relies on budgetary allocations for funding, which means that the government allocates a specific amount of money

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to the waste management agencies to operate and provide services. This approach has been explained to have several implications for the sector.

Firstly, the study outcome has identified that the amount of funding allocated to the sector is not sufficient to meet the demands of the waste management agencies. As a result, the agencies lack the resources to effectively manage waste and provide services, leading to poor service delivery and inadequate infrastructural development. The study has indicated that even though the insufficient funds allocated are mostly delayed and pass the planned project timeline, it is scrapped and abandoned. This revelation has not been seen in the works of literature.

Secondly, allocating funds to the waste management sector is subject to competing priorities within the government, which may result in reduced funding for the sector over time. This could lead to a situation where the sector receives even less funding than it needs, further exacerbating the challenges it faces. These findings correspond with some studies' statements (Amasuomo and Baird, 2016; Igbinomawanhia and Ideho, 2014; Abila and Kantola, 2019).

Thirdly, the study has highlighted that the dependence on budgetary allocations means that waste management agencies do not engage in revenue generation, which could limit their ability to fund their operations and invest in infrastructure development. This discussion was made by the works of literature discussing the inability of the Nigerian government to generate public revenue for cost recovery and waste generation in the waste management sector, Winter and Ujoh (2020). The study has discovered that the lack of cost recovery resulting from the refusal to pay for waste services is a significant problem for the waste management sector, Winter and Ujoh (2020).

Furthermore, it was concluded in the study that the lack of specific waste management policies has also contributed to the issue of public revenue generation because no the waste sector burrowed other policy guidelines for solid waste management, and there did not have provision for revenue generation or payment for solid waste services generated in households,. No literature was found to discuss this connection. Also, another reason raised by both the study and literature was that of poverty. It has been argued that poverty is also a contributing factor to the lack of public generation, which means even though the policies are on ground, public

revenue generation may not be successful in Nigeria until poverty is alleviated and most people can afford to pay for waste services.

The issue of whether the public pays for waste management services in Nigeria is a complex one. While some states, such as Lagos and the Federal Capital Territory (Abuja), have implemented taxes on waste management services, the fees vary between high-income and low-income areas. This lack of willingness to pay for waste services has resulted in a lack of cost recovery for the waste management sector, exacerbating the funding challenges the sector faces. Therefore, while some areas in Nigeria collect fees for waste management services, the issue of general waste payments across the country requires further study to determine the overall situation. Another angle from the literature says the refusal of residents to pay waste collection bills can be attributed to poor services from waste management authorities Nnaji (2015).

Therefore, the study investigated to ensure the validity of the claims about the public's refusal to pay for waste services In conclusion, the reliance of the Nigerian waste sector on budgetary allocations for funding has several implications for the sector's ability to manage waste effectively. It limits the sector's ability to generate revenue and invest in infrastructure development and could lead to inadequate service delivery if the amount of funding allocated to the sector is insufficient to meet its demands.

In order to verify claims regarding the public's refusal to pay for waste services, The study conducted further investigations by collecting survey data from the public. The results showed that many respondents paid for waste services, contrary to the claim made by experts and the literature. However, it should be noted that, as discussed earlier, some areas vary, such as the difference Between high- and low-income areas. For instance, Lagos state has been enforcing waste service payment and the highest distribution of respondents were from Lagos state and Abuja, where there is enforcement of waste payment. This suggests that many respondents replied positively because they live in areas where such laws are in place.

Additionally, these enforcements work mostly in high-income areas where people can afford to pay for waste services. The results also correspond with a World Bank report where Silpa, Yao, Bhada-Tata, and With (2018) and Gajere, Olaniyi, Obadaki, and Iruobe (2019)

highlighted how waste management practices differ among different areas, including waste generation, composition, and services. This is particularly evident in the difference between high-income and low-income areas.

Additionally, it has been established in the study that gender, and employment status are influential to Nigeria's payment for waste services. This is in line with a study by Angeles et al.(2009) on the Determinants of households' willingness to pay for private solid waste management services in Ibadan, Nigeria where their results showed that employment status in influential towards the payment for waste services.

As financial challenges have been found to be the most prominent challenge affecting municipal solid waste management in Nigeria, results have also shown that there is a relationship among the factors and financial funding is the most influential challenge causing other challenges. The interrelationship indicates that one factor can give rise to the occurrence or prevention of the other. For instance, inadequate funding can lead to lack of awareness due to insufficient funds for the logistics in sensitising the people. Also, the absence of policy has caused inadequate funding because no regulations are set to collect taxes and waste services adequately from the public. The linkages mean that if there is no policy, laws cannot be enforced, and lack of enforcement leads to non-compliance and overall legal challenges.

7.5   Legal challenges

A prominent factor that coincided with the research findings was the prevalence of legal challenges and policy issues in Nigeria's municipal solid waste management sector. The study revealed that until late 2020, there was no solid waste policy in place, which was later launched by the President of Nigeria as the National solid waste policy and the National plastic waste policy in May 2021. Surprisingly, prior literature studies did not indicate the absence of a solid waste policy in Nigeria but rather highlighted issues related to flawed policy formulation, incoherent policies, lack of documentation, and poor implementation of policy guidelines (Ezeah et al., 2012; Igbinomawanhia & Ideho, 2014; Maiyaki et al., 2019; Okoli et al., 2020). This suggests that previous studies did not thoroughly investigate the specific legal challenges faced by Nigeria's waste management sector. However, the stakeholder theory employed in

this study allowed for a comprehensive evaluation of the policy landscape from different expert perspectives.

While the issues raised in the literature are valid in explaining the failures of earlier policies, these studies implied the existence of a solid waste policy with inadequacies. It was not until recently discussed by Ogechukwu (2020) and Nzeadibe & Ejike-Alieji (2020) that the absence of a solid waste policy was explicitly acknowledged. Thus, based on the most up-to-date literature available, this study has shed light on the emergence of these new policies, as many references are dated years back and do not confirm the current guidelines. This research gap underscores the need for more updated studies in the municipal solid waste management field in Nigeria.

7.6   Institutional challenges

The main findings of this study regarding institutional challenges in waste management in Nigeria include communication problems, lack of inclusivity, insufficient utilization of research and development, inadequate infrastructure, and a top-to-bottom approach. The study highlighted the need for improved communication within Nigeria's municipal solid waste sector, as there is a gap in information transmission from the government to agencies to households, resulting in local authorities not communicating as directed. This issue was identified due to a lack of cooperation between the federal government, which directs waste management operations at the national level, and local government authorities, who are responsible for implementing waste services at the local level. This top-to-bottom decision-making approach neglects local government authorities, leading to inadequate communication, lack of autonomy, and limited knowledge at the local level, as argued by previous studies (Maiyaki et al., 2018; Ezeah et al., 2013).

The study also emphasised the lack of inclusivity in decision-making related to waste management, as decisions are not made together with input from all levels of government and consideration of the public and their needs. The top-to-bottom approach means that the federal government may not have first-hand knowledge and information on the ground issues. Additionally, the study highlighted the lack of expertise in Nigeria's municipal solid waste sector, as the government rarely provides training to improve human capacity, resulting in a

lack of expertise in the waste sector. Previous literature has also highlighted this issue (Orhorhoro and Oghoghorie, 2019; Ezeudu et al., 2021; Amasuomo and Baird, 2016; Kadafa, 2017). The study found that most workers, especially senior staff members in the industry, pay for their personal training to gain technical knowledge and expertise in the sector. It was also observed that the private sector is more proactive in providing training for their workers compared to the public sector, indicating differences in dynamics between the two sectors in waste management operations. This raises the need for further research to understand the dynamics and differences between public and private sector workers in the waste management sector and how the gap can be bridged. The lack of expertise training in the public sector may be attributed to financial challenges such as inadequate funds or a lack of political will to fulfil such obligations.

In addition, the study highlighted the lack of adequate infrastructure as a barrier to waste management activities, such as source separation and public participation in waste management. For example, the lack of infrastructure hinders the provision of bins to every household in Nigeria to promote source separation. Previous literature also discussed this inadequacy (Babaei et al., 2015b; Coker et al., 2016; Abd'Razack et al., 2017; Alhassan et al., 2020), attributing it to the absence of policy and inadequate funding due to the public's refusal to pay for taxes and waste services. The absence of a solid waste policy in Nigeria, which includes the waste hierarchy principle of reduce, reuse, and recycling, further exacerbates the issue as there are no guidelines or provisions for source separation and waste collection. This is also related to financial challenges, as projects like this require sufficient funds for production and cost recovery through revenue generation from taxes. For example, in the UK, council tax payments are made monthly to allow the government to recover bins and waste collection services costs. Without such public revenue, the concept of source separation cannot be effectively implemented.

Furthermore, the study conducted a survey to understand the general level of participation in source separation, and it discovered that Nigeria has a very low level of participation due to the reasons mentioned above. It also highlighted that employment status and location influenced the people's participation in source separation. This tallies with literature, a study in Ghana that those employed in the formal sector, attitude and source separation of solid waste

drive households' decision to use the services of informal waste collectors Alhassan et al. (2020).

7.7 Discussion of potential opportunities for addressing municipal solid waste management challenges.

This section addresses objective 3, which focuses on examining the opportunities that can be utilised to resolve municipal solid waste challenges in Nigeria. Its study is the links, similarities, and differences between literature reviews and the study's research findings. Specifically, it explores the questions asked in the study regarding the opportunities they perceive for resolving the key challenges identified. The responses provided in this study is compared to the drivers identified in the literature, using a group of developed countries known for their successful waste management systems (UK, EU member states, and Japan) as a benchmark. This comparison aims to draw lessons from these countries for the study.

The opportunities identified by the study are based on empirical data, and any similarities with the literature will be considered crucial factors to be utilized as potential solutions. Similar to section 6.1, the opportunities are categorised into a taxonomic classification and discussed accordingly in the following sections.

7.8 Behavioural opportunities

The importance of sensitisation in resolving waste management challenges particularly in promoting circular economy practices and encouraging public participation for financial benefit and environmental sustainability, has been highlighted in this study. This approach has been extensively discussed in the literature, with examples from developed countries where adequate sensitisation has been utilized to create awareness among citizens about waste management, as mentioned by the(European Commission 2010; Lonkova and Gerrard 2018) in the European Union and Japan.

Financial incentives have also been identified as a potential driver for change in public attitudes towards waste management in Nigeria, considering the country's poverty level. A study in Lagos has highlighted that financial incentives are one of the key factors that drive household

willingness to participate in municipal solid waste activities in Nigeria, as Abila (2018) reported.

Furthermore, the integration of waste education into the primary and secondary school curriculum has been identified as another successful driver in other countries, such as Japan, where children educated their parents at home, creating a ripple effect, as mentioned by Lonkova and Gerrard (2018). Although waste education is not well-established in Nigerian schools, this study emphasizes the importance of integrating waste management education at an early age, as it has been found to be a successful solution in fostering lasting behavioural change and awareness among young individuals.

7.9   Financial opportunities

This study underscores the significance of emphasizing the implementation of financial drivers in the Nigerian waste management sector. The study identifies potential financial opportunities that the government could explore, such as public-private partnerships and collaborations with foreign investors. This also aligns with recommendations by some studies (Olukanni & Nwafor, 2019; Ezeudu et al., 2021; Fatai et al., 2021). The literature also highlighted the success of generating public revenue using the polluter pays principle and fixed taxes. However, unlike other countries with higher GDPs and less poverty rates this option was not identified as a driver by this study in Nigeria due to the absence of waste policies and the high poverty level in the country. Therefore, eradicating poverty should be prioritized before implementing the polluter pay principle and tax payments in the Nigerian waste sector. In contrast, the literature review reveals that countries such as Switzerland, Sweden, and the United States have successfully implemented the polluter-pay principle to finance their waste management sectors, as discussed by Ionkova and Gerard (2018) and Jaligot and Chenal (2018). Experts suggest that adopting such principles could be a potential solution for the funding challenges faced in Nigeria, considering the country's poverty rate. A study conducted by Stephen Mshelia et al. (2020) where a study conducted in Kano state revealed that people refused to pay for waste services because they could not afford it. Therefore, adopting principles that enable cost recovery and revenue generation must be carefully considered to ensure adequate financing of the waste sector.

Furthermore, the study identifies the relevance of public-private partnerships in Nigeria to boost the waste sector and empower small businesses for business growth, as evidenced in Lagos state where expert two mentioned that the Bank of Industry authorized their company, and currently, about 400 small businesses are operating in the waste sector, indicating positive growth and improvement that other parts of the country can learn from Olukanni & Nwafor (2019). They also further caution that While there are many opportunities in private sector involvement, it should not be seen as a cure-all for the financial problem in the solid waste sector. This is because there are other more effective ways to resolve financial solutions that might not be feasible immediately in Nigeria, such as the polluter pay principle.

Lastly, the study focuses on another opportunity for Nigeria's waste management sector, which is introducing the concept of a circular economy. It emphasises that raising awareness about the financial benefits of a circular economy, including job creation and business opportunities, is crucial to promote its adoption among the public. This notion is agreed by Ezeudu and Ezeudu (2019).

7.10 Legal Opportunities

This study has identified the importance of competent policies in the waste management sector. As the study has identified the negative impacts caused by the absence of solid waste policy, and the study most utilised solid waste policy globally. Therefore, the study identified the waste hierarchy principle as the best way to implement solid waste management in Nigeria. According to the World Bank (2018) and DEFRA (2013), the waste hierarchy principle is the most common policy used in developed countries for solid waste. According to the European Commission (2014), this principle originated in Europe and has been a guideline that has prompted success in the waste industry. Some EU member states, like Sweden, have become world leaders in recycling, following the waste hierarchy principle. Achieving these results means that policy guidelines for solid waste management are adequately implemented. The focus was separate from the solutions provided by experts, mainly because the sector is trying to achieve the basics of waste management for now. Also, because the new policies have recently been launched and include the waste hierarchy policy, the outcomes of their implementation will be monitored.

Sweden is a notable example of a country that has achieved significant progress in solid waste management by following the waste hierarchy principle. Sweden has implemented a comprehensive waste management system that prioritizes waste prevention, reuse, and recycling and has established a robust infrastructure for waste collection, sorting, and processing. As a result, Sweden has achieved high recycling rates and minimised the amount of waste sent to landfills, thereby reducing its environmental impact and resource consumption.

Overall, the waste hierarchy principle has emerged as a prominent policy framework for solid waste management in developed countries, with Sweden and other EU member states are leading examples of its successful implementation. However, continued monitoring and evaluation of the outcomes of its implementation are essential to ensure its effectiveness in addressing the challenges associated with solid waste management and promoting sustainable waste practices in the future.

7.11 Institutional opportunities

It was stated by Kaza et al. (2018) that one of the most successful drivers of waste management operations in the EU is the transfer of autonomy to the local authorities. In the qualitative data, expert seven also pointed out the need for inclusion among all the stakeholders. Expert 2 discussed the need for the federal government to transfer autonomy to the local government, including finances, to achieve seamless and more straightforward operations.

Ionkova and Gerard (2018) also discussed how the EU and Japan have proper coordination between the central government and the municipalities. Good communication brings harmony and excellent communication, defining key responsibilities at all government levels. Similarly, communication was mentioned by experts 1 and 2 about the need for proper communication among all tiers of government so that there is good synergy.

Another critical opportunity experts 1 and 7 mentioned is the need for the government to have the political will to accomplish effective waste management systems. Political will is highly relevant for Nigeria, as discussed earlier in section 4.4.3.1, about the absence of political will that has led to most of the challenges faced in the waste sector. However, the need for political will has yet to be mentioned as a driver in literature, majorly because the developed countries

have already created the political will and have put all their systems into place and continue to implement them.

Classifications	Literature	Qualitative data (Experts)
Behavioural	• Enlighten people/create awareness. • School education • Use of incentives to change behaviour	• Enlightenment • School education • Incentives
Legal	• Well-coordinated policy formation • Enforcement • Constant policy monitoring & review	• Enforcement • Establishment of circular economy
Financial	• Revenue generation (fixed tax , polluter pay principle, sale of plastic bags)	• Revenue generation (Public private partnerships, foreign investments) • Collaborations with small businesses.
Institutional	• Inclusion and coordination at local level • Detailed communications • Authority for municipalities.	• Inclusion • Political will • Effective communication

Table 7.2 compares the literature-identified drivers with the emergent themes from the interview.

There are numerous similarities between the variables that have led to the success of municipal solid waste management in developed countries and the opportunities indicated by the experts. However, some notable additions by experts demonstrate the stage at which Nigeria is managing waste and where it needs to begin. The most significant opportunity is seen in the institutional factors where "Political will" is mentioned by experts. It is observed that developed countries do not require the political will to make waste management relevant to their government because it is already in place and with fully operational frameworks. In contrast, in Nigeria, political will is required for the hope to utilise all resources available and achieve the drive to a thriving waste management system. Political will and good governance are necessary for every country to have a prosperous waste management operation system.

Additionally, financial opportunities also show slight differences between expert recommendations and literature. For instance, the literature suggests revenue generation

through fixed tax or polluter pay principle. However, the experts discussed this issue as a challenge, but no experts suggested it as a solution. He shows how aware the experts are of their environments. He is well versed in waste management in section 4.4.2 of the financial challenges affecting municipal solid waste management, expert six and expert seven argued that collection of fixed tax or payment for waste services might be fruitless in Nigeria because of the poverty level in the country. Many cannot comply because they are striving for their basic needs. Another challenge was discussed in section 5.4.4 under legal challenges about the infective enforcement and laws; without strict enforcement of tax laws and polluter pay principle, no revenue can be generated, and as it is, experts 12 and 13 described that there is little or no enforcement of waste laws in Nigeria hence people do not comply. In that case, these principles take time to implement.

However, the experts suggested collaborations with foreign investors, private partnerships, and empowering small businesses. This suggestion is a better option in the Nigerian context because even if waste payments are made in some states or areas, most low-income areas cannot afford to pay taxes or waste services. Statistics from the National Bureau of Statistics NBS (2022) reported that 63% of Nigerians (133 million people) are multi-dimensionally poor. These statistics mean that over half of the population of Nigeria is multi-dimensionally poor, and poverty levels vary significantly across states, National Bureau of Statistics (2022). For instance, Sokoto state is said to be the most impoverished state in Nigeria, with a 91% poverty rate, while Ondo state has the lowest poverty rate of 24% Fayehun (2023).

Chapter 8: Conclusion and Recommendations

8.1 Introduction

The conclusion and recommendation chapter of this study encompasses the research aim of the study, analysing the current status of municipal solid waste in Nigeria. The section focuses on research objectives and the key recommendations to address the challenges and opportunities identified in Nigeria's municipal solid waste management. The study also explored the variations in waste management practices based on the influence of education, gender, employment status and location on waste payment behaviours.

From the literature review, the study identified that there is a scarcity of updated findings on the socio-economic factors affecting the implementation of municipal solid waste management in Nigeria. Most studies have omitted to list some crucial factors, such as inadequate sensitisation and the public's refusal to pay for waste services, as challenges hindering the implementation of municipal solid waste management in Nigeria. Also, no studies have identified the criticality of these challenges and the casual interrelationship between them. Also, no studies have empirically identified practical opportunities that can be utilised in Nigeria based on successful global drivers. Therefore this study has bridged the identified gaps and has combined all findings to develop a framework that can potentially serve as a guide for relevant stakeholders and decision-makers to use as a road map to improve municipal solid waste management in Nigeria.

Practical recommendations have been developed based on the unique Nigerian context to potentially help improve the challenges faced in Nigeria's municipal solid waste management. These recommendations include the need for comprehensive cost recovery and public revenue generation programs in all states, which the research has identified as the most critical factor in the Nigerian solid waste management value chain, with special attention to low-income areas lacking access to waste services due to financial constraints. Targeted efforts towards sensitisation and income generation in the country are essential to promote sustainable waste management practices and ensure equitable access to waste services for all socio-economic groups.

Based on the findings in this study from the identified challenges and opportunities in municipal solid waste management in Nigeria via in-depth interviews with 15 industry experts such as inadequate funding, inadequate sensitisation, lack of awareness, public's attitude towards waste, etc. Also, identifying the factors influencing the identified challenges via an online survey questionnaire, acquiring and analysing 208 responses analysed in-depth by conducting multiple layers of statistical analysis, resulting in comprehensive and detailed results. The conceptual framework was developed and can serve as a roadmap for improving Nigeria's municipal solid waste management. It highlights the importance of policy interventions at multiple levels, including developing cost recovery and public revenue generation programs, strict waste law enforcement, and addressing socio-economic disparities through education and income-generation initiatives. The framework also emphasises the need for gender-sensitive approaches and consideration of employment status in waste management policies and practices. By implementing the recommendations and following the roadmap outlined in the conceptual framework, Nigeria can potentially make significant progress in addressing the challenges associated with municipal solid waste management and promoting sustainable waste management practices across the country.

8.2 Identifying the current challenges affecting municipal solid waste management in Nigeria.

This section identified the challenges affecting municipal solid waste in Nigeria and determined the criticality of the identified challenges. In conclusion, this study has identified and categorised eighteen key challenges facing municipal solid waste management in Nigeria, which are consistent with existing literature and indicate a lack of progress in the industry despite some government efforts and international support. The study has further highlighted additional challenges not adequately addressed and listed in prior research, such as inadequate sensitisation efforts and the absence of public revenue from waste services. Moreover, the study has revealed that some challenges are more significant and influential than others, with inadequate funding and lack of awareness being the most frequently mentioned.

The study has also established connections and linkages between the challenges, indicating their interrelated nature and the need for a holistic approach to address them. For instance, inadequate sensitisation can lead to a lack of awareness, resulting in negative attitudes and

behavioural issues among the public. Similarly, financial challenges, such as inadequate funding and lack of political will, can impact other variables, such as awareness and sensitisation efforts. Therefore, it is crucial to understand the interconnectedness of these challenges and prioritise them accordingly when devising solutions for municipal solid waste management in Nigeria. Overall, this study contributes to the existing literature by providing a comprehensive analysis of the challenges and their interdependencies, the empirical analysis resulting in identifying potential opportunities unique to Nigeria's municipal solid waste management sector, the development of a conceptual framework that shows a road map to understanding the dynamic of the country's municipal solid waste sector, potential contextual solutions and stakeholders responsible at every stage, underscoring the need for further research and policy interventions to effectively address the persistent issues in the Nigerian waste management sector.

8.3   Opportunities that can be utilised in potentially resolving the challenges based on the Nigerian context.

In conclusion, this study highlights significant similarities between the factors contributing to successful municipal solid waste management systems in developed countries and Nigeria. It also emphasises the need for certain additions and adaptations in Nigeria's waste management context. One notable difference is the importance of political will, which was identified as a crucial driver in developing countries like Nigeria at the early stages of waste management operations. Political will is essential to prioritise waste management for the government and allocate the necessary resources to achieve success. Despite challenges in persuading those in power to take waste management seriously, it remains a vital opportunity that can be utilised.

One key strategy for building political will for waste management in Nigeria is through waste education in schools. By educating the younger generation on waste management, raising awareness of its importance, and instilling a sense of responsibility for its impacts, future leaders may be more inclined to prioritise waste management and ensure environmental sustainability. However, this may require patience and sustained efforts to preserve knowledge and discipline in the younger generation.

Another critical aspect of waste management in Nigeria is revenue generation to support an effective waste management system. The polluter pays principle, commonly used in developed countries, may not be effective in Nigeria due to the high poverty levels, with over 63% of the population living in poverty. The low personal income tax rate and lack of strict enforcement for tax collection further hinder public revenue generation, particularly in the waste sector, where more awareness is needed. As a result, alternative avenues such as public-private partnerships, collaborations with small businesses, and foreign investments may be more suitable for generating waste management revenue, as exemplified by the success of Lagos state in developing 400 small waste management businesses from 40.

In conclusion, this study highlights various opportunities for potential solutions to improve waste management in Nigeria, but they must be applied considering the country's current state, including its financial situation, people's attitudes, and level of political will. While public revenue generation may not be practical at this stage due to poverty levels, collaborations, foreign investments, and public-private partnerships offer promising alternatives. Addressing the identified opportunities and challenges can contribute to developing a successful and sustainable waste management system in Nigeria.

8.4   Evaluating the Public's Perception and Experience in waste management.

The study also focused on objective 4, evaluating the public's perception and experience in waste management, specifically emphasising their level of awareness, participation in source separation, and payment for services. Waste management is a critical issue that affects public health, environmental sustainability, and overall quality of life. Understanding the public's perception and experience in this area is crucial for understanding the accurate state of waste management and for developing effective waste management strategies that are responsive to their needs and preferences.

Throughout this study, the research examined various factors influencing the public's perception and experience in waste management. These factors include their level of awareness about waste management practices, their participation in source separation programs, and their willingness to pay for waste services. The findings of this study shed light on the public's perception and experience in waste management. They reveal that awareness about waste

management practices varies among different segments of the public, with some individuals showing a high level of knowledge and engagement while others lack awareness and understanding due to differences in backgrounds. This study has shed light on the significant influence of age on waste management awareness.

The findings reveal that age plays a crucial role in determining individuals' awareness levels. It has been observed that younger age groups may have limited understanding and participation in waste management activities due to their developmental stage, while older age groups may face challenges in comprehension or engagement due to cognitive decline or limited involvement in household responsibilities.

The study underscores the importance of tailoring waste management sensitisation efforts to specific age groups to communicate and foster awareness effectively. Sensitisation efforts need to be age-appropriate, considering the target audience's cognitive and developmental capacities. For example, using visual aids or interactive methods may be more effective for younger age groups, while providing clear and concise information may be beneficial for older age groups.

Additionally, the findings highlight the need for ongoing and targeted sensitisation efforts for individuals of different age groups. It is essential to regularly reinforce the message of waste management awareness and practices to ensure that individuals of all ages are well-informed and engaged in sustainable waste management behaviours.

Similarly, participation in source separation programs varies, with a few individuals actively participating while others have limited engagement or face challenges to participation. Various factors, including affordability, perceptions of fairness, and trust in the effectiveness of waste management systems, influence the payment for waste services. In conclusion, the findings of this study indicate that waste activities, such as source separation and recycling, have low participation rates in Nigeria. The lack of specific solid waste policies and infrastructural provisions for these activities has hindered widespread participation. Also, the study reveals that most people are unwilling to participate in waste activities if given the opportunity due to the lack of government performance.

Additionally, the study highlights that age, employment status influences participation in waste activities. Currently, source separation is primarily practised in some formal environments, such as offices or recycling businesses, where infrastructure and policies may be in place. Therefore, targeting employed and self-employed individuals in their work environments could be a strategic approach to promote participation, as they are mature and can potentially influence their households and communities.

Furthermore, payment for waste services is influenced by various factors, including affordability and trust in the effectiveness of waste management systems. In conclusion, the findings of this study reveal that Nigeria lacks a comprehensive cost recovery and public revenue generation program for waste management, with exceptions in Lagos state and Abuja, where strict waste law enforcement exists. This means that only a few state governments and relevant agencies can levy fees in the form of taxes or service charges in certain areas. However, even within these states, there are significant variations between high-income and low-income areas. High-income areas tend to be cleaner and more well-maintained, with generally educated residents who are financially capable of paying for waste services. On the other hand, low-income communities struggle to afford these service charges, particularly in rural areas on the outskirts of towns or local areas and markets within cities.

For instance, in Abuja, the Asokoro district, known as the city's, most exclusive area with high real estate prices, is inhabited by the wealthy who can afford to pay taxes and waste services. However, locations like the Zuba district on the outskirts of town, with a large population of struggling traders, face financial challenges in affording waste services. Regular fee payments become increasingly difficult for this demographic to make consistently.

Furthermore, the study has also identified that gender and employment status play a role in influencing the payment for waste services in Nigeria. Further research could explore these factors in more depth to better understand their impact on the country's waste management practices and policy development. Overall, the findings highlight the need for targeted efforts towards income generation in low-income areas to promote sustainable waste management practices and ensure equitable access to waste services across different socio-economic groups in Nigeria.

8.5 Recommendations

The findings of this study reveal the significant challenges in Nigeria's municipal solid waste management and the critical need for urgent actions to improve the current situation. The previous chapters have analysed various issues, including poor waste management infrastructure, inadequate funding, low public participation, and weak policy implementation. This chapter provides recommendations that could potentially mitigate these challenges and improve waste management in Nigeria. Nigeria's municipal solid waste management requires urgent attention and multi-faceted actions to address the critical challenges identified in this study. If implemented, The recommendations in this chapter can provide a roadmap for improving waste management infrastructure, funding, policy implementation, and public participation, ultimately leading to environmental sustainability and preventing health and environmental impacts.

8.6 Recommendations for Mitigating Nigeria's waste sector financial challenges.

This study suggests that institutional and financial reforms should be implemented to enable the government to manage waste both as a social service and a commercial entity in Nigeria. However, it is emphasized that resolving the funding issue in the Nigerian waste sector requires it to be done in layers and stages because some solutions cannot initially be utilised. For example, public revenue cannot be generated due to the country's high poverty rate. A robust mitigation strategy must be in place before taking any steps. Mitigating the financial challenges in Nigeria's waste management sector requires a multi-faceted approach that focuses on poverty alleviation to promote cost recovery and revenue generation through tax collection, public-private partnerships, foreign investments, institutional reforms, and public participation. Implementing these strategies in a coordinated manner can improve Nigeria's waste management system's financial sustainability and prevent adverse health and environmental impacts.

A holistic approach should be adopted to address the funding issue in Nigeria's waste sector. Recognise that resolving the funding challenge requires a multi-pronged approach that involves addressing various underlying factors simultaneously, such as poverty alleviation, tax system improvement, and public-private partnerships.

The system must explore revenue generation through tax collection and cost recovery mechanisms. This includes implementing principles like the polluter pays principle and fixed taxes, where waste generators and service users pay for waste services. However, the tax system in Nigeria needs improvement, and efforts should be made to strengthen tax collection mechanisms to reach their full potential. The government should emphasize public participation in waste management activities and revenue generation. This approach can be more cost-effective, as waste generators bear the expenditure, and waste can be segregated at the source, reducing the cost of waste collection and transportation. However, given the poverty level in Nigeria, this may not be a practical solution in the short term, and poverty alleviation efforts should be prioritised.

Moreover, the interlinkages between waste management and the United Nations' Sustainable Development Goals (SDGs) should be recognised. Poverty alleviation, zero hunger, and good health and well-being are all related to waste management, and efforts to eradicate poverty can contribute to achieving other SDGs. Therefore, poverty alleviation should be prioritized as a means to enable people to afford to pay for waste services and taxes, ultimately increasing revenue generation for sustainable waste management practices.

Public-private partnerships and collaborations should be encouraged with the private sector in waste management. This can leverage private sector expertise, resources, and innovation to improve waste management operations and generate revenue. Foreign investors can also be attracted to invest in Nigeria's waste sector, creating additional job opportunities and generating revenue.

8.7 Recommendations for mitigating behavioural challenges for Nigeria's municipal solid waste management.

Given the diverse linguistic and cultural landscape in Nigeria, it is crucial to establish effective communication routes to reach all segments of the population for effective sensitisation, especially those in rural areas who may not be fluent in English or the major ethnic languages of Hausa Yoruba, and Igbo. This can be achieved through a multi-media approach that utilises various communication channels, such as radio, television, newspapers, and other available

means, including face-to-face sensitisation in rural areas to ensure that waste management messages are disseminated widely.

To secure payment for waste fees, it is important to focus on educated demographics first, as they are more likely to be employed or self-employed and able to afford waste services. This includes targeting workplaces, universities, ministries, and other institutions where the educated demographic is concentrated for sensitisation efforts. This will enable the government to gain funds faster than other low-income groups. Also, efforts should be tailored to different age groups, recognising that primary and secondary schools and introducing waste education in the school curricula may effectively promote waste payment behaviours among students who may influence their household's payment decisions.

8.8 Recommendations for mitigating institutional challenges affecting Nigeria's municipal solid waste management.

To mitigate the institutional challenges in Nigeria's waste management sector, adopting a bottom-up approach, investing in employee training and development, and fostering collaboration between academia and government is essential. These strategies can contribute to developing sustainable waste management systems, enhance efficiency, and reduce waste-related issues in the country.

Given Nigeria's federal government structure, adopting a bottom-up approach in waste management is essential. This involves rebalancing the relationship between local, state, and federal government ministries and agencies responsible for waste management. This approach empowers local government councils to discharge their waste management responsibilities more efficiently, reducing waste and minimizing unnecessary role conflicts among different levels of government and agencies.

Also, waste management and related government agency employees should receive regular training and retraining to enhance their skills and knowledge. The government should prioritise human capital development in the waste management sector to achieve sustainable waste management systems. This can include training programs, workshops, and capacity-building initiatives to improve the expertise of personnel involved in waste management.

Furthermore, The government should invest in research and development in waste management to make informed policy decisions. Establishing a bridge between academia and government can facilitate collaboration, highlighting key issues and developing efficient methods for maintaining sustainable waste management systems. This can include research grants, joint initiatives, and partnerships between universities, research institutions, and government agencies to promote evidence-based decision-making in waste management policies.

8.9   Recommendations for mitigating legal challenges affecting Nigeria's municipal solid waste management.

The newly launched National Solid Waste Policy in Nigeria provides a comprehensive framework for waste management. However, for the policy to effectively address the financial challenges in the waste management sector, strict adherence to the policy guidelines, monitoring of stakeholders and responsible parties, and enforcement of laws are crucial. This recommendation chapter outlines strategies to ensure efficient policy implementation through strict compliance and enforcement measures.

 Robust monitoring and accountability mechanisms should be established to ensure the effective implementation of the National Solid Waste Policy. This involves regularly monitoring the activities of stakeholders and responsible parties, including waste management companies, local government councils, and other relevant agencies, to ensure compliance with the policy guidelines. This can be achieved through regular inspections, audits, and performance evaluations. Non-compliance should be met with appropriate sanctions, including fines and penalties, to hold stakeholders and responsible parties accountable for their actions or inactions.

Also, the government and responsible agencies should impose stricter laws and regulations to promote compliance with the National Solid Waste Policy. This can include regulations on waste collection, transportation, disposal, and recycling and penalties for violations. The enforcement of laws should be consistent, transparent, and impartial, with no exemptions for any stakeholder or responsible party. The government should also allocate adequate resources, including personnel and equipment, to support the enforcement efforts.

Furthermore, awareness campaigns and public education programs should be conducted to ensure maximum public engagement in waste management efforts. This can include community outreach programs, public lectures, workshops, and media campaigns to educate the public on the importance of proper waste management practices, the benefits of compliance with the National Solid Waste Policy, and the consequences of non-compliance. Engaging the public in waste management initiatives can foster a sense of ownership and responsibility, resulting in increased compliance and participation.

Finally, efficient policy implementation requires collaboration and coordination among stakeholders, including government agencies, waste management companies, local government councils, communities, and other relevant parties. Regular meetings, workshops, and stakeholder engagements should be organized to facilitate information sharing, exchange of ideas, and coordination of efforts. This can help identify challenges, explore innovative solutions, and enhance stakeholder coordination, leading to more effective and sustainable waste management practices.

8.10 Conceptual framework

The study's conceptual framework incorporated stakeholder theory to examine the roles and responsibilities of government agencies, waste management companies, local government councils, and communities in implementing waste management operations. This included exploring the challenges and opportunities associated with stakeholder involvement and their impact on waste management practices. The stakeholder theory served as a guiding framework in developing the conceptual framework in this study. It provided a theoretical basis for understanding the role of stakeholders in policy implementation processes and helped to uncover the dynamics of stakeholder engagement and participation in waste management practices.

Nigeria's potential waste management solutions are complex and require careful consideration of various factors. Therefore, this study has developed a conceptual framework which outlines identified challenges and proposed mitigation measures in different phases and identifies the actors responsible for each step. This framework will serve as a roadmap and guide for decision-makers when addressing waste management challenges in Nigeria.

The conceptual framework in this study draws on lessons learned from developed countries, where various strategies and approaches have been employed to address waste management issues using awareness, technology, finances, and governance. However, it is important to contextualise these solutions to the Nigerian waste sector, considering the country's unique capabilities and available resources. This involved comparing drivers identified from developed countries with insights gained from interviews with waste management experts in Nigeria.

Not all solutions implemented in developed countries may be directly applicable to developing countries like Nigeria due to socioeconomic differences. Therefore, it is crucial to cultivate a suitable framework model tailored to the local context and focus on the local environment's strengths. In this study, an attempt has been made to propose a conceptual solution specifically designed based on all available resources, stakeholders, and challenging factors.

This study aims to provide a foundation for effective waste management implementation strategies in Nigeria by developing a context-specific conceptual framework. The framework considers the unique challenges and opportunities in the Nigerian waste sector and seeks to align solutions with the local context. Hopefully, this framework will contribute to the success of sustainable waste management practices in Nigeria by providing a comprehensive and adaptable approach that considers the country's capabilities and available resources.

Figure 8.1: shows a conceptual framework for potentially improving municipal solid waste management.
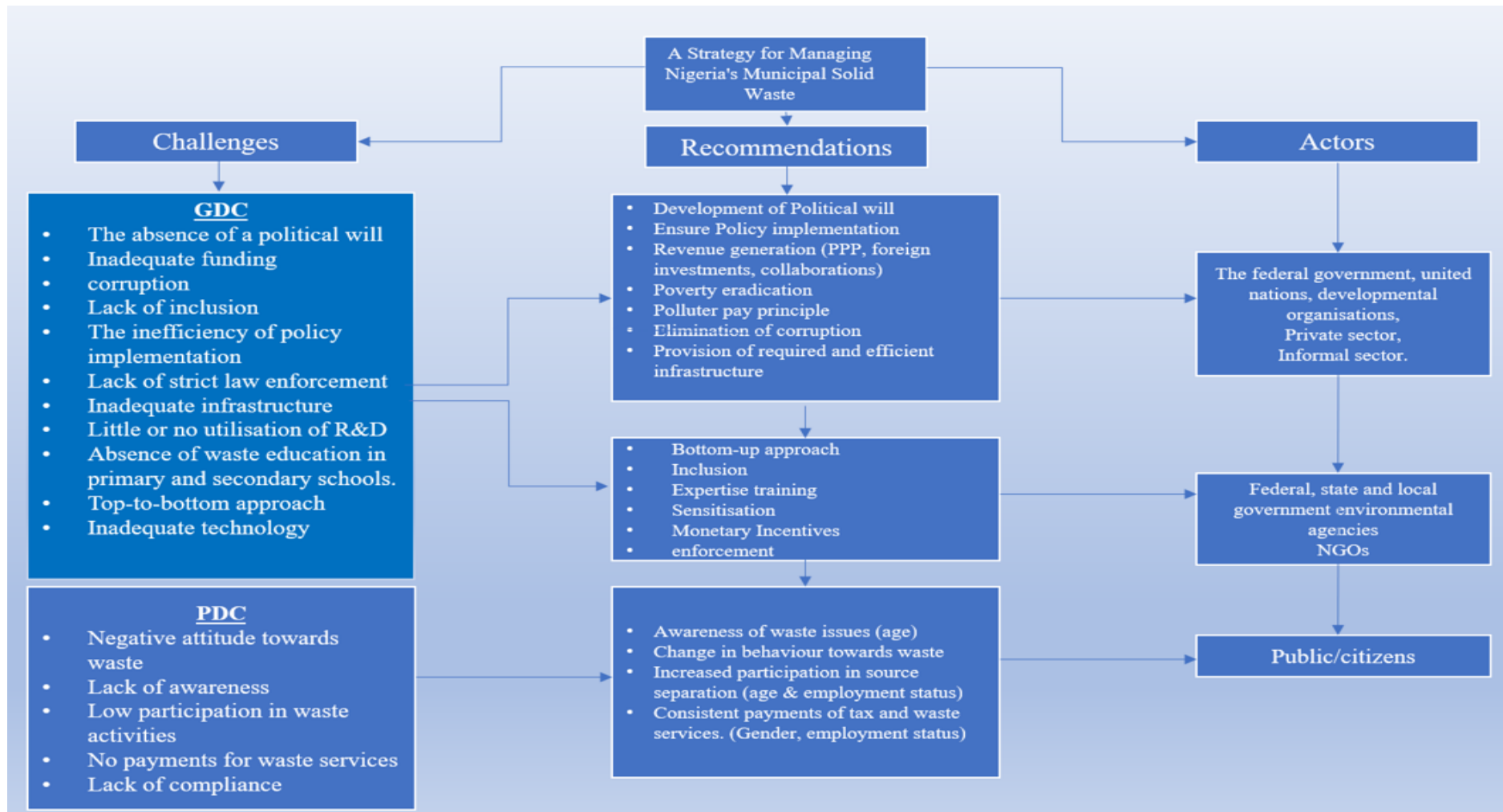
In Figure 7.2, the current state of municipal solid waste management is depicted, outlining challenges that hinder effective waste systems, potential opportunities for exploitation, and stakeholders accountable for required actions. The challenges are classified into two categories: government-driven challenges and public-driven challenges. The challenges posed by the federal government's GDP result from government inaction, such as the lack of political will to implement mitigation strategies and produce solutions. The public-driven challenges involve people's inaction, such as improper waste behaviour and its impact.

The recommendations in the framework are further divided into three groups, with each aspect listed in order of importance. The federal government is primarily responsible for waste management actions and must lay the foundation for all waste management efforts. This includes the political will to engage in waste management mitigation initiatives, as it sets the urgency for comprehensive efforts. The federal government also plays a pivotal role in developing waste management policies, implementing policies, and making funding decisions.

The next stage of the recommendations is to ensure the proper implementation of the newly formed National solid waste policy. However, financing is crucial for adequate policy implementation. Due to insufficient funding in the sector, revenue generation strategies must be explored based on practical and contextual approaches to the country's current situation. Transition to a more efficient waste management system will occur in phases, considering policy, socioeconomics, and environmental factors. Revenue generation is the first option, achieved through public-private partnerships and collaborations, as explained in section 7.3.1. However, these solutions may not fully recover costs, so the government must constantly persuade the public to pay taxes and waste service fees. This may require an indirect approach centred on poverty eradication, as eliminating poverty will enable people to pay personal income taxes. The Federal Inland Revenue Services collecting system must also be modernized and expanded to accommodate the country's population.

Although poverty eradication is a gradual process, the government needs to develop pro-poor policies that combat corruption and take favourable actions to support people experiencing poverty, including strengthening small enterprises, facilitating ease of business, implementing youth and women empowerment programs, creating employment opportunities, and more. It is also recommended that the Nigerian government closely cooperate with the United Nations

to achieve a zero-poverty sustainable development target and ensure that funds disbursed for poverty alleviation programs from developmental organisations are used ethically and efficiently.

Once suitable funding is available, the government should provide adequate infrastructure at all levels to enable smooth waste management operations. To ensure effective waste management, the federal government must understand the context and conditions of each constituency and state to make informed decisions, which requires a bottom-up approach. This means that all levels of government need to be involved and communicate effectively, with all environmental ministries and agencies working together for successful sensitisation programs. Employees at all levels must also be trained to ensure proficiency in educating citizens about the impacts of waste and encouraging their engagement. When public awareness is raised, the appropriate environmental agencies must enforce regulations vigorously. The success of the third phase of the framework relies on the public's understanding and engagement in waste management operations following sensitisation. People must comply with waste management regulations for sustainable waste management systems to be achieved, and the affordability of consistent payment for waste services should be within reach for many people due to the initiatives implemented in the first phase.

8.11 Framework development

The development of this study's conceptual framework is intrinsically tied to the key findings derived from the study's extensive research and analysis. This section illuminates how the conceptual framework evolved from these crucial findings, elucidating its pivotal role in advancing knowledge in the municipal solid waste management field in Nigeria. It is a tangible embodiment of the research's contribution to knowledge, enriching the understanding of MSWM in Nigeria and providing actionable insights to propel advancements in waste management practices within the country.

The framework was conceptually developed by integrating both qualitative and quantitative outcomes of the study including the stakeholders involved. It synthesises the research findings by linking them together based on each challenge's criticality of impact. The foundation of the conceptual framework was laid upon discovering several recurrent themes and patterns

through empirical research and data analysis. These themes, often interrelated, revolved around stakeholder perceptions, policy effectiveness, public participation, and several other challenges in waste management, opportunities for improvement, and stakeholders responsible at all levels. Each of these themes represented a fundamental facet of the MSWM landscape. For example, inadequate finding resulted as the most critical challenge affecting MSWM in Nigeria based on the expert's frequency of mention. Therefore, it was placed alongside the various outcomes of potential opportunities such as revenue generation through polluter pay principle (PPP) that can mitigate the challenge as well as the actors responsible at that stage i.e the federal government.

Alignment with Research Objectives:

Crucially, the development of the conceptual framework was meticulously aligned with the research objectives. Each component and subcomponent of the framework directly corresponded to one or more research objective, ensuring that it functioned as an organised guide for the study. This alignment was paramount in achieving the overarching research goal to deepen the comprehension of MSWM in Nigeria and contribute valuable insights to the field. For instance, the listed challenges in the framework addresses objective 1 & 2, the second column that listed the opportunities addresses objective 3 and the influential demography mentioned aside the opportunities address objective 4.

The conceptual framework's development from key findings ensures that the research contributes substantively to knowledge by providing a robust and logically organized framework that can be employed to assess and enhance MSWM in Nigeria. It functions as a bridge between theory and practice, offering a practical tool for stakeholders in the waste management sector to gain a deeper understanding of the challenges and opportunities in MSWM.

8.12 Limitations of the study.

There can be no research without limitations. As is the case with other studies, this research has several limitations that need to be addressed, as discussed below.

- In conducting the literature review for this study, one of the limitations found was the manual search for articles in different data basis, it was found to be tedious and took a long time to assess, and it is impossible to access every single article written on this topic.

- From the literature review conducted in the study, it was observed that there is a dearth of recent research studies on the challenges affecting municipal solid waste management. Most relevant articles still currently cited for factors affecting municipal solid waste management studies emerged between 2009-2013. Analytics were checked on SCOPUS for evidence, and the results confirmed the same.

Another limitation of this research is that the collection of empirical data depended mainly on the level of access obtained. The study was conducted in 2021 at the peak of the covid 19 pandemic. Due to the lockdown, there were travel restrictions so the study could not travel to Nigeria to meet people.

Although the online interviews used by the study gained access to a wider pool of respondents, the study was limited to internet and social media users in Nigeria. Hence, the study could not reach rural areas to collect data from the public. there was no opportunity to travel to access the local rural communities to get their responses to the survey questions. Therefore, the study had limited access to participants to understand the situation fully. Due to that, most of the respondents are the highest number of internet and social media users such as Lagos state, Abuja and other subsequent states.

8.13 Recommendations for further research

The research findings and limitations have led in the identification of prospective future research paths for exploration. The following are the recommendations for future research as a consequence of this study.

As the search for data was found to be a limitation of this study, it is recommended that for further research studies in waste management, academics can begin to research how waste management studies can be conducted with the help of artificial intelligence. One potential application of AI in waste management research is in the analysis of large amounts of data related to all aspects of waste management. Also, AI algorithms can be trained on this data to

identify patterns, predict future trends, and optimize waste management practices. For example, AI can be used to develop predictive models that can forecast the amount of waste that will be generated in a given area based on population growth, economic development, and other factors.

Another recommendation for future research is the utilisation of blockchain. Further studies can research how Blockchain can be used to incentivise waste reduction and recycling efforts. By creating a token economy where individuals or organisations are rewarded for reducing waste or increasing recycling rates, Blockchain can encourage greater participation in waste management efforts.

Further investigation is required to gain a comprehensive understanding of the experiences and viewpoints of people in rural areas of Nigeria regarding municipal solid waste. This may involve utilizing various languages, as necessary, to ensure that their perspectives are incorporated. To enhance the applicability and significance of the framework, it is crucial to validate it across multiple domains. Additionally, further research may be necessary to incorporate any new elements arising over time and expand the framework accordingly.

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Appendices

Appendix 1

Correlations

			payment for waste services	employment status	Gender	Age	awareness	waste separation	Level of Education	location
Spearman's rho	payment for waste services	Correlation Coefficient	1.000	-.021	-.215**	.115	-.048	-.047	.202**	-.036
		Sig. (2-tailed)	.	.766	.002	.099	.490	.499	.003	.607
		N	208	208	208	208	208	208	208	208
	employment status	Correlation Coefficient	-.021	1.000	-.101	-.046	.035	-.039	-.227**	.042
		Sig. (2-tailed)	.766	.	.146	.508	.620	.572	<.001	.551
		N	208	208	208	208	208	208	208	208
	Gender	Correlation Coefficient	-.215**	-.101	1.000	.110	.056	-.032	.049	.115
		Sig. (2-tailed)	.002	.146	.	.115	.420	.647	.481	.097

	N	208	208	208	208	208	208	208	208
Age	Correlation Coefficient	.115	-.046	.110	1.000	.181**	-.101	.292**	.017
	Sig. (2-tailed)	.099	.508	.115	.	.009	.146	<.001	.807
	N	208	208	208	208	208	208	208	208
awareness	Correlation Coefficient	-.048	.035	.056	.181**	1.000	.119	.051	.074
	Sig. (2-tailed)	.490	.620	.420	.009	.	.088	.461	.291
	N	208	208	208	208	208	208	208	208
waste separation	Correlation Coefficient	-.047	-.039	-.032	-.101	.119	1.000	.001	.146*
	Sig. (2-tailed)	.499	.572	.647	.146	.088	.	.985	.035
	N	208	208	208	208	208	208	208	208
Level of Education	Correlation Coefficient	.202**	-.227**	.049	.292**	.051	.001	1.000	.047

	Sig. (2-tailed)	.003	<.001	.481	<.001	.461	.985	.	.499
	N	208	208	208	208	208	208	208	208
location	Correlation Coefficient	-.036	.042	.115	.017	.074	.146*	.047	1.000
	Sig. (2-tailed)	.607	.551	.097	.807	.291	.035	.499	.
	N	208	208	208	208	208	208	208	208

*. Correlation is significant at the 0.01 level (2-tailed).

. Correlation is significant at the 0.05 level (2-tailed).

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Appendix 2

INFORMATION SHEET

1. Research Project Title
Analysis of municipal solid waste management in Nigeria.

2. Invitation paragraph
I would like to invite you to take part in the above-mentioned research project. It is important that you understand the purpose of this research before deciding to participate. Kindly take a minute to read the following information and take time to decide whether to participate in this study or not. You are free to request for additional information or clarification on the research, before, during and after your participation.

3. What is the purpose of the study?
The aim of the research is to explore the current situation of municipal solid waste management (MSWM) challenges and opportunities) in Nigeria.

4. Why have I been invited?
You have been invited to take part in this study because you can share your view, experiences and thoughts regarding key barriers and challenges that hinders effective implementation of MSWM policy in Nigeria, and how to address these barriers. To achieve the aim of this research, interviews and focus group discussions will be conducted with key stakeholders responsible for implementation of municipal solid waste management policies in Nigeria.

5. Do I have to take part?
Participation is voluntary. However, if you agree participate in the study, we will share detail information sheet and consent form with you. After reading the information sheet, you will be asked to sign a consent form. Even after singing the consent form, you can withdraw your consent to participate in the study at any time without giving any reason.

6. What will happen to me if I take part?
If you agree to take part, you will have the choice to participate in interviews or focus group discussions. Participants will be invited for interviews and focus group discussions via emails (provided) and this can take face-to-face or remotely via zoom with the researcher. Both the interview and focus group discussion will take at least 1 hour (approximately). Please note that *your identity will be confidential*. The researcher will not collect or record any personal/private or commercial information during and after the study.

7. What are the possible disadvantages or risks of taking part?
There will be *no risks or possible disadvantage* of participating in this study. Your thoughts will be treated as "personal views" and not that of the organisation you represent or engage in business with. Neither your personal details nor institutional names would be included in the data collected. Hence, all your response or comments will be presented and treated as anonymous.

8. Will my taking part in the study be kept confidential?
Absolutely yes, all information/data collected will be kept anonymous, treated with strict confidentiality, and *under no circumstances will your identity be revealed* in this report or any other publications.

9. What will happen to the results of the research project?

All data/documents/information will be completely confidential and will not be shared or exchanged with any third party. The findings of this research will be available at The University of Salford.

10. Who has ethically reviewed the research project?
The research has been ethically approved through the research ethics panel of the University of Salford.

Appendix 3

PARTICIPANTS' CONSENT FORM

By completing and signing this form you are indicating that you have read the information sheet and have made a decision to participate in the study.

Title of Project: Analysis of Municipal Solid Waste Management in Nigeria.

I confirm that I am over 18 years old	YES	☐
	NO	☐
I confirm that I have read and understood the information sheet for the study mentioned above and I am aware that only my opinion/experience is needed	YES	☐
	No	☐
The researcher has given me the opportunity to ask clarification questions before, during and after deciding to participate in this study	YES	☐
	No	☐
I agree to the interview be tape recorded	YES	☐
	No	☐
I am aware that my participation in this study is voluntary and that I can withdraw my consent to participate at any time without giving reason(s)	YES	☐
	No	☐
I agree to take part in the above study	YES	☐
	No	☐

_____   ___/___/___

Name of participant   Date

__ANISA GUMEL_____   _27__/__05_/__21_

Name of researcher   Date

1 copy for the participant; 1 copy for the researcher

Appendix 4

University of Salford
MANCHESTER

Invitation Cover Letter

Dear Participant,

You are invited to participate in a research that aims to explore municipal solid waste management (MSWM) challenges and opportunities in Nigeria. This study is conducted by Anisa Haruna Gumel (PhD student at the University of Salford) and the supervisors are Dr Romas Malevicius and Dr Maria Paola Rana.

During this research (interview and focus group discussions), you will be kindly asked to share your views on barriers and challenges preventing effective implementation of MSWM policy implementation and identify opportunities for improving these barriers.

Please, note that participation in this research is voluntary. You are not under any obligation to participate in this study, as you are at liberty to withdraw from partaking in the interview and focus group discussion without giving any reasons. In addition, you can decide to answer all or some or none of the questions without giving a reason.

I assure you that this research is for academic purpose. Your responses will be treated in confidence and I promise not to disclose your personal details or the name of the company you work for.

If you are happy to proceed, kindly look at the information sheet and consent form attached to this letter.

Your participation will be highly appreciated.

Sincerely,

Anisa Haruna Gumel
Post –Graduate Research Student

Appendix 5

A. INFORMATION BEFORE THE INTERVIEW STARTS

Thank you for taking the time to participate in this research.

Introduction: *My name is Anisa Gumel. I am a doctoral student from the University of Salford at Salford business school. I am conducting this interview considering my research thesis with the topic "Analysis of municipal solid waste management in Nigeria"*

You are invited to participate in this study as a key informant due to your expert knowledge and experience about the investigated topic.

Through your participation, I hope to understand your views (*experiences) on key challenges* affecting the implementation of municipal solid waste management (MSWM) and explore improvement opportunities.

Please, note that participation in this research is voluntary, your responses will be treated in confidence and I promise not to disclose your personal details or the name of the company you work for.

If you do not mind, I would like to tape-record this interview just to ensure I have an accurate discussion account. If are not comfortable being audiotaped, I will take notes instead.

Estimated interview time is: **1 hour.**

Key words: solid waste, waste management, challenges, opportunities

B. PARTICIPANT'S PROFILE

Instruction:
Please read each item carefully, and then tick ☑ the answer that best represents your opinion.

1. Please Sir/Ma what is your position in your organisation?

2. Please tell me about your role in the organisation as regards to municipal solid waste management.

3. How long have you been working in the organisation?

4. How has the experience been in dealing with waste management?

5. Do you go through trainings in waste management?

6. What type of training, can you give me an example of some you recently attended?

C. BARRIERS TO MSWM

7. What can you say about the Management of municipal solid waste in Nigeria?

8. Who are the stakeholders involved in the waste management process?

9. What do you feel has been achieved so far in the waste management sector?

10. Based on your opinion, is the government policy on waste management effective? Please tell me why? Are all stakeholders involved during policy making?

11. Have there been new MSW policies adopted in the past five years?

12. How do you ensure that policies and regulations are implemented?

13. Do you think waste management laws are being enforced in Nigeria?

14. How is waste management funded in Nigeria?

15. In your opinion, are the funds allocated for waste management enough?

16. Are there up to date technological systems for waste management operations in the country?

17. What are the key challenges that you feel affect municipal solid waste management implementation?

18. How would you describe the public's attitude towards waste management?

19. How do you carry out public awareness and communication on Municipal Solid waste? management

D. OPPORTUNITIES FOR IMPROVEMENT IN MSWM POLICY IMPLEMENTATION

20. Are there plans in place to improve Municipal solid Waste Management?

21. What are the strategies to implement the plan?

22. Based on your experience, can you suggest what opportunities can be utilised to achieve effective municipal solid waste management?
And who should then be responsible for making these changes.

23. Based on the challenges you have mentioned, what are the most important areas that need urgent attention in the current MSWM system
And why are they more important?

24. Do you have something else to add to what we have discussed so far?

For the private sector ask about who and how they provide WM services to.

Appendix 6

Public survey questionnaire link.

https://bit.ly/3iOXTOK

Appendix 7

Evidence for Ethics approval

ethics

Ethics Application: Panel Decision

13 May 2021 at 14:00

To: Anisa Gumel

The Ethics Panel has reviewed your application: Analysis of municipal solid waste management in Nigeria. Application ID: 1499

The decision is: Application Approved.

If the Chair has provided comments, these are as follows:

Comments:

overall a clear application...

regarding data collection method this seems like a mixed method- could specify for clarity- also – in relation to collecting demographic data from participants -applicant must ensure anonymity and confidentiality... the applicant has not clarified the dissemination channel- dissertation and /or other channels...

Please use the Ethics Application Tool to review your application.