

**A study of factors influencing development of unofficial waste disposal sites in developing countries: A case study of Minna, Nigeria**



**By**

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## **ABSTRACT**

Implementation of effective waste management is a significant challenge facing government authorities of major cities in developing countries. The lack of resources and infrastructure has often led to the creation of unofficial waste disposal sites (UWDSs) within urban areas. Previous studies suggest that there is a lack of empirical understanding of the factors influencing the development of UWDSs and how to manage their impact on human health and the environment.

The aim of this research was to explore factors influencing the development of UWDSs in developing countries by drawing evidence from a case study of Minna, Nigeria. The study sought to utilise the concept of Integrated Sustainable Waste Management (ISWM) in analysis of research findings and to recommend strategies to manage UWDSs in developing countries.

The research utilised a mixed-method research approach which involved geospatial mapping of waste disposal sites (141 UWDSs, 45 CWCPs, and 1 Landfill) in Minna metropolis, a resident survey (n=134 respondents), and interviews (n=14) with key stakeholders (e.g. waste management authorities).

Geospatial mapping indicated that UWDSs are unplanned, unregistered and unregulated, located within residential areas and created by residents for convenience and immediate disposal of their waste. In addition, results suggested that location (restricted to major roads due to ease of access for vehicular collection) and the limited number of official central waste collection points (CWCPs) and poor urban planning are contributory factors in the creation and abundance of UWDSs in Minna.

The findings of the public survey revealed the main challenges of waste management in Minna as: insufficient waste collection and infrequent services, location of CWCPs, corruption, ineffective policies, regulation and implementation, lack of public education and awareness, lack of public engagement/participation, poor public attitudes, and poor/old transportation facilities (e.g. trucks).

Interviews findings suggested that incorporating community leaders into waste management planning and delivery is vital to strengthen public involvement that can result in more effective waste management. In addition, stakeholder collaboration is important to enhance communication flow and monitoring for delivering effective and tailored services.

The findings from the study agreed with the elements of the ISWM model which considers stakeholder interest and involvement/participation in an enabling environment (such as accountability, policy/legal, financial, political, etc.) as key to achieving a sustainable waste management system. Utilising ISWM to conceptualise the findings of this study produced a workforce model putting current waste management strategies and findings into consideration. The proposed workforce model can be used/adapted by waste management authorities to improve current waste management practices and foster stakeholder collaboration in an enabling environment which will mitigate the creation of UWDSs within residential areas.



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## **LIST OF ABBREVIATIONS**

AfDB	Africa Development Board
BOS	Bristol Online Survey
CWCPs	Central waste collection points
DFID	Department for International Development
EMCA	Environmental Management and Coordination Act
EPC	Environmental Protection Council
EU	European Union
FEPA	Federal Environmental Protection Agency
FGN	Federal Government of Nigeria
GIS	Geographical Information System
GPS	Global Positioning System
GRA	Government Reserved Areas
HGVs	Heavy Good Vehicles
ISWA	International Solid Waste Association
ISWMM	Integrated Sustainable Waste Management model
IWM	Integrated waste management
JAMB	Joint Admissions and Matriculation Board
LAWMA	Lagos Waste Management Authority
LGAs	Local Government Areas
MDG	Millennium Development Goals
NEMA	National Environmental Management Authority
NEPAD	New Partnership for Africa Development
NESREA	National Environment Regulation and Enforcement Agency
NGOs	Non-governmental organizations
NIMBY	Not in my backyard
NISEPA	Niger state environmental protection agency
NSUDB	Niger state urban development board
NTA	Nigeria Television Authority
PPE	Personal Protection Equipment
QGIS	Quantum Geographical Information System Software

SGAs	State Government Agencies
SGMs	State Government Ministries
STEMH	Science, Technology, Engineering, Medicine and Health
SWM	Municipal Solid Waste Management (MSWM)
SWM	Solid Waste Management
UBA	United Bank for Africa
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations International Children’s Emergency Fund
UNIDO	United Nations Industrial Development Organization
UWDSs	Unofficial Waste Disposal Sites
WCD	Waste Collection Districts
WDS	Waste Disposal Site
WM	Waste Management

## **CHAPTER ONE: INTRODUCTION**

This chapter introduces the research topic:

*A study of factors influencing the development of unofficial waste disposal sites in developing countries: A case study of Minna, Nigeria.*

Despite increasing policy enactment to reduce the number of unofficial waste disposal sites (UWDSs), there is still limited or sparse research to understand the reasons for the proliferation of these sites in developing countries. The introduction provides a background to the study and research aims and objectives. At the end of this chapter, an overview of the thesis structure is provided.

### **1.1 RESEARCH BACKGROUND**

An increasing population, rapid economic growth and a rise in community living standards have accelerated the rate of solid waste generation, thus causing its management to be a major challenge in developing countries (Al-Khatib et al., 2010). Waste management practices differ between developed and developing nations, urban and rural areas, residential and industrial producers. The whole concept of waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. However, typical waste management systems comprise of collection, transportation, pre-treatment, processing and final disposal of non-recyclable residues. In urban cities of developing countries, solid waste management is a highly neglected area. Lack of awareness and ineffective collection of waste has led to creation of UWDSs and its impact on the public health and environment required urgent attention (Al-Khatib et al., 2010).

The main purpose of waste management is to provide sanitary living conditions to reduce the amount of waste material that enters or leaves society and encourages re-use within society (Demirbas, 2011). Waste collection has been identified as a major problem since, in many areas, waste management authorities are either unable or unwilling to provide waste collection services to all residents in their jurisdiction (Al-



Khatib et al., 2010). For example, Al-Khatib et al (2010) and McBean et al., (2005) state that on average, up to 50% of residents in urban areas of low and middle-income countries lack collection services because government budgets are limited, and collection is not seen as a priority area. This is supported by, McBean et al., (2005) who suggest that effective solid waste management is strongly influenced by political, legal, socio-cultural, environmental and economic factors. These factors often have complex interrelationships (Qdais 2007) and therefore, all need to be addressed to reach a sustainable solution.

Increased waste generation in urban areas has become an environmental concern across the world (Ojeda-Bení and Beraud-Lozano, 2003). This is because the amount of refuse destined for final disposal rapidly consumes landfill capacity and the impact on quality of life in densely populated areas is alarming. Also, increasing waste generation in developing countries has been linked to several key factors identified by Oguntoyinbo (2012). These are: (i) rapid population growth, (ii) high rural-urban migration, (iii) high levels of poverty, (iv) lack of urban planning, and (v) accelerated production and consumption rates. Similarly, the creation of UWDSs can be linked to similar factors but also have the added influences of weak environmental policy, lack of commitment by the stakeholders, limited financial resources, and lack of appropriate technology for waste disposal systems (Lederer et al., 2015). For example, Mexico is experiencing serious environmental problems due to inadequate planning and unsustainable waste management systems as the country is undergoing a rapid rural-urban migration process with 70% of the population now located within cities (Buenrostro and Bocco, 2003). This has led to an increase in the number of UWDS within residential areas of urban cities in developing countries.

Effective siting and management of waste disposal sites are essential in terms of protecting public health and the environment. The absence of these measures impacts on both the local environment and local human health (Daniel & Laura 1999; Sever, 1997). Improper siting of waste disposal sites is common in most low and middle-income developing countries. As a result, waste disposal sites, irrespective of type, should be

located on the outskirts of urban areas (Abul, 2010). This is not always possible due to the growth of urban areas and many sites find themselves within urban boundaries.

The migration of people from rural to urban areas not only places a financial strain on local authorities, already short of funds, but impacts on limited urban planning (Parrot et al., 2009). Cohen (2006) states that each year, cities attract new migrants who, together with the increasing native population, expand the number of squatter settlements and shantytowns, exacerbating the problems of urban congestion and sprawl and hampering the attempts by local authorities to improve basic infrastructure and deliver essential service. It has been recorded that more than half of urban residents live in crowded slums and shantytowns where basic sanitation facilities are lacking (Boadi and Kuitunen, 2005; Drechsel and Kunze, 2001). Urban congestion, shantytowns, and limited urban planning (crowded settlements) may hinder effective waste management services due to lack of access roads which can result in the creation of UWDSs within residential areas.

Therefore, most sub-Saharan African countries, have little choice other than to accept/employ the use of UWDSs (Benedine, et al., 2011; Muhammed and Chukwuma, 2011). Table 1.1 identifies UWDSs as a system or method that has no development and operational cost requirements and therefore is the most prevalent waste disposal option in most developing countries (UNEP, 2005). These UWDSs are predominantly unplanned, unmanaged sites (unregistered and unregulated), used by both individuals and commercial groups (Afon, 2007) within residential areas for immediate disposal of their waste. Urban communities tend to manage vermin and odour issues and to reduce waste volumes on UWDSs through burning (Ball and Rodic-Wiersma, 2010) which has an adverse impact on the environment and human health. However, such UWDSs can be a resource through the collection of the recyclables/re-useable materials and local farmers harvesting the organic matter from the UWDSs for their crops. Therefore, the UWDSs are a threat to both human health and the environment due to their location (within residential) and the mode of management (by burning) but can still be a resource for the local population.

Table 1.1: Comparison of unofficial waste disposal sites with managed sites

Criteria	UWDSs (unregulated sites)	Controlled dump (managed)	Standard Sanitary Landfill (Managed)
<b>Leachate management</b>	No leachate management	• Partial leachate management	• Full leachate management
<b>Gas management</b>	No gas management	• Partial or no gas management	• Full gas management
<b>Fencing (Wall)</b>	No fence (unrestricted access)	Fencing present but site accessible	• Secure fencing with gate (restricted access)
<b>Start up and operational cost</b>	No start up and operational cost but high long-term impact	Low to moderate start up and operational cost	High start-up and operational cost
<b>Location (siting)</b>	Amidst residential, on roads and drainages	Outskirts of city/town	Outskirts of city/town
<b>Capacity</b>	Site capacity is not known	Planned capacity	Well planned capacity
<b>Waste input</b>	No control over quantity and/or composition of incoming waste	Partial or no control of waste quantity, but waste accepted for waste disposal is limited	Full control over quantity and composition of incoming waste, special provisions of special type of wastes

<b>Environmental and health impacts</b>	High potentials for fire and adverse environmental and health impacts	Lesser risk of adverse environmental and health impacts compares to unofficial and open dumpsites	Minimum risk of adverse environmental and health impacts
<b>Closure</b>	No proper closure of site after cease of operation	Closure activities limited to covering with loose partially compacted soil and replanting of vegetation's	Full closure and post-closure management

Source: (Adapted from UNEP, 2005)

Considering the description of UWDSs in Table 1.1, strategies are required for the management of UWDSs in urban areas of developing countries. There is an open waste disposal system as an intermediary step between UWDSs and Controlled System which in turn does not protect the environment and human life. Table 1.1 also presents a controlled waste disposal system as a step higher than open waste disposal system and two steps higher than UWDSs, which can be achieved through a simple application of fundamental control measures, such as strengthening and implementing environmental policies that limit the use of UWDSs (Ball and Rodic-Wiersma, 2010). Practices such as material recovery facilities, source separation collection etc. are highly expensive and technology-oriented in sanitary landfilling process (Al-Khatib et al., 2010), which may not be attainable in developing countries. However, in developing countries, although open dumping (including UWDS) is common, there is also a realization that this is inadequate, and efforts are underway to control systems to minimize the health and environmental impact (Shekdar, 2009). For example, South Africa, being a developing country, supports and practises waste hierarchy in its approach to waste management by promoting cleaner production, waste minimisation, reuse, recycling, and waste treatment with final disposal as the last resort in the management of waste (Department of Environmental Affairs, 2018). Therefore, policymakers should not ignore these UWDSs, but rather incorporate them into their waste strategy, improving present practices to mitigate the impact of existing sites and prevent the creation of new sites.

## **1.2 AIM AND OBJECTIVES**

### **Aim**

This research aims to explore factors influencing the development of unofficial waste disposal sites (UWDSs) in developing countries by drawing evidence from the case of Minna, Nigeria. The purpose of the research is to utilise the concept of the Integrated Sustainable Waste Management Model in the analysis of research findings and suggest ways to address issues of managing UWDSs in developing countries.

The following objectives are designed to achieve this research aim;

## Objectives

- i.To establish the geo-spatial distribution of both official and unofficial waste disposal sites in the case study area of Minna:
- ii.To identify the socio-economic and political factors influencing the siting and management of UWDSs in Minna:
- iii.To use ISWMM to contextualise the findings from objectives 1 and 2:
- iv.To recommend interventions for effective management of UWDSs within formal waste management strategies.

Table 1.2 present the relationship between research objectives and methods used.

Table 1.2: Research Objectives and Methods

<b>Objectives</b>	<b>Methods</b>
<b>I.To establish the geo-spatial distribution of waste disposal sites (including UWDSs) in Minna</b>	Geo-Spatial Mapping
<b>II.To identify the Socio-economic and political factors influencing the siting and management of UWDSs in Minna</b>	Questionnaire
	Semi-structured interviews
<b>III.To use ISWMM to contextualise the findings from objectives 1 and 2</b>	Triangulation
<b>IV.To recommend interventions for effective management of UWDSs within formal waste management strategies.</b>	Triangulation

### **1.3 STRUCTURE OF THE THESIS**

**Chapter 1 - Introduction:** This chapter provides a research background, research aims and objectives, and the thesis structure.

**Chapter 2 - Case Study Area – Minna Nigeria:** This chapter describes Minna in the context of its location in Nigeria, its population, constituent wards and local government areas and infrastructural attributes. In addition, analysis of roles of residents and government in generating and managing waste respectively in Minna as well descriptions of how waste management operations are financed to facilitate waste collection and transportation and enforcement waste management policies across Minna metropolis are provided.

**Chapter 3 - Literature review:** This chapter provides an understanding of UWDSs in developing countries by reviewing the literature on this topic. It covers areas of waste management policy in developing countries and waste management practices in Nigeria.

**Chapter 4 - Research methodology:** This chapter presents the research methodology applied to this study. Reasons for the choice of methods are also explained considering the expected outcome of the research.

**Chapter 5 - Geospatial mapping of waste disposal sites:** This chapter provides an analysis of data collated using a geo-spatial information system to map and describe UWDS, CWCP (Central Waste Collection Points), and the open landfill site in Minna. The mapping activities is designed to know the location of UWDSs in Minna.

**Chapter 6 - Public perception of waste management in Minna:** This chapter presents findings from the public survey. It brings together collated data and provides synthesis in the context of research questions.

**Chapter 7 - Stakeholders attitudes and perception of waste management in Minna:** This chapter provides an analysis of semi-structured interviews designed to examine the roles of stakeholders in managing UWDSs in Minna.

**Chapter 8 - Discussion, conclusion, and recommendations:** This section discusses and relates the findings from geo-spatial mapping, public surveys, and stakeholder's interviews in the context of the ISWMM concept. The chapter concludes by identifying key research contributions and makes recommendations for effective management of UWDSs within formal waste management strategies.



## **CHAPTER TWO: A CASE STUDY OF WASTE MANAGEMENT IN MINNA, NIGERIA**

### **2.1 INTRODUCTION**

It is important to provide a descriptive analysis of the socio-economic and cultural characteristics of Minna to contextualise the processes and operations of waste management. This chapter describes Minna in the context of its location in Nigeria, population, constituent wards, local government areas and infrastructural attributes. In addition, analysis of residents and local government roles in managing waste as well as descriptions of waste management operations, finance and enforcement are provided.

### **2.2 MINNA: STUDY SITE OVERVIEW – LOCATION, SOCIO-ECONOMIC CHARACTERISTICS**

Minna is the capital city of Niger State. It is one of 36 state capitals in Nigeria and is in the North Central region of the country as shown in Figure 2.1 Minna has a land area of approximately 6,789 square kilometres (Ishiaku et al., 2014). The city is located between Longitude 3°30' E and 7°20' N and Latitudes 8°20' N and 11°30' N and is 84 miles from the Nigeria Federal Capital Territory, Abuja. Within Niger State, it is located 56 miles away from Bida, 62 miles away from Suleja and 81 miles from Kotangora (major urban centres in the state) as shown in Figure 2.2. Minna has a typical tropical climate with a rainy season from around April until October and a mean annual rainfall of 334 mm. The temperature is highest in March (30.5 °C) and lowest in August (22.3 °C).

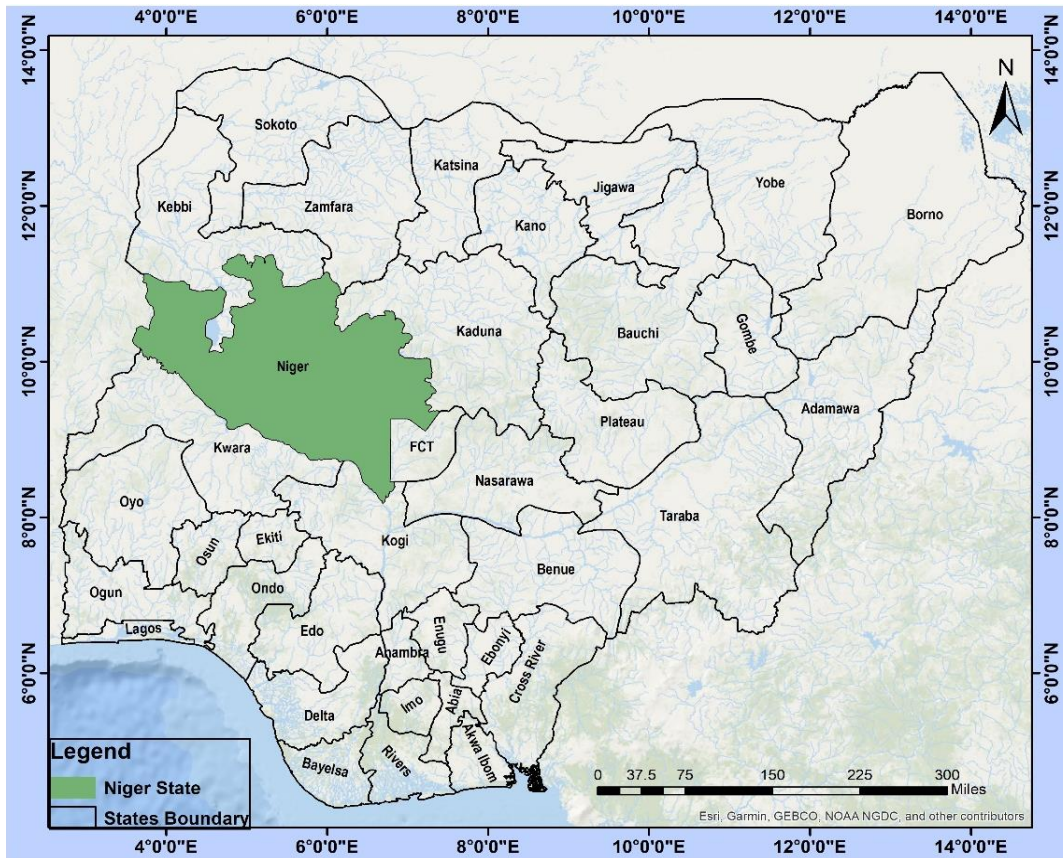


Figure 2.1: Location of Niger State (in green) in Nigeria (Author, January 2020)

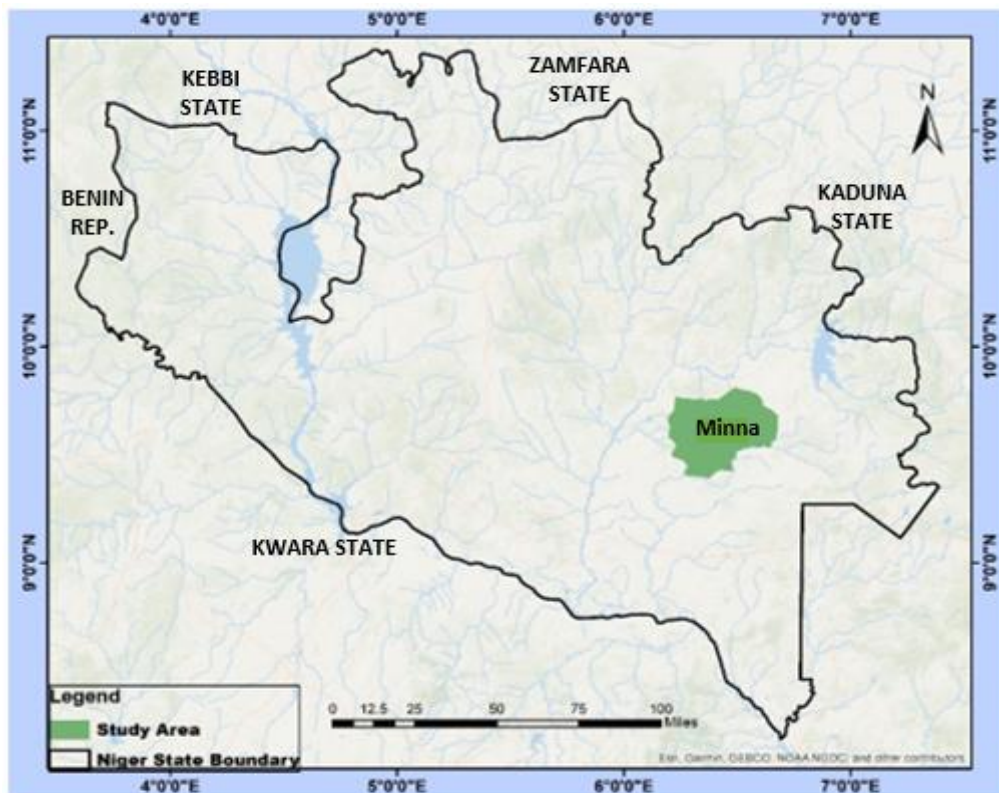


Figure 2.2: Location of Minna within Niger State, Nigeria (Author, January 2020)

Minna city is part of the Minna Central ward one of 11 local government wards of the Chanchaga local government area in Niger state (Chanchaga is one of the 25 local government areas in Niger state). Minna lies 240-270 m above sea level. It is surrounded by a range of hills that stretch from the north-east westward towards Bosso (Sanusi, 2006). The town is dissected in the southern region by the River Suka and its tributaries. The river Chanchaga runs through the Southeast part of the city and has been dammed to provide water.

### 2.2.1 Population of Minna

In 2015 Minna had an estimated population of 291,900 (Population City, 2015), which was 0.16% of the total estimated population of Nigeria (194,201,375). Minna has a population density of 3448 per km<sup>2</sup>. If population growth rate remained the same as in the period 2006-2015 (+0.85%/year) (Figure 2.3), the population was estimated to be 299,373 in 2018 (Population City, 2018).

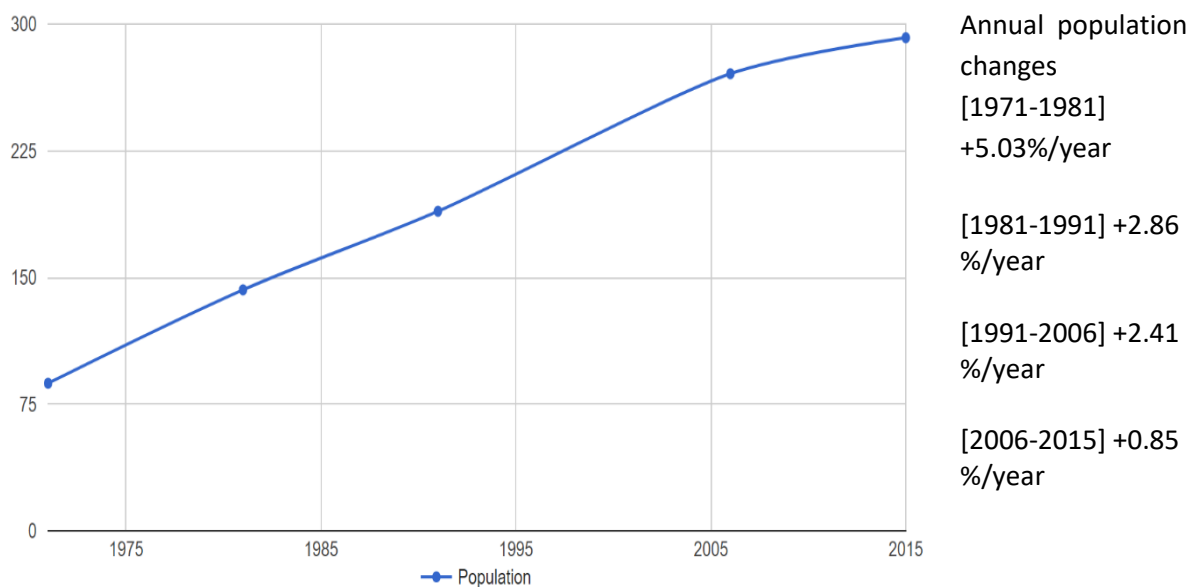


Figure 2.3: Minna: Population History from 1971 to 2015 (Population City, 2015)

In recent years the city has experienced continued population growth (figure 2.3). In 2006, Minna had a population of 350,287 (2006 National Population Commission's census report, 2007) compared to 506,113 in 2009 (Adeoye et al., 2011). Variations in population estimations cast doubts on the exact population of Minna. However, for this research, the

estimated population of Minna is accepted to lie between 300,000 - 600,000. Population growth is higher than the national average due to its proximity to Abuja (the Federal Capital of Nigeria) and an increasing influx of commercial activities overflowing from Abuja and other major cities such as Bida and Kotangora (Adeoye et al., 2011). This has an influence on the resources available within Minna to mitigate the impacts of urban expansion.

### **2.2.2 Socio-economic and cultural characteristics**

Minna is a major trade centre for agricultural products, including peanuts, cotton, yams, and shea nuts. The economy of Minna is boosted by the export of these cash crops, mainly: cotton, sorghum and ginger. Other agricultural products exported from Minna include tobacco, indigo, kola nuts, cattle, goats, chickens, and guinea fowl. The city is popularly known for its woven and dyed cotton cloth, raffia mats and baskets, pottery, and brassware. Recently, Minna has been recognised for its innovation in brick-making and other traditional small-scale craft businesses such as leatherwork and metalwork. The major consumer-focused companies in Minna include PZ Cussons that produces consumer products (e.g. toilet soaps, baby products, medicaments) in commercial quantities.

### **2.2.3 Infrastructural Characteristics**

Minna has been the administrative centre of Niger State since 1976 and has therefore seen an increase in the number of educational, government and health Institutions including teacher training colleges, radio broadcasting centres, and government agency centres. For example, the city has several educational institutions including the Federal University of Technology, Niger state school of health, Niger state school of Nursing and Midwifery, Niger State University of Education and DECS New College.

Minna is mainly comprised of peri-urban residential areas which exhibit similar characteristics in terms of the pattern of development, infrastructure inadequacy and development of scattered settlements. It is characterised by a dispersive urban growth pattern that creates hybrid landscapes of fragmented urban and rural characteristics. Minna has been the headquarters of the Chanchaga local government area since the creation of Niger State in 1976. Minna still maintains its status as the headquarters of

Minna Municipal Council with all administrative and functional requirements of local government. There are two local government areas (LGAs) in Minna, Chanchaga and Bosso. These two constituent local government areas have a total of 21 wards. For ease of management and allocation of waste collectors in Minna, the Niger State Environmental Protection Agency (NISEPA) has grouped the 21 wards into ten waste collection districts (Figure 2.4 and 2.5).

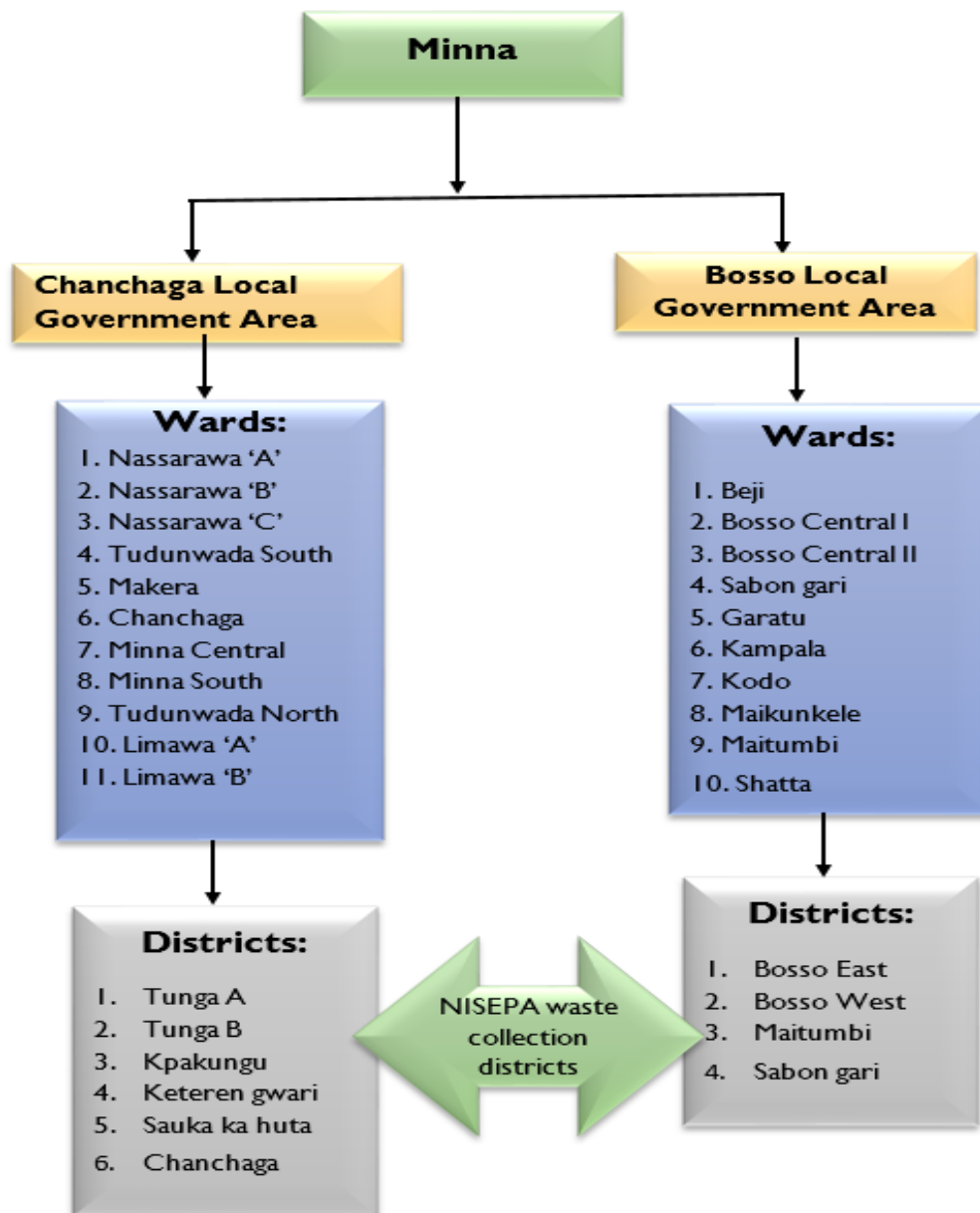


Figure 2.4: The two Local Government Areas, constituents' wards and their districts in Minna.



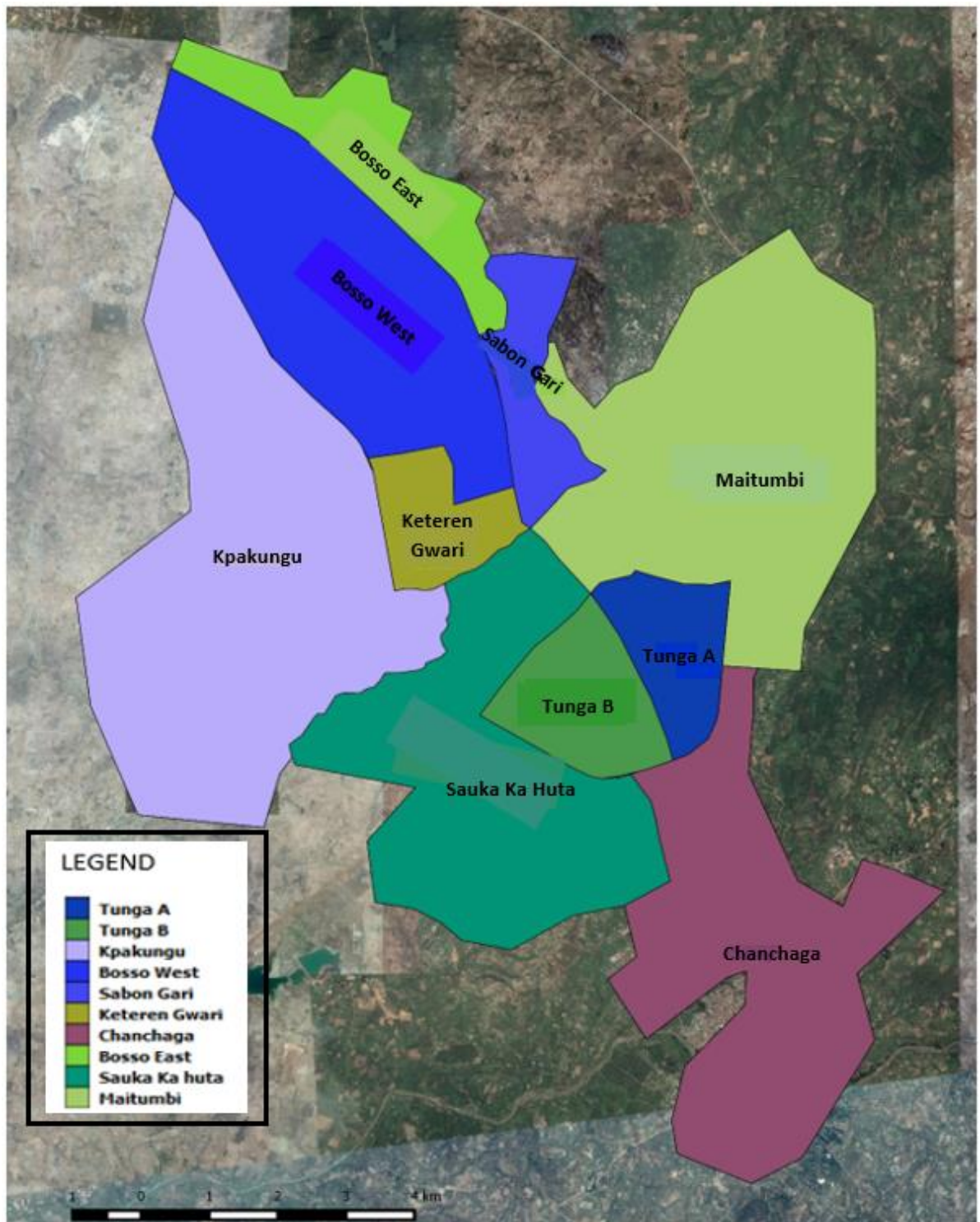


Figure 2.5: Map of the ten Waste Collection Districts in Minna (Author, March 2017)

Minna is characterised by inadequate infrastructure and relatively poor housing conditions typical of an urban centre in a developing country. Previous studies (e.g. Popoola et al., 2016), using a cluster sampling of 600 houses, examined the physical condition indices of

infrastructure attributes in Minna. Using two-step cluster analysis, they assessed similarities in physical characteristics of environmental conditions in five neighbourhoods in Minna. Popoola et al. (2016) selected three neighbourhoods: Dutsen-Kura (Gwari), Fadikpe and Barkin-Sale, were selected in Chanchaga LGA and two neighbourhoods: Bosso and Maitumbi, in Bosso local government area. Their study rated the environmental conditions of the sampled neighbourhoods as fair, though, quality of houses and conditions of infrastructure varied within and across neighbourhoods. However, Popoola et al. (2016) concluded that the conditions of houses rated higher than the infrastructural facilities in the neighbourhoods. This is an indication that all selected neighbourhoods are deficient in infrastructure to support the increasing development of the built environment. These neighbourhoods sit within the ten NISEPA waste collection districts in Minna.

Table 2.1 and 2.2 summarises the infrastructural characteristics (e.g. general neighbourhood layout, building types, building, condition, condition of access road, drainage condition, water source, frequency of power supply, waste disposal, general sanitary condition and security) in relation to their environmental attributes, in Chanchaga LGA and Bosso LGA respectively. Figure 2.6 and 2.7 give examples of clustered areas of Kpakungu which is one of the slum areas in Minna and an aerial view of Bosso showing clusters of housing and restricted vehicular access (e.g. for NISEPA waste collection vehicles).

Minna is experiencing growth that is unplanned and uncontrolled, most notably at the urban fringes. With an increasing population and settlement overflow from Abuja to Minna, the impact of urban growth is significant. There is also increasing pressure on limited basic amenities such as clean water, waste disposal and adequate sanitation. The quality of most of the building infrastructure and road networks in the metropolis fall below recommended quality standards of urban planning in Nigeria (Niger State Government, 2009). This rapid development has other negative impacts, including the loss of agricultural land and degrading environmental health.

Table 2.1: Infrastructural characteristics of three selected neighbourhoods in Chanchaga LGA

<b>Environmental Attributes</b>	<b>Dutsen-Kura (Gwari) (Kpakungu waste collection district)</b>	<b>Fadikpe (Kpakungu waste collection district)</b>	<b>Barkin-Sale (Kpakungu waste collection district)</b>
<b>General neighbourhood layout</b>	<ul style="list-style-type: none"> <li>• Unplanned;</li> <li>• Predominantly Residential.</li> <li>• Other complementary land uses.</li> </ul>	<ul style="list-style-type: none"> <li>• Unplanned;</li> <li>• Predominantly Residential.</li> <li>• Other complementary land uses.</li> </ul>	<ul style="list-style-type: none"> <li>• Unplanned;</li> <li>• Predominantly Residential.</li> <li>• Other complementary land uses.</li> </ul>
<b>Building Types</b>	<ul style="list-style-type: none"> <li>• Ranges from old traditional houses to modern structures.</li> <li>• A mixture of tenement buildings and owner-occupied houses.</li> <li>• residential &amp; few commercial properties</li> </ul>	<ul style="list-style-type: none"> <li>• Ranges from old traditional houses to modern structures.</li> <li>• A mixture of tenement buildings and owner-occupied houses.</li> <li>• residential &amp; few commercial properties</li> </ul>	<ul style="list-style-type: none"> <li>• Ranges from old traditional houses to modern structures.</li> <li>• A mixture of tenement buildings and owner-occupied houses.</li> <li>• residential &amp; few commercial properties</li> </ul>
<b>Building Condition</b>	*Ranges from poor to very good.	* Ranges from fair to very good. *considerable numbers of good houses.	*Ranges from fair to very good.



<b>Condition of Access Road</b>	<ul style="list-style-type: none"> <li>• Poor accessibility within the neighbourhood.</li> </ul>	<ul style="list-style-type: none"> <li>• Fair accessibility within the neighbourhood.</li> </ul>	<ul style="list-style-type: none"> <li>• Poor accessibility within the neighbourhood.</li> </ul>
<b>Drainage condition</b>	<ul style="list-style-type: none"> <li>• Open drainage available.</li> <li>• Poor condition.</li> </ul>	<ul style="list-style-type: none"> <li>• Open drainage available.</li> <li>• Poor condition.</li> </ul>	<ul style="list-style-type: none"> <li>• Open drainage available.</li> <li>• Poor condition.</li> </ul>
<b>Water source</b>	<ul style="list-style-type: none"> <li>• Partly connected to water mains- not regular.</li> <li>• Well, water vendors.</li> </ul>	<ul style="list-style-type: none"> <li>• Partly connected to water mains- not regular.</li> <li>• Borehole, well, water vendors.</li> </ul>	<ul style="list-style-type: none"> <li>• Partly connected to water mains- not regular.</li> <li>• Borehole, well, water vendors.</li> </ul>
<b>Frequency of Power supply</b>	<ul style="list-style-type: none"> <li>• Not regular</li> </ul>	<ul style="list-style-type: none"> <li>• Not regular</li> </ul>	<ul style="list-style-type: none"> <li>• Not regular</li> </ul>
<b>Waste Disposal</b>	<ul style="list-style-type: none"> <li>• Government.</li> <li>• Private operatives.</li> <li>• Open dumping.</li> </ul>	<ul style="list-style-type: none"> <li>• Government.</li> <li>• Private operatives.</li> <li>• Open dumping.</li> </ul>	<ul style="list-style-type: none"> <li>• Roadside kerb</li> <li>• Open dumping</li> </ul>
<b>General Sanitary Condition</b>	<ul style="list-style-type: none"> <li>• Good</li> </ul>	<ul style="list-style-type: none"> <li>• Good</li> </ul>	<ul style="list-style-type: none"> <li>• Fair</li> </ul>
<b>Security</b>	<ul style="list-style-type: none"> <li>• Close to Police headquarters.</li> <li>• House guards, dogs.</li> </ul>	<ul style="list-style-type: none"> <li>• Police post not available.</li> <li>• Vigilantes.</li> <li>• House guards, dogs.</li> </ul>	<ul style="list-style-type: none"> <li>• Police post available</li> <li>• Vigilantes.</li> <li>• House guards, dogs.</li> </ul>

Source: (adapted from Popoola et al., 2016)

Table 2.2: Infrastructural characteristics of Bosso and Maitumbi in the Bosso LGA

<b>Environmental Attributes</b>	<b>Bosso</b>	<b>Maitumbi</b>
<b>General neighbourhood layout</b>	<ul style="list-style-type: none"> <li>• Unplanned;</li> <li>• Predominantly Residential.</li> </ul> <p>*Other complementary land uses.</p>	<ul style="list-style-type: none"> <li>• Unplanned;</li> <li>• Predominantly Residential.</li> </ul> <p>*Other complementary land uses.</p>
<b>Building Types</b>	<ul style="list-style-type: none"> <li>• Ranges from old traditional houses to modern structures.</li> </ul> <p>A mixture of tenement buildings and owner-occupied houses.</p> <p>* residential &amp; few commercial properties</p>	<ul style="list-style-type: none"> <li>• Ranges from old traditional houses to modern structures.</li> <li>• A mixture of tenement buildings and owner-occupied houses.</li> <li>• * residential &amp; few commercial properties</li> </ul>
<b>Building Condition</b>	<ul style="list-style-type: none"> <li>• Ranges from very poor to good.</li> </ul>	<ul style="list-style-type: none"> <li>• Ranges from very poor to good.</li> </ul>
<b>Condition of Access Road</b>	<ul style="list-style-type: none"> <li>• Fair accessibility within the neighbourhood.</li> </ul>	<ul style="list-style-type: none"> <li>• Poor accessibility within the neighbourhood.</li> </ul>
<b>Drainage condition</b>	<ul style="list-style-type: none"> <li>• Good drainages available in some part.</li> <li>• Condition ranges from poor to good.</li> </ul>	<ul style="list-style-type: none"> <li>• Good drainages available in some part.</li> <li>• Condition ranges from poor to good condition.</li> </ul>

<b>Water source</b>	<ul style="list-style-type: none"> <li>• Partly connected to water mains- not regular.</li> </ul>	<ul style="list-style-type: none"> <li>• Partly connected to water mains- not regular.</li> <li>• Borehole, well, water vendors.</li> </ul>
<b>Frequency of Power supply</b>	<ul style="list-style-type: none"> <li>• Not regular</li> </ul>	<ul style="list-style-type: none"> <li>• Not regular</li> </ul>
<b>Waste Disposal</b>	<ul style="list-style-type: none"> <li>• Government.</li> <li>• Roadside kerb.</li> </ul>	<ul style="list-style-type: none"> <li>• Roadside kerb.</li> <li>• Open land dumping.</li> </ul>
<b>General Sanitary Condition</b>	<ul style="list-style-type: none"> <li>• Poor</li> </ul>	<ul style="list-style-type: none"> <li>• Poor</li> </ul>
<b>Security</b>	<ul style="list-style-type: none"> <li>• Police post available.</li> <li>• House guards, dogs.</li> </ul>	<ul style="list-style-type: none"> <li>• Police post available.</li> <li>• Vigilantes.</li> </ul>

Source: (adapted from Popoola et al., 2016)



Figure 2.6: Satellite image showing clustered residential areas of Kpakungu (Google Earth, 2017)

The red circle in 2.6 indicate how crowded and clustered residential settlements in most part of Minna. Although Kpakungu has ancient settlements and known as one of the slum areas in Minna. Therefore, accessibility to most of the residents (in clustered areas) for effective waste collection may be difficult considering the nature of the road network.



Figure 2.7: Aerial view of Bosso, showing clusters of housing (Popoola et al., 2016)

### **2.3 WASTE MANAGEMENT IN MINNA**

Waste management in Minna is comparable to other urban areas in Nigeria. In 1985, a task force was created by the federal government of Nigeria (for both state and federal) to improve the essential environmental sanitation habits in the people (Adeoye et al., 2011). The task force was created by the federal government which later failed and led to the creation of Environment Protection Agencies (EPA) for both federal and states. The Niger State Environmental Protection Agency was created in 1996 to manage and protect the environment - excluding waste management (Musa et al., 2016). On the 21<sup>st</sup> December 1998, the Niger State Urban Development Board (NSUDB) was established and given responsibility for waste management in Minna which was later transferred back to Niger State Environmental protection Agency (NISEPA) in 2007 who remain responsible for waste collection and disposal in Minna. The transfer of the waste management responsibility from NSUDB to NISEPA was due to their redefine responsibilities of being the environmental protection agencies. The Niger state government in conjunction with NISEPA manages waste in Minna (state government fund waste management). Primary responsibilities, such as the provision of waste management facilities and services are provided by local and state governments' (landowners provide waste disposal facilities). In some cases, donor agencies with the support of federal, state and local governments are the primary service provider for waste disposal management for public spaces. These bodies work together to ensure that waste disposal facilities and services are made available in the bus stations, open market spaces and public places.

It is the role of NISEPA to manage generated wastes effectively and to promote the quality of waste collection and management services. With an increasing population in Nigeria, the volume of waste generated is increasing. This imposes substantial financial and management responsibilities on government agencies saddled with waste management. Various initiatives have been devised to tackle this problem. In some cases, support of both national and international environmental management agencies is solicited. NISEPA through the Niger state Prestige FM radio station reported in 2017 that the Niger state government had entered into partnership with the South Korean

government to work together with other agencies (e.g. UN-Habitat, Niger state Ministry of planning, water board, NISEPA, Housing Corporation, Public-Private Partnership, lands and office of the Secretary) in providing critical facilities for effective waste management and sanitation in the state. Through this partnership, waste collection service personnel would be sent to Seoul, South Korea, for training. The state government proposed to provide all necessary documentation and readiness that would make the partnership realistic, reliable and sustainable to ensure long term implementation of government efforts to address waste disposal issues in the state. However, the partnership process has still not been finalized as of the time of this study. It is important to send waste management personnel for training but without the appropriate resources and facilities/technology in place to practice the knowledge and skills acquired in return it will yield no result. Considering the current issues surrounding the waste management system in Minna ranging from insufficient waste collection vehicle and the lack of funding due to lack of priority for waste management the effectiveness of this scheme may not be possible.

Notwithstanding these efforts, waste management in the major cities in Nigeria is still a challenge. Some studies (e.g. Agwu, 2012; Musa et al., 2016) argued that the lack of positive outcome from the efforts of governments and agencies could be linked to the attitude of citizens. Musa et al. (2016) noted that the key factors influencing the poor outcome in waste management in Nigeria included waste disposal habits of individuals, ignorance, and lack of priority in waste disposal across institutions. Meanwhile, Adeoye et al. (2016) highlighted that the waste management agency did not have enough resources to tackle the ever-increasing solid waste generation. The lack of resources contributed to the inefficiency of the waste management system. Adeoye et al. (2016) listed the contributory factors to collecting the waste being insufficient manpower and the availability of collection vehicles. It was also noted that inadequate capacity of provided waste bins and inappropriate location of collection bins added to the poor management of waste.

The Niger state government has put together proposed long-term interventions in the Niger state Vision: 2020 Report to tackle these critical challenges related to waste management and environmental management.

Table 2.3: Niger state Vision 2020 to tackle waste management challenges

<b>Intervention initiatives</b>	<b>Cost (Naira)</b>	<b>Funding options</b>
Integrated, holistic and sustainable Environmental management baseline data bank for the State, including household enumeration for household waste generation data and collection of data on e-waste.	N568,000,000	MDG DFID UNDP PPP
Environmental monitoring and Evaluation Initiatives, including setting up regional and zonal environmental management centres.	N850,000,000	MDG NGSG PPP
Capacity building, training and institutional strengthening including: training of all staff of the ministry of environment and NISEPA; <ul style="list-style-type: none"> <li>• provision of internet facilities for NISEPA and ministry of Environment;</li> <li>• training of decision-makers and required technical staff on skill competency and advocacy in all areas;</li> <li>• building communities capacity for sustainable waste management strategies and waste to wealth programmes.</li> </ul>	N100,000,000	
Institutional development and strengthening including; <ul style="list-style-type: none"> <li>• Procurement of payloaders, compactors, trucks, vans and bins for waste management and sanitation.</li> <li>• The purchase of vegetation control equipment;</li> <li>• Acquisition of operational vehicles for various environmental management</li> </ul>	1,500,000	Bonds, Donors, FG, UNDP, MDG, UNIDO, UNEP, World Bank, Centre for Sustain

		Able Development, GEF, PPP.
The synergies and collaborations including <ul style="list-style-type: none"> <li>• securing local government areas participation in environmental management funding;</li> <li>• Involvement of MDGs in the provision of integrated solid waste management; plant and establishment of a robust climate change monitoring centre.</li> </ul>	1,200,000	GEF/NGOs, LGAs, UNEP, UNIDO, MDGs, Ecological funds, PPP
Sustainable Environmental Management and its infrastructural provision including; <ul style="list-style-type: none"> <li>• Establish dumpsites;</li> <li>• Develop skills to use indicators for sustainable environmental management;</li> <li>• Enhance environmental sanitation and waste disposal in the State;</li> <li>• Promote research in biotechnology, waste recycling and alternative energy sources for domestication.</li> </ul>	2,300,000,000	Centre for sustainable development, UNEP, UNDP, MDGs, Ecological funds, UNIDO, FGN, World Bank.
Policies, enforcement and legal framework and Environmental education and awareness to ensure implementation and compliance with all public health laws, sanitation and waste management regulation.	760,000,000	UNDP, MDGs, LGAs, PPP, UNDP, DFID, LGAs, World Bank, UNICE F, GEF, PPP.

Source: (Ministry of Environment and Forest Resources, Minna, 2009)

The initiatives have been summarised in table 2.3. The Vision report indicated that waste management services in Niger state were still inadequate. There were several challenges such as inadequate waste collection service coverage which is influenced by lack of capacity for maintenance of waste collection facilities (Waste collection trucks)



and ageing infrastructure. There is a restricted number of waste collection points in rural areas influenced by inaccessible road networks; and inadequate waste management education and awareness lead to creation of UWDSs. In addition, increasing rate of urbanisation; inadequate revenue generation; low institutional capacity; legal and policy issues; lack of data and inadequate monitoring; inappropriate pricing and tariff collection for waste management services; and low participation of private sector in the waste management sector.

The UWDS depicted in the figure 2.8 and 2.9 were sited within residential settlements of Maitumbi waste collection district. This is an example of UWDS and their locations. There are walkways close to the UWDS (figure 2.8), indicating that residents do not only access the UWDS but also walk through the sites to available town amenities – markets or shops. It is evident from figure 2.9 that animals graze on the waste sites, which shows that waste foods are also disposed of in the sites. The shape of the sites shows that an uneven level – elevated above the ground level of the land. There are elevated heaps of waste – blackish in colour, indicating the amount of the combusted material which also mean that the dumpsites have been in existence for several years. In some heaps, there are pools of liquid around the refuse-heaps which could be a combination of leachate and rain water (figure 2.9). indicating that liquid wastes are also disposed of in these sites. The proliferation of such sites within Mina shows there is a mismatch between the reality of waste management and the policies, laws, and regulation enforcement claimed by NISEPA.



Figure 2.8: An unofficial waste disposal site within a residential area of Maitumbi district (Author, April 2017)



Figure 2.9: An unofficial waste disposal site with animals feeding on-site within a residential area of Maitumbi district (Author, April 2017)

### 2.3.1 Waste generation in Minna

There are three categories of waste in Minna as suggested by Babayemi and Dauda (2009): domestic, industrial and institutional. The material constituents of wastes characterise these respective sources.

Table 2.4: Waste categories based on their sources

Type	Sources
Domestic waste	the solid waste generated by households, markets, food centres and commercial premises such as hotels, restaurants,
Industrial waste	Wastes from hospitals, factories, workshops,
Institutional waste	Solid waste from various government installations like schools and recreational facilities.

Sources: (Babayemi and Dauda, 2009)

Ogwueleka (2009) estimated that an average Nigerian generates 490 grams of solid waste per day, with households and commercial centres generating more than 90% of total waste generated in all major cities. This would estimate the amount of waste generated in Minna to be 294 tonnes (29,400 kg) per day based on the population of 600,000.

A joint report published by the Niger State Environmental Protection Agency (NISEPA) and United Nations Development Programme (UNDP) demonstrated that the quantity of waste has continued to rise. It was predicted that waste generation would continue to increase as long as the population of the city and industrialisation increase. The official figure from NISEPA (Nigeria Sun Newspaper, 2017) stated that Minna generates over 100,000 tonnes of solid waste annually. NISEPA also noted that at least a minimum of 32 tipper-loads of solid waste is disposed of daily. Again, there is a mismatch on generation and collection which is added to the development of UWDS in the city. Considering the amount of waste generation reported by NISEPA (over 100,000 tonnes), the minimum amount of collected waste (32 tipper-load) daily, and the number of

UWDSs mapped (141) it is evident that there is insufficient data on waste management in Minna.

### **2.3.2 Waste collection and Transportation in Minna**

NISEPA operates two primary waste collection methods in Minna, which include door to door and centralized waste collection points (CWCP). It has been reported that good planning and management are required for effective door to door waste collection (Musa et al., 2016). Vehicles are required to come on specified days to empty the bins and transfer the waste to the official landfill site. Therefore, this system requires a minimum outlay of resources and equipment to function effectively which is not the case in Minna. In areas where access to residential areas is limited due to improper road planning, households are expected to take their waste to a centralized waste collection points (CWCPs). However, inadequacies in door-to-door waste collection and the location of CWCPs being only on major roads shows wrong design and strategy.

CWCP are stationary containers (open drums) generally kept at open spaces along street ends or junctions. The most commonly used trucks for waste collection and transportation in Minna are tippers and open trucks, as shown in figure 2.10 below.





Figure 2.10: Commonly used truck/tipper for waste transportation in Minna (Author April 2017)

For an effective and efficient collection system, the collection vehicle must be well maintained and serviceable. Most of the available trucks (Approximately 60%) used for waste collection and transportation are out of service at any point in time. Consequently, there is inadequate service coverage in the city, which results in waste generation exceeding collection capacity. The collection of waste from generation source is an aspect that has been considered not effective in most urban areas which poor urban planning is a contributory factor (Ayuba et al., 2013). Accessible Road networks are essential for effective waste management, which is deficient in Minna. Lack of access roads has resulted in the creation of informal waste collectors (pay and collect) as they use wheelbarrows/carts to access and collect waste from the interior residents in Minna (see figure 2.11). The waste collected by the informal collectors are majorly (90%) dispose of in UWDSs as shown in figure 2.11 or in CWCPs (10%).



Figure 2.11: Informal Waste Collectors in Minna (Author, April 2017)

### 2.3.3 Treatment and final disposal

The state government operates a non-engineered formal landfill site on the outskirts of the city. The landfill site is in Tayi village, 12 km from the centre of Minna city. The site suffers from frequent fires as shown in figure 2.12 and residents grow crops on the site. The site is also a home for scavengers sorting and selling waste (figure 2.13).



Figure 2.12: Waste burning at the government-regulated landfill Minna (Author, April 2017)

In the current waste management system in Minna, there is no waste treatment before or after disposal, except the fumigation of the government regulated site to reduce the rate of flies and insects disturbing nearby communities. This is carried out only when infestations levels reach a certain level.

#### **2.3.4 Waste recycling**

There is no formal waste recycling in Minna and NISEPA do not offer such services. Informal recycling (recycling activities of scavengers and waste pickers) (Wilson et al., 2006) is undertaken at the open landfill site. These activities are labour-intensive, low or no technology, low-paid (50 naira per kg of recyclables), unrecorded and unregulated work often completed by individuals or family groups. For example, individual/unofficial scavengers are living at the government-regulated site, sorting and picking a very negligible percentage of recyclables from the bulk of waste on-site to be sold for a living.



Figure 2.13: Waste scavengers at the government-regulated landfill site in Minna (Author, April 2017)

#### **2.4 WASTE MANAGEMENT LAW ENFORCEMENT AND POLICIES IN MINNA**

It is widely accepted that solid waste management issues should be addressed from a system perspective by considering technological, financial, institutional, legal, and socio-cultural factors to determine appropriate policies for the local surroundings (Adeoye, 2016). Adeoye (2016) added that regulations regarding littering and improper

disposal of solid waste should be formulated, and stiff penalties should be imposed on defaulters. However, there are regulations and policies in place for waste management in Nigeria but poor enforcement. Waste management in Minna is not different from that of Nigeria. The legal frameworks for solid waste management in Minna are provided by the National Environmental Standard and Regulations Enforcement Agency (NESREA) and include:

- The State Environmental Sanitation and solid waste control Regulations (2009)
- General Guidelines for Solid Waste Collection and Transportation vehicle (2009)

A state environmental policy has been developed in accordance with the National Policy on Environment (1989), Sustainable Development targets and the aims of the New Partnership for Africa Development (NEPAD) initiatives. The State Policy aims to provide sound Environmental Sanitation, which shall assure the sustainable environment and protection of human health. Failure to address the problem of environmental sanitation in the state (Minna Niger State) has been attributed to various factors. Prominent among these are unhealthy socio-cultural practices; poor environmental sanitation education and awareness, low literacy levels; poor governance; disregard for the law and other forms of discipline (Ministry of Environment and Forest Resources, Minna, 2009).

As part of waste management law enforcement, it was reported that the NISEPA had arrested and prosecuted at least 250 persons for various waste disposal related crimes (e.g. open defecation, indiscriminate dumping of refuse, wrong channelling of wastewater, open burning of plastic wastes etc.) in the Niger states between January to April 2017. The prosecution charges range from either prison terms and fines or both. However, this did not stop people from carrying out the crimes listed, instead the crimes are on the increase.

Government authorities in Minna have recently implemented mechanisms to help address some service inadequacies regarding waste management. Niger State Environmental protection Agency (NISEPA) reported in 2017 through Vanguard News Nigeria (2017) that it had implemented N1,000 (\$2.5) wastes expenses to be paid per



household to help government lessen the financial burden incurred through waste collection services. It was stated that the proposed tax for sewage collection and disposal would support the state government and its agencies to scale waste collection and services (Nigeria Sun Newspaper, 2017).

The Nigeria Television Authority reported in 2017 that NISEPA had purchased 1,000 waste collection bins as part of its strict law enforcement operation to stop indiscriminate waste disposal and littering in Minna. It was noted that these bins were made available along community roads sides and within public centres. The bins were positioned to target passers-by and made them available at their disposal to get rid of cans and plastic bottles. However, these were also called central waste collection points (CWCPs) which leads to confusion in reporting by the Nigeria Television Authority on the street bins targeting the passers-by. In addition, NISEPA has launched vehicle litter bags to reduce the indiscriminate throwing of wastes and litters from moving vehicles in Minna. However, since drivers purchase the litter bags to be use in their vehicles, they still throw them along the roads when it is full. NISEPA also stated that proper authorities had been put in place to ensure monitoring of the bins against thieves and vandals. This is because there are cases of people removing the CWCP bin at night and selling them to householders or shops owners for money. The agency also reported that they have established solicited support of religious and traditional leaders, heads of government wards, councillors, women and youths through the Environmental Vanguard Scheme to work with them to create awareness, to regularly monitor their communities' environment, and educate citizens on the impact of indiscriminate waste disposal in Minna. This measure is very important for effective waste management when closely monitored and supported. However, in the case of Minna, this measure is not effective because there are no define roles and responsibilities for effective collaboration and working relationship.

Although, NISEPA oversee the waste management affairs in Minna; meanwhile, there are other many capable groups who could be used to support the management of waste.

## 2.5 TIERS OF GOVERNMENT AND HOW WASTE MANAGEMENT IS FINANCED

Nigeria operates a three-tier system of government made up of Federal, State and Local government with distinct functions based on the constitution (Afon, 2007). The milestone Federal Legislation on environmental protection in Nigeria was decree 58 (1988), which established the Federal Environmental Protection Agency (FEPA) to control the growing problem of waste management and pollution (Agunwamba, 1998; Walling et al., 2004; Imam et al., 2008; Chukwu, 2008). Solid waste management is constitutionally the responsibility of local government, but both Federal and State governments step in to complement their efforts especially in state capital cities (Afon, 2007) by creating federal and state environmental protection agencies. This could have been good news as the top tiers of government step in to take responsibility, but however, lack of top priority for waste management caused ineffectiveness of the system. As shown in figure 2.14, the Niger State Environmental Protection Agency has an intermediary role between the State and Local government.

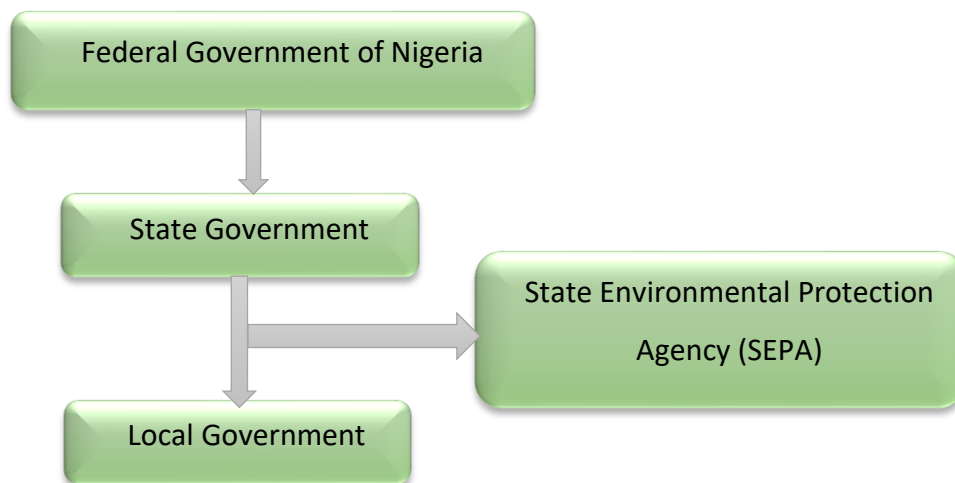


Figure 2.14: The three tiers of Government in Nigeria.

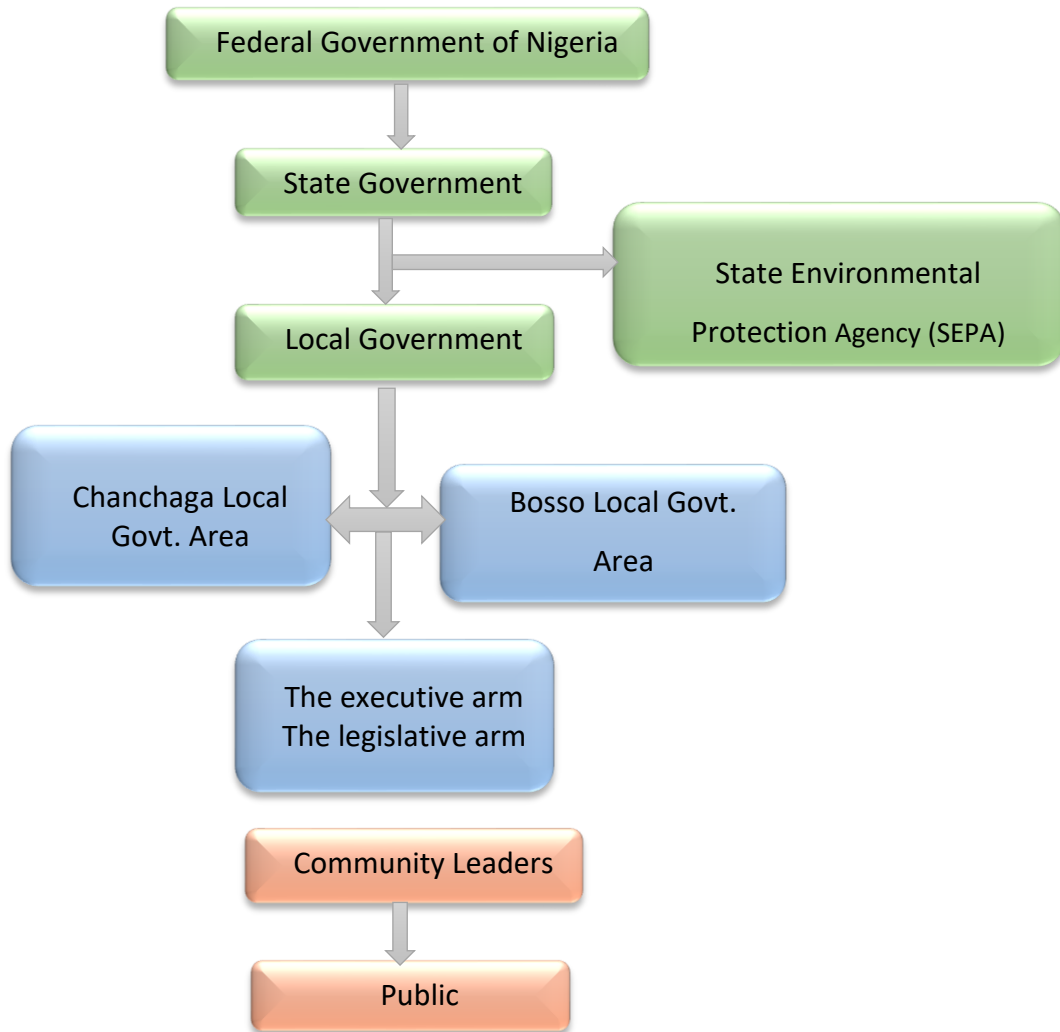


Figure 2.15: Structure of how funds flow across tiers of Government

The Nigerian government financial system operates a structure where funds allocated to environmental management flow in a top-down model from Federal government account to the state government and then down to the local government (figure 2.15). Federal government allocate funds to State, and Local Governments to fund waste management and other developmental projects as well as maintain their respective workforce. Community leaders do not receive central funds and have no formal role in the democratic structure or political power, but they play a role in resolving minor conflicts between people using state funds. Ayuba et al. (2013) suggested that the flow of funds is corrupt stating that ‘Corruption has eaten deep into every level of our society, the budget allocation for these agencies are inadequate and often not all of what is allocated is received and the funds that are received are not always used for waste

management or cleaning up the environment'. Ayuba et al. (2013) added that the exclusive management of waste by the government does not give room for competition and the non-payment of fees by the people being served makes the business of waste management, as practised in Minna unsustainable and unattractive for the private sector.

### **2.5.1 The role of Local government**

The Federal Government of Nigeria, through the 1976 Local Government Reforms, explained Local Government as follows:

“Local Government is Government at Local level exercised through representative councils established by Law to exercise specific power within defined areas” (Government print: 1976).

Though these definitions may tend to vary, the following are characteristic features of Local Government in Nigeria:

1. It has its autonomous existence and endowed with legal status;
2. Specific powers are reserved for it;
3. It can impose taxes and incur expenses;
4. it exists within a defined territory;
5. It is seen as a distinct tier of Government;
6. It must provide authority over a given population;
7. It must provide avenues for the promotion of the welfare of the members of the community;
8. It comprises elected members, such as chairmen and councillors.

#### ***2.5.1.1 The structure of local government under the 1999 constitution of Nigeria***

The structure of the presidential system of Local Government at the grass-root level consists of the legislature and the executive, with the judiciary absent.

**The executive arm:** consists of the chairman, vice-chairman, supervisors and secretary of the council. The chairman of the Local Government council is the chief executive and

accounting officer of the council. The chairman of the council appoints the secretary of the council and the supervisory councillors.

**The legislative arm:** is composed of the leader of the council and other councillors. The functions performed by the legislative arm are defined by law but primarily include:

1. Debating approving and amending the annual budget of the Local Government;
2. Vetting and monitoring the implementation of projects and programmes in the annual budget of the Local Government;
3. Examining and debating the monthly statement of income and expenditure rendered to it by the Chairman of the Local Government;
4. Advising, consulting and liaising with the Chairman of the council;
5. And performing such other functions that may be assigned to it from time to time by an edict or law of the state in which it is situated.

Although there is no political power giving to Community leaders, they have influence with the executive arm in local government. For this reason, a community leader may meet a local government chairperson with a pressing community issue and the chairman will act fast using political power from the top government. For example, a community leader may complain to his local government chairman about a heap of waste that has turned into a crime centre which needs to be cleared, the chairman instructs NISEPA, and collection trucks are diverted to the site to remove the waste.

### **2.5.2 The role of Community Leaders**

Community leaders often derive their titles from the rulers of independent states or communities that existed before the formation of modern Nigeria (Oma et al., 2003). Although they do not have formal political power, in many cases, they continue to command respect from their people and considerable influence. Leaders previously acquired office strictly through inheritance or through appointment by a council of elders, but the government is now increasingly involved in the succession process (Oma et al., 2003). Even though they have no formal role in the democratic structure, they play useful roles in mediating between the people and the state, enhancing national identity, resolving minor conflicts and providing an institutional safety-valve for often

inadequate state bureaucracies (William, 1993). Therefore, community leaders today are highly respected in many communities and have considerable political and economic influence.

Community leaders may have a significant role in waste management practices. This is because community leaders relate and interact with the local people at the grassroots daily. Specifically, community leaders in Minna work with the youth in cleaning the drainage systems and surroundings. Therefore, incorporating community leaders in waste management is a means of public engagement, which is a recognised pathway to achieving sustainable waste management.

## **2.6 SUMMARY**

Waste management practices in Minna is comparable with most urban areas in developing countries. They face issues ranging from inadequate waste collection, improper waste disposal, inadequate infrastructures, poor waste management funding, lack of stakeholders' interaction, weak policies, lack of political power to some key stakeholders (e.g. community leaders) and lack of waste management strategies.

## **CHAPTER THREE: LITERATURE REVIEW**

### **3.1 INTRODUCTION**

Municipal Solid Waste Management (SWM) is a basic sanitary service that is crucial for maintaining the health of urban and rural communities and protection of the environment (Demirbas 2011). Waste management systems consist of activities related to handling, treating, disposing or recycling/re-using waste materials (Al-Khatib et al., 2010). An effective waste management system ensures that waste materials are removed from the source or location where they are generated and treated, disposed of or recycled/re-used safely and properly (Demirbas 2011). Modern waste management systems, which many developing country cities aspire to, are often characterized by high recycling rates of clean, source-separated materials (McBean et al., 2005) with prioritized strategies to minimize environmental problems and preserve resources (Demirbas, 2011).

This chapter reviews waste management practices in developing countries focusing on Sub-Saharan Africa. Waste management practices in Nigeria are also explored in detail to provide specific context for the development and use of unofficial waste disposal sites in the Minna case study.

### **3.2 OVERVIEW OF WASTE MANAGEMENT IN DEVELOPING COUNTRIES**

Understanding what should be considered as waste is important in establishing how best to manage it. This is because different people/countries have different perspectives on waste, as some see waste as 'useless' while others see it as a 'resource'. However, circular economy practice is now that waste is a resource. Wilts et al. (2016) state that treating waste as a resource and the design of a circular economy have been identified as key approaches for resource efficiency. Drechsel and Kunze (2001) argue that material is only a 'waste' if it is useless; as soon as it is useable it becomes a 'resource'. Igoni et al. (2007) and Sunday (2013) also state that waste is said to be any material or substance which has no value to the owner or producer and must, therefore, be disposed of. In addition, Sridhar and Hammed (2014) see waste as an unavoidable

material resulting from a domestic activity or industrial operation for which there is no economic demand and must be disposed of.

However, the EU Waste Framework Directive (Directive 2008/98/EC), defines waste as “any substance or object the holder discards, intends to discard or requires discarding”. Once a substance or object has become waste, it will remain waste until it has become fully recovered and no longer poses a potential threat to the environment or to human health (Defra, 2012; Ceclan. et al., 2011). Therefore, waste can only be minimised and controlled but cannot be completely avoided due to the unavoidable activities that lead to the generation of waste.

Waste management has been an integral part of every human society and it is one of the priority issues concerning the protection of human health and the environment (Shekdar, 2009). There is increasing attention by waste managers to integrate strategies that will help achieve sustainable waste management systems (Wilts et al., 2016; Costi, et al., 2004) which consider economic, technical, and environmental issues. Wilts et al. (2016) state that moving towards a more circular economy is essential to deliver the resource efficiency agenda established under the Europe 2020 Strategy for smart, sustainable and inclusive growth.

However, this is a difficult task as effective waste management is strongly influenced by political, legal, socio-cultural, environmental and economic factors as well as available resources (Sharholy et al., 2007). Solid waste management is one of the most challenging issues faced by developing countries that suffer from serious pollution problems caused by uncontrolled waste generation and disposal (Al-Khatib et al., 2010). Abarca-Guerrero et al. (2015) add that solid waste management is a significant urban challenge for the cities’ waste management authorities in developing countries because of the continued increase in waste generation, high costs associated to its management, lack of understanding over a range of factors affecting the different stages of waste management and linkages necessary to enable effective handling of waste (Guerrero, 2013).



Historically solid waste disposal was not a problem in developing nations as habitations were sparse and there were many open spaces. However, waste became a problem in urban areas due to people congregating in pursuit of livelihood (Ahmed and Ali 2004). In addition, land scarcities for waste disposal in many urban areas of developing countries is becoming an issue of concern. Mexico is experiencing severe environmental problems due to inadequate planning and unsustainable waste management systems as the country is undergoing a rapid urbanization process with 70% of the population concentrating on the cities (Buenrostro and Bocco 2003).

Financial constraint is the major factor hindering the development of effective waste management in developing countries. Brunner and Fellner, 2007 state that the economic condition of a nation can determine the waste management strategies of that country. Shekdar (2009) added that approaches for solid waste management should be compatible with the nature of a given society, and in this regard, African countries are no exception, especially in terms of waste disposal activities.

Disposal of waste in urban areas of developing countries is a significant environmental concern (Ojeda-Bení and Beraud-Lozano, 2003). Waste disposal sites, irrespective of the type (either open or sanitary) should be sited on the outskirts of the city or community, because of their effect on the environment and human health (Abul 2010). This is because the absence of control measures may cause the waste constituents to enter the environment as gaseous emissions that pollute the atmosphere, solid waste in the lithosphere, or effluents that contaminate both surface and groundwater, thus affecting the livelihood of the surrounding communities (Sever 1997; Daniel & Laura 1999). Poor control of mixed waste (both medical and hazardous), results in it ending up at municipal dumpsites in most developing countries even though there are special dumping areas (Mangizvo, 2008). In Dar es Salaam City, Tanzania for example, businesses and hospitals take their waste to Vingunguti dumpsite (Mato & Kaseva, 1999). While in Ibadan, Nigeria, pathological waste and sharps from the city's hospitals are dumped in an unregulated and haphazard manner in open dumpsites at Aba-Eku, Aperin-Oniyere, and Ajakanga which is environmentally unfriendly.

Generally, the management practice at most dumpsites in developing countries is not effective. Dumping is unrestricted and industrial, agricultural, domestic, and medical waste ends up in one site. Dumpsites are not always fenced off or in some cases, the perimeter fence has been stolen or vandalized (Mangizvo, 2008). This allows easy access to the site at any time of the day or night providing scavengers with access to salvage any valuable material.

Thousands of Africans make a living through salvaging recoverable materials from waste disposal sites where they spend long hours sifting through the rubbish for valuable items. Wilson, et al. (2005) notes that people use their bare hands and wear no protective clothing which puts them in direct contact with hazardous waste such as broken glass, human and animal faecal matter, paper that may have become saturated with toxic materials, as well as containers with residues of chemical, pesticides, and solvents. They are also exposed to needles, bandages, and other waste from hospitals, exposing them to diseases, such as HIV and hepatitis (Oyaro, 2003). This was observed at Dandora dumpsite, Nairobi Kenya where informal waste pickers are at high risk as basic principles of occupational health and safety are disregarded (Mangizvo, 2008). As such, scavenging in open dumps is considered one of the most detrimental activities to health. Also, the lack of cover materials as liner or leachate control enables rainwater to infiltrate refuse and produce leachate that contaminates groundwater reserves.

Lack of environmental control at waste disposal sites in most developing countries is a cause for concern. For example, Nakata et al. (2015) conducted a study to assess contamination levels of nine metals and metalloids in animals (e.g. pigs, goats, sheep and cattle) feeding on Dandora dumpsite, Nairobi, Kenya. The study shows that cadmium and lead (Cd and Pb) levels in animal blood were high, suggesting that human exposure to cadmium and lead (Cd and Pb) through consumption of livestock was a significant risk. Therefore, given the low priority allocated to waste management with very limited funds provided to the solid waste management sector, it is a struggle to achieve the level of protection required for public health and the environment (Yuen et al., 2013).

Any urban development without effective waste management faces serious environmental and health implications as a result of unavoidable waste creation (Al-Khatib et al., 2010; ISWA, 2002). Agenda 21 (1992) sought to reduce unregulated waste creation and disposal in developing countries by deploying the 3R system and stated that:

*“environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable pattern of production and consumption”* (Agenda 21, 1992).

Agenda 21 emphasizes the importance of stakeholder roles in managing the challenges of waste creation currently faced in developing countries. In agreement, UNEP (2009) noted that waste management infrastructures, tools and stakeholder's skills should be integrated as an important device in determining the effectiveness of waste management in developing countries. The basic infrastructures required for waste management in developing countries including access roads, collection vehicles and controlled waste disposal sites are lacking. Most waste operators and handlers in developing countries lack the required skill to carry out their responsibilities and activities effectively. These responsibilities include overseeing the storage, collection and disposal of waste, coordinating and planning, education and training, and many more. Waste management stakeholders require key basic skills such as waste management interest, ability to grasp and apply dynamics and complex legislation and regulations, good analytical and decision-making skills, effective communication skills, good administrative and organizational skills, ability to prioritize and organize schedules, and having the management and leadership qualities to function effectively. Although, Agenda 21 (1992) identifies that many developing countries lack national capacity to handle and manage waste effectively due to inadequate infrastructure, deficiencies in regulatory framework, insufficient education and training programs and lack of coordination between the different ministries and institutions involved in various aspect of waste management. Therefore, it is important to integrate waste

management infrastructure, tools and stakeholder skills for effective waste management in developing countries.

### **3.2.1 Waste Management Practice in Sub-Saharan Africa**

A considerable amount of literature has been published on waste management practice in developing countries. Waste management in countries with developing economies is mostly characterised by inadequate collection services, little or no treatment and uncontrolled dumping of waste (McDougall 2008). In many developing countries, large proportions (between 30 to 50 per cent) of solid waste generated by residents are uncollected (Hardoy et al., 2001; Pacione 2005). Adedibu and Okekunle (1989) cited in Achankeng (2003) use the case of Lagos, Nigeria to illustrate the issue:

"in most parts of the city, streets are partially or wholly blocked by solid waste. Similarly, open spaces and marketplaces are littered with solid waste. In most cases, drains are clogged or blocked, and many compounds are hemmed in by solid waste."

Generalizing for Africa, Onibokun (1999) observed that:

"a visit to an African city will reveal solid waste problems such as heaps of uncollected waste, roadsides littered with waste, streams blocked with junk, waste disposal sites constituting hazards to residential areas and inappropriately disposed of toxic waste."

A similar condition exists in many other countries like Ghana, where only 11 per cent of the 1.4 million people in Accra benefit from a household collection of their solid waste (Achankeng, 2003). Even China, with its rapid industrial development, has waste management issues, as more than 90 per cent of waste generated in 2009 was directly disposed on land in an unsatisfactory manner (Hazra, and Goel, 2009). In 2015 Thi et al. report that China has weak recycling systems due to insufficient infrastructure for collection and inadequate treatment facilities. Also, government ministries and agencies in China are currently working rather independently which causes inefficiency in implementing waste management policies and regulations in China (Thi et al., 2015).

However, the adverse impact that waste has on the environment and health is beginning to create awareness, with policies being put in place and institutions and

programmes created to enhance waste management practices (Al-Khatib (2007; McDougall, 2008).). In most Sub-Saharan African countries, Municipal Authorities are required by law to co-ordinate institutional or policy waste frameworks, but often they fail to carry out this function (Walling et al., 2004). This is because waste management is not a major priority with limited funding, which reduces operational capabilities. The consequences are the creation of unofficial waste disposal sites within residential areas of urban communities. To highlight these issues, Waste Management Practices across four major countries of Sub-Saharan Africa: South Africa, Ghana, Kenya and Nigeria are reviewed.

Table 3.1: Relationship between policy and mechanisms to support waste management in Kenya, Ghana, Nigeria, and South Africa

Country	Policy Documents Related to Waste Management	Economic instrument	Information Education/Awareness
Kenya	<p>Environmental Protection Council (EPC) is to make sure that:</p> <ul style="list-style-type: none"> <li>• Solid waste is segregated and reduce at production and consumption level</li> <li>• Effective primary storage, collection, Transportation and transfer station</li> <li>• Treatment and landfills</li> <li>• Incineration and recycling</li> <li>• Effective Resources recovery and proper handling of hazardous waste</li> </ul> <p>(Henry, 2006).</p>	Partially	Partially
Nigeria	<p>Federal Environmental Protection Agency (FEPA) is:</p> <ul style="list-style-type: none"> <li>• “To secure for all Nigerians a quality of environment adequate for their health and well-being,</li> <li>• To raise public awareness and promote understanding of the essential linkages between the environment and development; and</li> <li>• To encourage individual and community participation in environmental protection and improvement efforts (Agunwamba, 1998; Walling et al., 2004)</li> </ul>	Partially	Partially
South Africa	<p>South Africa's premier policy document on pollution and waste management to place emphasis on:</p>	Partially	Partially

	<ul style="list-style-type: none"> <li>• Minimizing the consumption of natural resources,</li> <li>• Avoiding and minimizing the generation of waste and reducing,</li> <li>• Re-using, recycling and recovering of waste,</li> <li>• Promoting and ensuring the effectiveness of the delivery of waste services.</li> </ul>		
Ghana	<p>The principal components of environmental sanitation policy include:</p> <ul style="list-style-type: none"> <li>• Collection and sanitary disposal of waste (include, solid waste, liquid waste, excreta, industrial waste, health care and other hazardous waste)</li> <li>• Stormwater drainage</li> <li>• Cleaning of thoroughfares, markets and other public spaces</li> <li>• Control of pest and vectors of disease</li> <li>• Food hygiene</li> <li>• Environmental sanitation education</li> <li>• Inspection and enforcement of sanitary regulations</li> <li>• Disposal of dead</li> <li>• Control of rearing and straying of animals</li> <li>• Monitoring the observance of environmental standards.</li> </ul>	Partially	Partially

In line with the table 3.1 above, a study was carried out by AfDB (2002) on solid waste management options for Africa, using four Sub-Sahara African countries as a case study for a component of waste management (Cape Town-South Africa, Nairobi-Kenya, Cairo-Egypt and Accra-Ghana). A qualitative evaluation of waste management components at each of the four studied municipalities was summarised in the form of Matrix proposed by the project consultant with an arbitrary marking scale from A to D as shown in Table 3.2. The table represents qualitative evaluation of waste management where A represents fully implemented waste management practices and technology down to D which represents limited waste management activity.

Table 3.2: A qualitative evaluation of waste management components in four Sub-Sahara Africa countries.

<b>Component of Waste Management</b>	<b>Cape Town</b>	<b>Nairobi</b>	<b>Cairo</b>	<b>Accra</b>
<b>Collection rate</b>	B	D	C	D
<b>Separation at source</b>	C	B	B	B
<b>Recycling</b>	B	D	B	D
<b>Waste pickers/buyers</b>	B	C	B	C
<b>Composting</b>	D	C	A	C
<b>Transfer station</b>	B	D	C	D
<b>Landfills</b>	C	D	D	C
<b>Privatization</b>	C	C	B	C
<b>Open and competitive bidding</b>	N/A	C	C	D
<b>Public education</b>	B	D	C	D
<b>Legislation</b>	B	C	C	C
<b>Government's priority</b>	B	C	C	C
<b>Overall</b>	<b>B-</b>	<b>C</b>	<b>C+</b>	<b>C</b>

Sources: (AfDB 2002)

Waste management practices/performance differ across countries with significant differences in operational components. Using Cape Town to generalize, the overall waste



management in South African based on table 3.2 is very good (Full implementation of waste management activities – B-) because they have a very good waste collection rate, recycling practises, waste pickers/buyers, transfer stations, effective public education, very good legislation, and Governmental priority. Based on the marking of A (fully implemented waste management practices) to D (limited waste management activity), South Africa had good landfills, privatization and separation at sources, fair in composting (mark C) with unavailable data on open and competitive bidding as a practice. On the other hand, Nairobi Kenya, Cairo Egypt and Accra Ghana have good waste management (mark C) as overall, although with different performance. Kenya for example (Nairobi) in 2002 was still struggling (mark D – limited waste management activity) with low collection rate, recycling, transfer station, landfills, and public education. However, Nairobi, Kenya perform very good (Mark B) with separation at source and good (mark C) with waste pickers/buyers, composting, privatization, open and competitive bidding, legislation and government’s priority (Table 3.2). Therefore, based on the case studies (Table 3.2), AfDB (2002) suggested that three Solid Waste Management (SWM) models could fit a typical African City at three different community income levels:

- High income community: Cape Town, South Africa;
- Medium income community: Cairo, Egypt; and
- Low income community: Nairobi, Kenya and Accra, Ghana.

### ***3.2.1.1 Waste Management practice in South Africa***

South Africa is said to be the most economically developed country in Sub-Saharan Africa with a Gross National Income per capita of:

“US\$2750 in 2003, energy use per capita in Kilogram (kg) of oil equivalent of 2,502 and electricity use per capita of 3860 kWh (KiloWatt Hour) in 2002” (Karani and Jewasikiewitz, 2007).

In the late 1990s, the South African government identified the need to develop a waste management system to support the implementation of pollution and waste reduction measures, and effective integrated waste management (Godfrey, 2008). An integrated waste management policy was outlined in the White Paper on Integrated Pollution and

Waste Management for the country (AfDB 2002). The White Paper served two purposes:

- To make the public aware of the government's objectives and the ways to achieve them
- To inform the government agencies and state organs of these objectives and their roles in achieving them (AfDB 2002).

Despite this, Karani and Jewasikiewitz, (2007) identify that South Africa is faced with some key waste management issues, which include inadequate waste collection services for a large portion of the population; illegal dumping and unlicensed waste management activities (including unpermitted disposal facilities). Also, a lack of space at permitted landfills, insufficient waste minimisation and recycling initiatives; insufficient waste information; lack of regulation and enforcement of legislation; and, indeed, limited waste-related legislation in the first place. Figure 3.1 is an example of an uncontrolled open disposal site in South Africa with open fire and scavengers referred to as open landfill by Karani and Jewasikiewitz (2007).



Figure 3.1: An open landfill site in South Africa (Karani and Jewasikiewitz, 2007).

Greben and Oelofse (2009) report that domestic waste in South Africa is disposed of in approximately 1203 landfills, of which only 524 were permitted in 2006 whereas the remaining 679 sites continue to operate illegally. For example, in the City of Cape Town, 2 million tonnes of waste are disposed of at municipal landfill sites each year (average over a 10-year period 2001 - 2011) (Nahman, 2011). Interestingly, even with the quantity of waste generated in South Africa, regulating and monitoring waste production, enforce waste control measures, and coordinating administration of integrated pollution and waste management is done through a single government department. Therefore, this is a significant benefit and achievement as many countries have a range of departments with the responsibility for waste management.

Matete and Trois (2008) argue that unlike other emerging countries, South Africa has a well-established recycling industry, although there is no specific legislation enforcing or addressing recycling. They add that current methods of publicly-run recycling includes organised scavenging (informal recycling) taking place on landfill sites or transfer stations; drop-off centres operated by municipal and used by the general public; buy-back centres where recyclables are collected manually (usually by scavengers). Also, Greben and Oelofse (2009) attest that in South Africa, landfilling is generally considered the most practical waste management method. However, the scarcity of available land in proximity areas of waste generation as well as the uncontrolled landfill gas (CH<sub>4</sub>) and leachate emissions from organic waste have caused landfilling to become a less attractive option. Therefore, moving towards a sustainable waste management regime, the internationally accepted hierarchy of waste management has shifted the emphasis from disposal to minimisation, recovery, recycling, and treatment.

Meanwhile, in 2010, Larney and Van Aardt confirm that South Africa entered a new political era in the previous decade, which inevitably entails accelerated economic growth and development, creating an opportunity for recycling of waste, although this opportunity was not fully exploited in South Africa because recycling is not economical (Larney and Van Aardt, 2010). Nevertheless, one of the extensive goals documented in the White Paper on Environmental Management Policy was to set targets to minimize waste generation and pollution at source and promote a hierarchy of waste management

practices, namely reduction of waste at sources, re-use, recycling and safe disposal as a last resort (Department of Environmental Affairs and Tourism 2018; Larney and Van Aardt, 2010,).

Ezeah and Roberts (2012) also affirm that a new policy of a nationally co-ordinated approach to waste management was adopted thereby streamlining legislation and implementation by various government organs to deal with waste-related issues. South Africa has committed itself to the development of ambitious integrated municipal waste management programmes via the Polokwane Declaration in September 2001 (Ezeah and Robert, 2012).

Objectives for integrated pollution control and waste management systems are present in environmental management policy:

- Promoting cleaner production and establishing mechanisms to ensure continuous improvements in best practices in all areas of environmental management;
- Preventing or reducing and managing the pollution of any part of the environment due to all forms of human activity;
- Setting targets to minimize waste generation and pollution at source and promoting a hierarchy of waste management practices, namely reduction of waste at source, reuse and recycling with safe disposal as the last resort;
- Regulating and monitoring waste production, enforce waste control measures, and coordinating administration of integrated pollution and waste management through a single government department;
- Ensuring the protection and proactive management of human health problems related to the environment in all forms of economic activity (Karani and Jewasikiewitz, 2007; Godfrey, 2008).

The Environmental Management Policy presenting the objectives for integrated pollution control and waste management systems in South Africa shows that landfilling is the last resort after waste reduction, reuse and recycling have been carried out. Waste management in South Africa is practised based on the principles of the White Paper on Integrated Pollution and Waste Management and the National Waste

Management Strategy designed by the Department of Environmental Affairs (Department of Environmental Affairs Republic of South Africa, 2018). South Africa supports and practises the waste hierarchy in its approach to waste management by promoting cleaner production, waste minimisation, reuse, recycling, and water treatment with final disposal as the last resort in the management of waste (figure 3.2). In South Africa, there are various Council-related regulatory and policy documents that contextualise the scope and principles of the policy to enable the management of waste in an integrated, sustainable, equitable, and responsible manner in order to maintain a safe and a healthy environment.

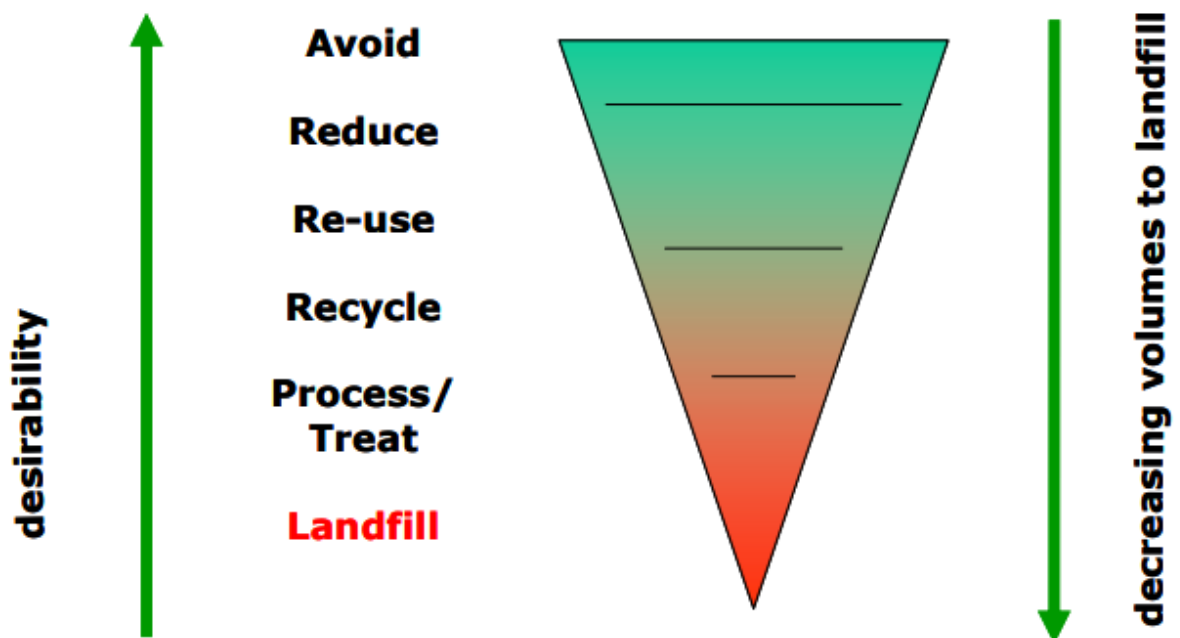


Figure 3.2: Waste Management Hierarchy (Department of Environmental Affairs, Republic of South Africa, 2018)

The Department of Environmental Affairs, Republic of South Africa (2018) outlined some bases for action to achieve integrated waste management and waste management hierarchy. The basis for action includes:

**1. Minimizing waste:** Unsustainable patterns of production and consumption are increasing the quantities and variety of environmentally persistent waste at unprecedented rates. The trend could significantly increase the quantities of waste

produced by the end of the century and increase quantities by four to fivefold by the year 2025. A preventive waste management approach focused on changes in lifestyles and in production and consumption patterns offers the best chance for reversing current trends.

**2. Waste reuse and recycling:** As the economics of waste disposal services change, waste recycling and resource recovery are becoming increasingly cost-effective. Future waste management programmes should take maximum advantage of resource-efficient approaches to the control of waste. These activities should be carried out in conjunction with public education programmes. It is important that markets for products from reclaimed materials be identified in the development of reuse and recycling programmes.

**3. Waste treatment and disposal:** In developing countries, the problem is of a more fundamental nature. Less than 10% of urban waste receives some form of treatment and only a small proportion of treatment follows any acceptable quality standard. Faecal matter treatment and disposal should be accorded due priority given the potential threat of faeces to human health.

**4. Extending waste management coverage:** The health and environmental impacts of inadequate waste management, however, go beyond the unserved settlements themselves and result in water, land and air contamination and pollution over a wider area. Extending and improving waste collection and safe disposal services are crucial to gaining control over this form of pollution.

### ***3.2.1.2 Waste Management practice in Ghana***

Ghana has been experiencing rapid urbanization for many years. The population in Accra has expanded rapidly leading to urban sprawl and an uncontrolled increase in waste generation (Boadi and Kuitunen 2003). Ghana is a typical example of a developing country, where waste management is often characterized by inadequate financial and logistical arrangements, poor service coverage, operational inefficiencies, the dearth of skilled manpower, lack of enforcement of regulations, and poor cultural attitudes to waste handling. In Ghana, problems are encountered at all levels of waste management, particularly, collection, transportation and disposal (Yoda, et al., 2014).

Generally, existing public facilities, including sanitary facilities, are inadequate to serve the population, coupled with an overwhelming volume of waste generation in the country's urban centres which is overwhelming (Yoda, et al., 2014). In addition, reliable national data on waste generation and composition that will inform effective planning on waste management in Ghana is absent (Miezah et al., 2015). Waste management efficiency is only narrowed down to the removal of waste from residential areas without much concern for either its safe disposal or its impact on the environment in case of improper waste disposal (Boadi and Kuitunen, 2005). There is little attention on reducing waste flows (through reuse, recycling and composting), or exploiting its economic value (Boadi and Kuitunen, 2005). This is because authorities in developing countries tend to overlook the significance of waste minimization strategies, leading to situations where all "waste" is sent to dumpsites for final disposal. In Accra for example, the solid waste infrastructure is inadequate, as over 80 per cent of the population does not have collection services with only 13.5 per cent served with door-to-door collection, while the rest dispose of their waste at communal collection points, in open spaces, and in waterways (Boadi and Kuitunen, 2005). The principal components of environmental sanitation policy in Ghana include:

- Collection and sanitary disposal of waste (include, solid waste, liquid waste, excreta, industrial waste, health care and other hazardous waste)
- Stormwater drainage
- Cleaning of thoroughfares, markets and other public spaces
- Control of pest and vectors of disease
- Food hygiene
- Environmental sanitation education
- Inspection and enforcement of sanitary regulations
- Disposal of dead
- Control of rearing and straying of animals
- Monitoring the observance of environmental standards.

Municipal authorities in Ghana operate in resource-constrained environments and are unable to deliver effective and efficient sanitation services as they continue to struggle

to implement the measures required to deal with the ever-growing problem of waste (IMANI-Policy and Education, 2018). This document reports that the situation is compounded by the lukewarm attitude of governments in the developing world who hardly recognize environmental sanitation and public health as issues of national priority against other competing interests on national budgets. The current methods being used in Ghana for the storage, collection, transport, treatment, processing and disposal of waste are fraught with a problem (Puopiel, 2010), adding that the existing practice tends to emphasize collection and transport over treatment and final disposal. Also, a significant portion of the budget of municipal authorities which is expended on waste management goes into collection and transportation of waste alone.

There are basically two main types of collection services in place, namely the House to House Collection (H/H) and the Central/ Communal Container Collection (CCC) (Puopiel, 2010). Conventional waste collection is mainly concentrated in the more affluent high-income areas to the neglect of the densely-populated inner-city locations which make up over 60% of the space in the cities (Puopiel, 2010; IMANI-Policy and Education, 2018). However, poor road infrastructure in these low-income areas makes it very difficult for conventional waste collection vehicles, subsequently, large amounts of solid waste remain uncollected in nooks and crannies, creating very unhygienic conditions in the already depressed environment.

Although, landfilling remains the most prevalent waste treatment and disposal method, despite carrying the greatest threat to human health in addition to its proven negative impact on the environment. The form of landfill operations implemented in Ghana is much often un-engineered open-pit waste dumping with no leachate control, scant application of cover material, open access to scavenging animals, rodents and other disease vectors (IMANI-Centre for Policy and Education, 2018). In addition, there is pressure on the government, due to public anger with the siting of landfills, increasing environmental awareness, scarcity of land among other factors means that waste management authorities must find a way of moving away from open landfill practice or at least reduce the waste destined for landfills. Therefore, in view of shrinking space



available for landfills or open dumpsites, any technology that can significantly reduce waste that would otherwise be destined for disposal in landfills is desirable.

### 3.2.1.3 Waste Management Practice in Kenya

Kenya is characterized by a rapid-population, rapid-urbanization (estimated at 4% per annum) and increasing urban-poverty; approximately 45% of the population is living on less than USD 1.25 per day (Madara, 2018), who adds that Kenya population according to the 2014 census was estimated at 48.5 million, with an average population density of 80 people per km<sup>2</sup>. NAMA (2016) presented urban population growth across Kenya and the associated waste generation amounts.

Table 3.3: Urban Population and MSW Generation Trends in Kenya

Year	National Population (million)	Urban Population		Estimated Urban Generated	Total MSW
		Million	% of the total population	(tons per day)	
2011	41.1	9.9	24.1	4,950	
2012	42.5	10.2	24.0	5,100	
2013	43.7	10.9	24.9	5,450	
2014	44.9	11.2	24.9	5,600	

Source: (Madara, 2018)

Environmental Protection Council (EPC) has the responsibility for making sure that:

- Solid wastes are segregated and reduced at production and consumption level;
- Effective primary storage, collection, transportation and transfer station;
- Treatment and landfills;
- Incineration and recycling;
- Effective Resources recovery and proper handling of hazardous waste (Henry, 2006).

Prior to the establishment of Kenya Environmental Management and Coordination Act (EMCA) of 1999, solid waste management was the sole responsibility of local authorities (Sibanda et al., 2017; Henry et al., 2006). However, the Ministry of Environment and Natural Resources (MENR) is the government agency charged with the principal responsibility of protecting Kenya's environmental resource. The overall responsibility of MENR involved coordinating the work of all lead agencies whose work has direct impact on the environment through the National Environmental Management Authority (NEMA) (Madara, 2018). Also, NEMA has the mandate to safeguard, restore and enhance the quality of the environment, through coordination and supervision of stakeholders for sustainable development; for example, exercise general supervision and coordination over all matters relating to the environment and implementation of environmental law and supervise and coordinate all environmental matters and implement all policies relating to the environment for sustainable development (Madara, 2018). This is a justification that Kenya has indeed developed and enacted a sufficient number of policies and legal provisions as well as created institutions and systems at a different level of governance. This conclusion agrees with Sibanda et al. (2017) that;

“In Kenya, there is sufficient and dynamic legislation, existing by-laws, policies, and programs regarding waste management”.

However, weak enforcement of laws and weak implementation of policies are coupled with the fact that many sectoral policies and laws are not harmonized with each other with the constitution which has remained a major issue of concern in Kenya's environmental sector (Sibanda, 2017).

In Kenya, waste management challenge is real as collection systems are inefficient and disposal systems are not environmentally and health-friendly (Gakungu et al., 2012). Nationally, it is estimated that only 40% of all solid waste generated is collected and disposed of at designated disposal sites (NEMA 2015) while the uncollected waste is either burned in the open air or indiscriminately dumped (Madara, 2018). This is because up to 80% of waste collection transport is out of service or in need of repair (Gakungu et al., 2012). Where available, waste collection services are geographically

skewed, with higher and middle-income residential and commercial areas better serviced, while the low-income neighbourhoods with poor infrastructure are largely neglected or receive the service at a very limited extent for it is free of charge (Madara 2018). Madara (2018) contends that none of the urban-centres in Kenya operates a sanitary landfill, and most of the generated waste ends up in open dumpsites where no waste compaction and capping (covering waste with soil at the end of each day) takes place. For example, in Nairobi, the capital of Kenya, the problem of waste management has reached dangerous levels with their dumpsites handling about 803,000 tons of waste/year. Also, other major cities and towns such as Mombasa, Kisumu, and Nakuru dispose of 1,124million tons of waste, combining with other smaller towns, it is estimated that 5.26 million tons of waste is disposed of through open burning and methanation (Madara, 2018; Sibanda et al., 2017; NEMA, 2015). In addition, healthcare waste generated in Kenya is approximately 909,182 tons/year, with infections waste comprising 75% (Madara, 2018; NEMA, 2015).

Nairobi's waste situation which could be taken to represent Kenya's status is largely characterized by low coverage of waste collection; pollution, from uncontrolled dumping of waste; inefficient public services; an unregulated and uncoordinated private sector; and lack of key solid waste management infrastructure (such as transfer facilities, sanitary waste disposal facilities, and systems for waste separation). However, it has been observed that borrow pits and quarries are often selected as a reclamation strategy in Kenya waste management system. For example, Kadhodeki dumpsite started in 1986 as a way of filling in the large gaping manholes that had been left open after quarrying activities in the construction of Nairobi/ Waiyaki highway. The dumping of the waste was a way of the landowners making some money (Njagi et al., 2013). Henry et al. (2006) argue that in Eldoret, Kenya, an abandoned sand quarry was used for the disposal of municipal solid waste, yet it was clear that the site was a water catchment area for small streams that drain into the Sosiani River. Also, the 30 - 40acre Dandora municipal dumping site in Nairobi, Kenya, is an old quarry which had to be refilled using garbage and It has turned out to be a health hazard to the people living close to its environs (UNEP, 2007). About 27% of the solid waste generated daily (2,000t daily)

makes it to the Dandora dumpsite, and this explains the multiple mini dumpsites found along the city roads and open spaces (Madara, 2018; UNEP, 2007). The UNEP (2007) describes Dandora dumpsite as the worst humanitarian crisis facing the Nairobi city.

Henry et al. 2006 visited open waste disposal sites and interviewed local authorities and concluded that there was little or no consideration of the environmental impact of selection and siting of disposal sites. Disposal of plastic bags has been the biggest SWM problem in Kenya. Close to 100 million plastic bags are given out every year in Kenya by supermarkets, most of which end up in garbage bins polluting the environment. These plastics bags block drains and gutters, which create storm waters; they provide breeding habitats for mosquitoes and this can lead to a malaria outbreak in a country (Njeru, 2006). The current ban (the Legal Notice took effect on 28th August 2017) covers all plastic carrier bags (single-use bags, carrier bags with handles, and flat bags without handles), which are used as secondary packages, because prosecution and fines for having bags is in place. However, with regards to policy implementation and the latest ban of plastic bags in 2017, Madara (2018) observed several scenes in different areas of Kenya where the food street vendors package their food for customers using old newspaper, due to the ban on plastic bags. Madara added that it seems that the enforcement of the plastic ban in the country was initiated without providing several affordable alternative plastic bags, particularly to the street vendors. Therefore, waste management in Kenya is not far different from the practices in developing countries surrounded by several issues.

#### ***3.2.1.4 Waste Management practice in Nigeria***

Nigeria, like many developing countries, is struggling with ineffective waste management and has not been able to achieve any reasonable success. The challenge of solid waste management in most Nigeria cities is not different from many urban developing cities. Solid waste generation rate in Nigeria is estimated at 0.65-0.95 kg/capita/day which gives an average of 42 million tons of waste generated annually (Ike et al., 2018). According to this source, the amount of waste generated in Nigeria annually is more than half of the 62 million tons of waste generated in sub-Saharan Africa

annually. Visionscape reported in 2018 that with the Nigerian population now exceeding 170 million, it makes Nigeria the most significant producer of solid waste all around Africa. Where and how to channel this waste appropriately without causing harm to human health and the environment has become a huge problem for many sub-Saharan African countries like Nigeria. The main aspect of waste management system: collection, processing, transportation, treatment and proper disposal practice appear ineffective (Porta et al., 2009). For example, Visionscape (2018) reports that with the high amount of waste generated in Nigeria, only 20 – 30% of it is collected.

Ogwueleka (2009) reports that waste management in Nigeria can be categorized by their inefficient methods of collection, insufficient coverage of the collection system and inappropriate disposal of waste (as shown in figure 3.3). There is now a popular saying in Nigeria that;

“In Nigeria, waste increases in a geometrical progression while the collection and disposal are at an arithmetical progression” (The Guardian, 2017; Visionscape, 2018).

There is indiscriminate dumping of waste because more than half of the Nigerian population has no access to the waste collection (Ogwueleka, 2009). Ike et al. (2018) confirm that the situation has not changed as indiscriminate habit of dumping waste along major roads and in temporary dumpsites (unofficial waste disposal sites) is a recurrent sight within municipalities in Nigeria.



Figure 3.3: Solid waste dump in the city centre of Ogun State Nigeria (Omole and Isiorho, 2011).

In 1998 there were only two open landfills in Nigeria (Agunwamba, 1998). By 2007, the situation had not changed as Abuja, the capital city of Nigeria did not have sanitary landfills for waste disposal, and all solid waste from the formal collection in the various districts was transported to a single site at Mpape (Imam et al., 2008). The Guardian Saturday Newspaper reported in 2017 that in Nigeria, it is common across the country to see heaps of festering waste dumps in almost every nook and cranny such as residential areas, markets, waterways, highways, street, and undeveloped plots of land turned to waste disposal sites by many households. Ike et al. (2018) added that most Nigerian cities, including major cities which used to be tourist centres, have been ranked as 'dirtiest and worst liveable cities in the world'. For example, Ibadan and Lagos which are commercial cities in South-West Nigeria were described as the dirtiest cities in 2010 while Onitsha and Aba in the South-East also join the list in 2015 (Ike et al., 2018). The story is similar in almost all cities in Nigeria where waste dumps are scattered everywhere. Also, Ike et al. (2018) continue that Port Harcourt, Nigeria's oil city, which used to be a tourist destination, in recent times has been ranked as one of the 15 most polluted in the world, due to the problem of waste disposal that contaminates rivers and affects the residents. Consequently, only Lagos State, through the Lagos Waste

Management Authority (LAWMA), an initiative for transforming the Waste Management and other related sectors, has attempted to restore Lagos to its lost glory.

In most urban cities of Nigeria, majority of the people are confused with the difference between waste disposal and waste management. A lot of people only take disposal as the scheme to manage their waste which is why most waste is being dumped in any available space (Visionscape, 2018). In this case, even some waste management authorities in developing countries see waste management as transportation, which means a collection of waste from an area and disposing it to another, that is far from waste management! Agunwamba (1998) affirms that sometimes the main objective seems to be to move the waste out of public sight, because, it is obvious that, although there is a program to keep the immediate environment clean, there is no adequate plan for waste disposal.

There are constitutions, legislations and policies to guide waste management as established in chapter two. Despite this legislation, solid waste management in Nigeria is characterized by a lack of accountability and uncontrolled dumping of waste in public areas. The legal frameworks for the management of solid waste in Nigeria enacted by FEPA are:

- The National Protection Management of Solid and Hazardous Wastes Regulations (1991);
- The Pollution Abatement in Industries and Facilities Generating Wastes Regulations (1991);
- The General Guidelines for Pollution Abatement in Industries (1991).

A national policy on the environment was formed and the goals of the policy include;

- “To secure for all Nigerians a quality environment adequate for their health and well-being,
- To raise public awareness and promote understanding of the essential linkages between the environment and development; and

- To encourage individual and community participation in environmental protection and improvement efforts” Agunwamba, 1998; Walling et al., 2004; Imam et al., 2008).

Despite the enacted environmental policy, waste management in Nigeria is still ineffective and inefficient. Generally, government policy on solid waste management is not comprehensive. For instance, while some effort is made to elicit public cooperation (in line with the goals of the national policy) during the nationwide monthly environmental clean-up exercise, no effort is being made to develop appropriate disposal sites (Agunwamba, 1998). Where good policies exist, their implementation might constitute the major obstacle. Therefore, there are no clearly formulated policies in Nigeria and where legislation exists in the country, there is often poor enforcement. Walling et al. (2004) affirm that the federal government has very little control over environmental regulation. Though local government was given the responsibility to fund waste management, most of them shirked the responsibility because of inadequacies and endemic corruption in the system (Ezeah, 2009).

It is obvious that some factors are responsible for poor waste management practice in Nigeria. These factors may include inadequate funding, overgrowing population, lack of a comprehensive legal framework and enforcement of the existing regulations. The Guardian (2017) highlighted other factors as low investment in infrastructure, inadequate human capacity for administrative and technical issues, wrong attitude of the public towards solid waste disposal, poor planning, low data management and uncontrolled urbanisation, uncoordinated institutional functions, low academic research and industry linkages and lack of the needed political will on the part of the leaders. Therefore, until these factors are properly and diligently addressed by the relevant authorities (e.g. waste management stakeholders) and individuals (e.g. public), managing waste disposal will remain a nightmare in Nigeria.

### **3.3 INTEGRATED WASTE MANAGEMENT (IWM)**

IWM involves designing, continuously monitoring and improving solid waste management systems to attain environmental effectiveness in urban cities (Chung and



Lo, 2003). IWM combines all solid waste streams, collection and a range of treatment methods, environmental benefits, economic optimisation and social acceptability in a sustainable system. Therefore, an integrated approach to solid waste management can deliver both environmental and economic sustainability (Ball and Rodic-Wiersma 2010).

According to McDougall (2008), a sustainable system for solid waste management must be environmentally effective, economically affordable and socially acceptable. IWM covers all waste management process, in a cradle to grave approach, and emphasizes the need to shift from uncontrolled to controlled disposal (Chung and Lo, 2003). Therefore, it is important for environmental protection agencies to employ integrated waste management patterns by selecting and applying suitable techniques, technologies and management programs to achieve specific waste management objectives and goals (Nkwachukwu, 2010). It is suggested that to ensure the effectiveness of an IWM system, all beneficiaries (e.g. the public, industries and local authorities) should pay for management services (McDougall, 2008). Economic instruments, such as environmental taxes and subsidies, seek to change behaviour indirectly by changing the relative prices (and hence incentives) that individuals and businesses face (Nahman and Godfrey, 2010). Such economic instruments have grown in importance in developed countries, where they are highly effective in achieving environmental objectives, such as reducing waste generation or diverting waste from disposal to recycling, provided that adequate enforcement mechanisms are in place.

The implementation of the waste management hierarchy (figure 3.4) in most developed countries has resulted in significant diversion of waste (White, et al., 1999) and semi-controlled landfill remains an ideal management option in the developing world (Srivastava et al., 2015).

The **first** step of ISWM is **Avoidance**. This concept involves Clean Technology and Internal Recycling in order to minimise waste production at the source. The second step of ISWM is **Material Recovery**. A stream of waste containing many valuable materials and hazardous fractions is involved in this step. The hazardous fraction should be

separated, and valuable material should be recovered according to technical and economic feasibility.

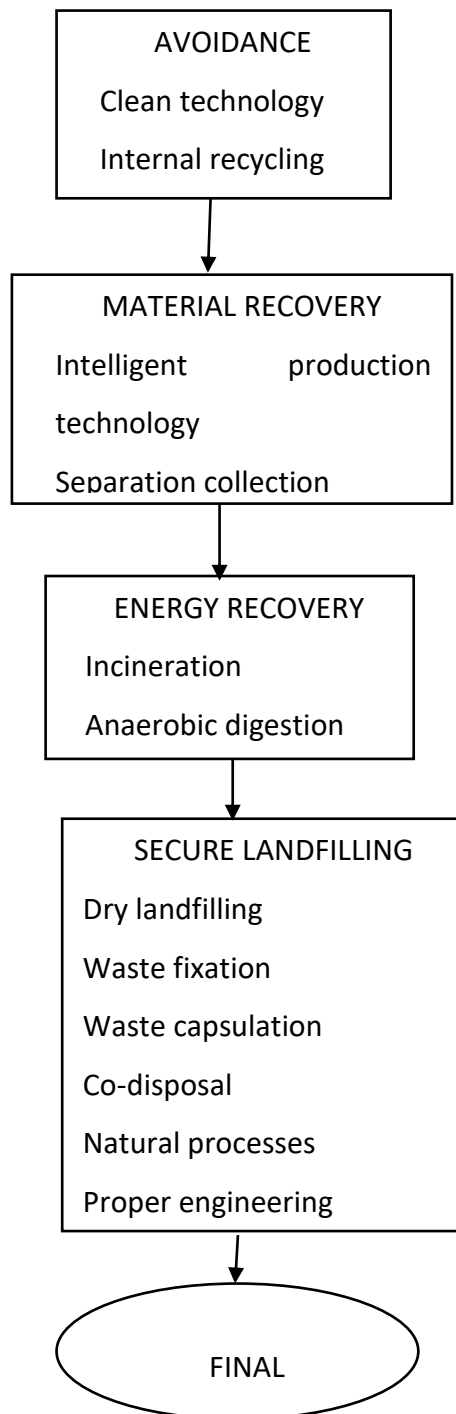


Figure 3.4: Scheme of ISWM (Integrated Solid Waste Management) (Christensen, 2012)

Ezeah (2009) states that most developed countries have embarked on ambitious environmental reforms and have made remarkable advances in best practice and

sustainable development in their waste management and have implemented strategies, effective policies and regulations to tackle environmental and health-related issues. Drechsel and Kunze (2001) estimated that 90% of waste from cities in developing countries is dumped when over 60% of it could be recycled. Although, the conventional waste management approach is that waste generation, collection and disposal systems are planned as independent operations (Seadon, 2010). However, all three are very closely interlinked, and each component can influence the other. The type of waste management practice adopted in each country is mostly a function of economic considerations but is also a reflection of technical aspects due to the quantity and type of waste to be handled (Giusti, 2009). In most countries, especially developing countries, waste is treated and managed when the pressure to handle the problem is greater than the convenience of collection and disposal (Seadon, 2010). Therefore, the solutions for waste management problems always appear when waste disposal negatively impacts the environment and the people.

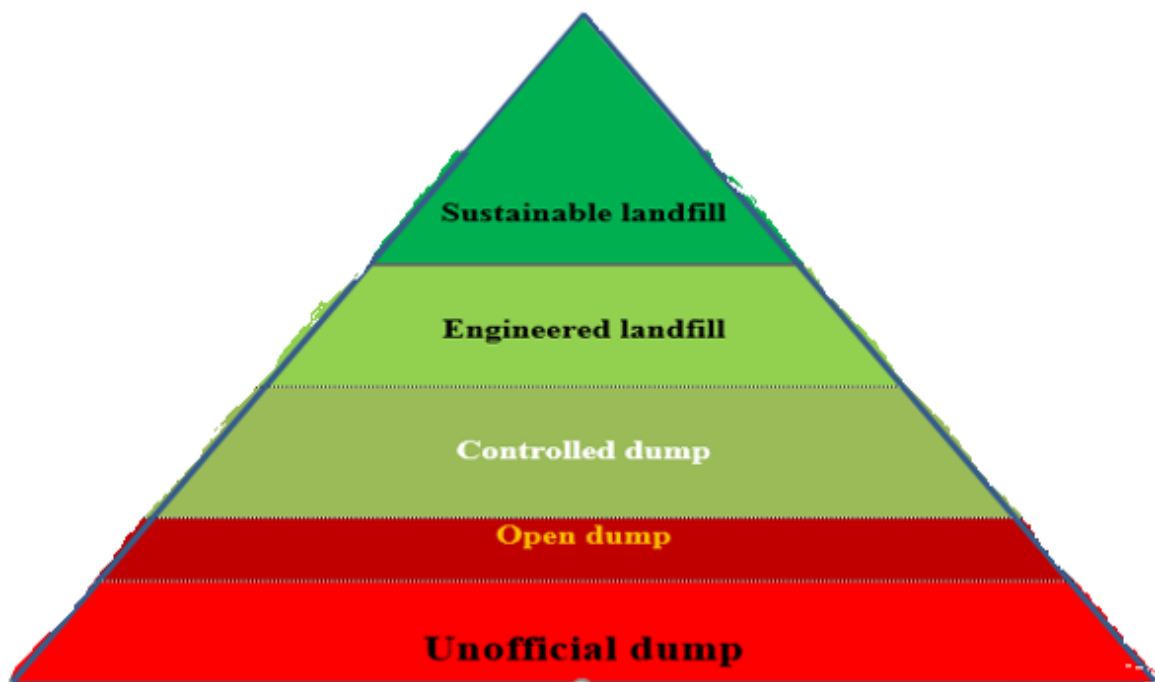


Figure 3.5: A Phased approach to dumpsite rehabilitation in developing countries (Adapted from Joseph and Nagendran, 2007; Rushbrook, 1999).

Figure 3.5 presents different waste management practices found in different countries. For example, a sustainable landfill and engineered landfill are the common waste

disposal practice in the developed world. This is because the sustainability of waste management requires stable economic and several policy interventions for support in terms of capacity building, people's participation, promotion and use of appropriate technologies (Joseph and Nagendran, 2007). A controlled dump is a step higher than the open dumpsite as there are certain "Basic Control Measures" in place. Open dumps are commonly found in developing countries and are susceptible to open burning, exposed to disease vectors, open to scavengers, and posing threats for human health and the environment. Also, unofficial dumpsites, commonly found in developing countries, are located within residential areas and locally managed by residents through burning. Therefore, closure of open dumpsites and unofficial dumpsites would moderate the environmental impact of such improper disposal practice. Higher priority may be assigned to dumpsites (e.g. open landfill and UWDSs) with high health environmental risks, maximum environmental impacts, minimum rehabilitation costs and maximum public concerns.

### **3.4 OFFICIAL WASTE DISPOSAL SYSTEMS – FORMAL WASTE DISPOSAL SITES**

Rapid urbanization has resulted in existing waste disposal sites originally located at a safe distance outside municipal boundaries being increasingly encircled by settlements and housing estates (Schertenleib & Meyer, 1992). This has caused the public increasingly to oppose their existence as they cause odour, dust, and other nuisances. People living close to uncontrolled/ engineered dumpsites are in danger of contracting diseases associated with odour, dust, and other nuisances. Three types of waste disposal sites are an integral part of solid waste systems: 1) open landfill, 2) controlled landfill, and 3) sanitary or engineered landfill (Remigios, 2010). The majority of urban centres in the developing world (including Africa) use open landfill as their principal disposal method. This picture is typical for the rest of Sub-Saharan African countries except for South Africa.

In open landfill or uncontrolled landfill, waste is simply dumped in low lying areas on open land which does not protect the environment. In open waste disposal sites, waste is tipped haphazardly which is neither hygienic nor safe. Open landfills are characterized

by the absence of engineered measures, no leachate management or consideration of landfill gas management, and few if any operational measures, such as registration of users, control of the number of tipping fronts, or compaction of waste (Dhokhikah and Trihadiningrum, 2012). Local governments see uncontrolled waste disposal as the only possible safe option of waste disposal due to the already existing financial and institutional constraints (Mangizvo, 2008), who proposes that most local governments are weak, underfunded, and are faced with growing populations; hence they cannot raise enough funds to construct properly engineered landfills.

Controlled landfills, on the other hand, are operated in some developing countries. For these, waste is disposed of at a designated site and the dumped waste is compacted, then a topsoil cover is provided daily to prevent nuisance (Narayana, 2009). The writer adds that all kinds of waste whether municipal, industrial, or clinical/hospital waste may be dumped without segregation, and this method is not engineered to manage leachate discharge and emissions of landfill gases. This is common in most developing countries, as there is a lack of technical expertise as well as engineering infrastructure preventing the transition of open dumps to sanitary landfills (Yuen et al., 2013).

Sanitary landfills have facilities for the interception of leachate generation and its treatment using a series of ponds, and they have arrangements for the control of gases from waste decomposition (Narayana, (2009). These are costly to construct, and most developing countries cannot afford them unless they get external funding (Idris, 2004). This is the desired method of disposal, but due to the high costs involved in the establishment, they remain a pipe dream in most developing countries. Therefore, these three categories of official/formal waste disposal sites i) Sanitary landfill, ii) Controlled or non-sanitary landfill, and open I or uncontrolled landfill are described in detail.

### **3.4.1 Sanitary Landfill Sites**

Landfills have played a vital role in solid waste management and are still considered an important part of the waste management system (Ismail and Manaf, 2013). The impact that landfills has on its surrounding environment is highly dependent on practice at the

landfill and the quality, or quality expectations, of the surroundings (Christensen, 2012). Basically, the major environmental impact from a sanitary landfill originates from the fact that the waste, in terms of composition, significantly differs from the surrounding land (Qasim, 2017). However, despite all the efforts to avoid solid waste production and to recover materials and energy, there will always be a residue which is non-avoidable, non-recoverable, non-recyclable and non-burnable which should be disposed of in a landfill (Christensen, 2012). Therefore, at this stage, the residual waste stream must be disposed of without a major environmental impact.

Sanitary landfills are scientifically engineered sites. It is the primary solid waste disposal option in most developed countries designed and engineered to contain waste until stabilised physically, chemically, and biologically (Christensen, 2012). Sanitary landfill sites have the required facility for management of obnoxious landfill gases and leachate produced from generating organic wastes thus lessening their effect on air and groundwater pollution respectively (Srivastava et al., 2015). It is an engineered method of disposing solid waste on land in a manner that minimizes environmental hazards and nuisances (Qasim, 2017). However, the economic and technological constraints make meeting all aspects of sanitary landfill requirements impractical in most developing countries. Most developing countries operate uncontrolled open landfill as a system of waste disposal due to the cost of maintenance associated with sanitary landfill. Therefore, sanitary landfills are used in developed countries because they have facilities for interception and treatment of leachate using a series of ponds (Narayana, 2009; Bijaksana and Huliselan, 2010).

So, the leachate control at a sanitary landfill is achieved by various types of liners, and barrier layers applied over a specially prepared base (Qasim, 2017).

#### **3.4.2 Controlled landfill**

Controlled landfill or non-sanitary landfills are designated sites where waste dumped is compacted without segregation (Srivastava et al., 2015). This type of landfill partially manages leachate discharge or emission of the landfill gases (Narayana, 2009). Christensen (2012) argues that the environmental aspects of the operating controlled

landfill manage the nuisance imposed on the neighbourhood including wind-blown litter and dust, noise, odorous gases, birds, vermin and insects attracted by the waste, surface run-off and the physiological disturbance of the view to the landfilled waste. However, the gas and leachate problems arising during the operating phase demand significant environmental controls because the absence of any control measures becomes a nuisance.

The attainment of highly engineered landfill design and construction as practised in the developed world is important to reduce the health and environmental impact of the sites (Joseph, and Nagendran, 2007). A controlled landfill is a step higher than an open landfill as there are basic control measures such as:

- A person in authority is on-site;
- Control of vehicle access to the site;
- Control over the types of waste entering the site;
- Control over where vehicles may drive and deposit waste on the site;
- Provision of good access roads;
- Waste will be deposited in a single controlled area where basic waste handling techniques will ensure a controlled and consolidated waste body;
- Elimination of uncontrolled waste burning;
- Establishment of preliminary drainage control measures;
- Control over salvaging operations by the scavengers;
- Control of foraging animals out of the site with a compound wall. (Rushbrook, 1999).

These control measures can be achieved in most middle and low-income countries in the short term without much additional investment and will significantly improve the site and reduce adverse impacts and associated nuisances, although to facilitate implementation requires policy intervention in areas such as capacity building, people participation, promotion and use of appropriate technologies. However, this phased approach is being used in South Africa (Ball and Bredenhann 2003, cited in Joseph and Nagendran, 2007).

Controlled disposal system has many advantages:

“Having staffed gate controls enables the segregation of hazardous and non-hazardous waste”,

- Reduces pollution from the site,
- Improves the occupational safety of workers and waste pickers at the site",
- Investing in a reasonable road to the site will reduce the costs of vehicle maintenance and prolong vehicle life and
- Diverting waste from disposal through materials recycling will extend the useful life of the disposal site (Ball and Rodic-Wiersma 2010).

Therefore, there are limited resources for upgrading or replacing waste disposal sites and, equally, limited funds and technical competence to operate and maintain controlled disposal sites.

### **3.4.3 Open landfill/uncontrolled landfill**

Eisted and Christensen (2013) posit that any landfill site having smoke, odour, scavengers on-site is not engineered or sanitary landfill site but open landfill or uncontrolled open dumpsites which required to be phased out. According to Ball and Rodic-Wiersma (2010), these sites (uncontrolled open dumpsites) are characterized by the dumping of all kinds of waste and by uncontrolled fires (often started to reduce the waste volume) which have an adverse effect on the environment and human life (air, water and soil), causing pollution. Therefore, it can be concluded that waste management in many urban cities of Sub-Sahara Africa needs improvement.

Open landfills lack controlled and engineered measures for leachate containment or management, landfill gas management as well as operational measures such as user registration, waste compaction, and controls on the number of tipping fronts (Zerbock 2003). In contrast, the EU directive on landfill requires, amongst other things, that a strategy on biodegradable waste is put in place that achieves the progressive diversion of biodegradable municipal waste from landfill (Defra,2010). Open systems of waste disposal entail the least development and operational costs and no liner to separate



hazardous and non-hazardous waste and are the most prevalent type of waste disposal facility in most developing countries (UNEP, 2005; Remigios, 2010).

Financial or institutional constraints can leave a country with little or no choice than to embrace open landfill. For instance, many countries have sought to close open disposal sites and create controlled waste disposal sites that are environmentally safe and sustainable. In Portugal for example, since 1990s closing disposal sites was adopted for municipal solid waste management; however, in 2001, more than 340 disposal sites were still to be closed" (Mangriho et al., 2006). Therefore, it is important to phase out open dumpsites alongside unofficial waste disposal sites in urban cities in favour of controlled-disposal facilities, even if they do not meet the full engineering standards associated with landfills in developed countries. It is argued by Ezeah (2009) that even though waste management is a global issue, most of the developed countries make conscious efforts and embark on ambitious environmental reforms, having remarkable advance in best practices and sustainable development in their waste. These developed countries make strategies, effective policies and regulations available to tackle any problem that might occur. For example, the EU Waste framework directive: Waste Management Directive 2008/98/EC (Defra, 2009) states that:

- Waste should be managed without endangering human health and harming the environment, for example, water, air, soil, plants or animals;
- No nuisance through noise or odours;
- No adverse effect on the countryside or places of special interest.

Insufficient waste collection and insufficient coverage of waste collection systems associated to lack of access roads and insufficient waste collection facilities seen as part of the problems of waste management in developing countries have resulted in the creation of central waste collection points (CWCPs) as a strategy. For example, more than half of the Nigerian population has no access to waste collection which might be as a result of improper planning (housing plan). Unlike the developed nations, waste management is not best practice as a preferred concept of handling waste.

#### **3.4.3.1 Central Waste Collection Points (CWCPs)**

In areas where access is constrained, waste from households is brought to a central collection point sometimes called communal collection facility or bring bank (Ezeah, 2009). A CWCP may be a portion of land assigned by the authority, a skip, a purpose-built structure, or metal drums (in the case of Minna). CWCPs, as the name implies, are centrally located for easy access to the waste collectors and those using them to deposit waste. The waste collectors (government or private) go to the CWCP on set days to empty the facility. However, in most cases, CWCPs or communal collection points are strategically positioned for residents to access. Therefore, CWCPs are not to be located too far away from residential areas as this would deter people from carrying their waste to these sites which might encourage the creation of UWDSs or waste burning.

#### **3.4.3.2 Unofficial Waste Disposal Sites (UWDSs)**

UWDSs are unregistered and unregulated sites used by residents for disposal of waste predominantly within residential areas. Al-Khatib (2007) posits that some developing countries have acknowledged the threat of UWDSs on human health and the environment which gives rise to some growing concern on researching for better ways of handling and treating waste (waste management) to reduce or minimise the effects. UWDSs are often unrecorded (Adeoye et al., 2011) and distributed indiscriminately, irrespective of the presence of infrastructural facilities available in those locations (Benedine et al., 2011). The proximity of these disposal sites to residential areas poses a severe threat to the public and is socially unacceptable as it does little or nothing to protect the environment and public health (McDougall, 2008). In most cases, informal sector participation in urban solid waste management (unregistered, unregulated or casual activities carried out by individuals or family or community enterprises) (Afon 2007)) encourages the creation of UWDSs. This is because these activities are also not monitored.

In addition, weak environmental policy and regulations may encourage UWDS formation (Afon 2007). Lederer, (2015) adds that lack of stakeholders' commitment,

coupled with the limited financial resources to select an appropriate technology for a more controlled site, can also contribute to the creation of UWDSs.

### 3.5. INTEGRATED SUSTAINABLE WASTE MANAGEMENT MODEL (ISWMM)

The fundamental concept of ISWM acknowledges the importance of three key areas. These areas are the attitudinal elements or 'lenses' through which the system is analysed; the stakeholders that have interests in waste management and their roles and the elements or operations of waste creation (ISSOWAMA Consortium, 2009; Scheinberg et al., 2010).

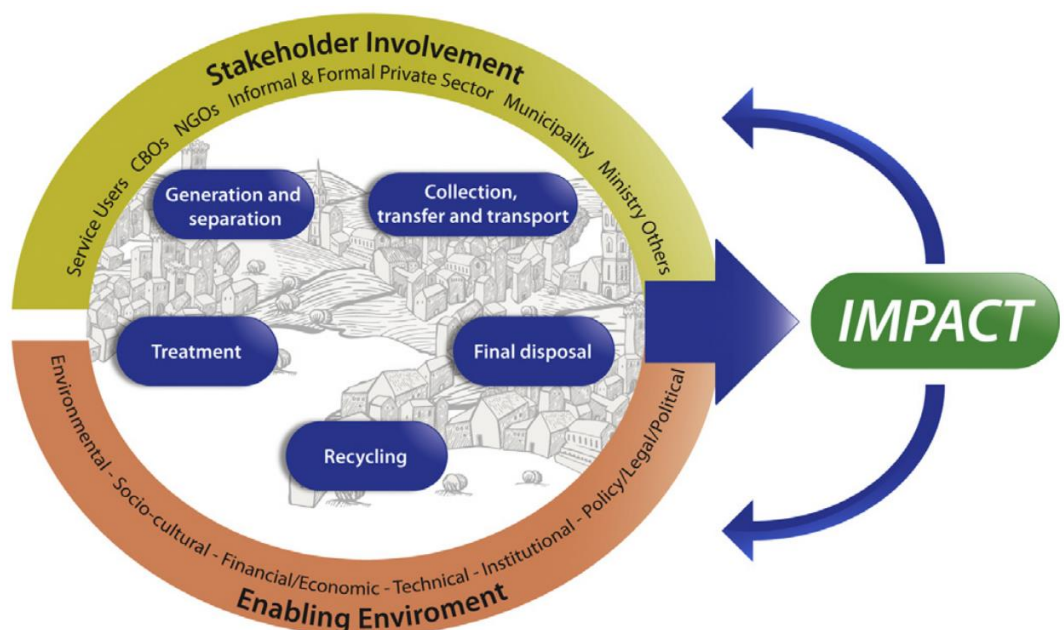


Figure 3.6: Integrated Sustainable Waste Management Model (ISSOWAMA Consortium, 2009; Guerrero et al., 2013).

The first area of the model focuses on the attitude of individuals and the factors that are influencing the creation of UWDS. In understanding the attitudes of individuals towards the creation of UWDS, the existing systems that influence the creation of UWDS are considered. Similarly, the second area of the model is designed to examine the roles of stakeholders in waste management (including managing UWDSs) and the extent to which existing policies are being implemented by stakeholders responsible for the management of waste disposal sites. In the same vein, the third area of the model focused on what elements or operations processes lead to the creation of UWDSs.

### **3.5.1. Public attitudes towards waste management**

Previous studies (e.g. Lougheed et al., 2016; Wilson, et al., 2013; Desa et al., 2011; Kapoor, 2009) show that effective management of the environment in urban areas is dependent on the willingness of residents to change their attitude and inculcate behaviour related to maintaining a cleaner environment. Kapoor (2009) identifies that dumping of waste materials is more dependent on human factors than other indicated factors (e.g. overpopulation, lack of resources and facilities). Recently, Lougheed et al. (2016) suggest that waste management practices are directly related to existing attitudes and the behavioural tendencies of individuals that utilise the immediate environment and public spaces for waste disposal. Indeed, Wilson et al. (2013) substantiate Lougheed et al. (2016) findings and concluded that a change in people's attitude is much more important than implementation and enforcement of waste management policies and regulations in developing countries.

Collectively, a clear and in-depth understanding of an individual's attitudes to waste management to provide effective waste management in urban areas of developing countries is important. Marshall and Farahbakhsh (2013) note the "not in my backyard" (NIMBY) attitude of residents in Nairobi. Disposing of waste in trenches and along roadsides is one of the waste management challenges in Kenya. This attitude of residents creates the perception that waste management is the responsibility of the government and its agencies. In some cases, this attitude is held by the businesses and public organisations who perceive that paying their property rent and charges is enough and therefore waste should be left in public spaces and unofficial disposal sites for environmental management agencies to clear (Ngau & Kahiu, 2009). This perception has not only influenced the amount of waste generation in cities of developing countries but also encourages the culture that waste disposal and management is a governmental responsibility.

### **3.5.2 Roles of stakeholders in waste management**

The roles of stakeholders in managing waste are multifaceted depending on their responsibilities in ensuring that efficient and effective decisions are made. Guerrero et

al. (2013) suggest that stakeholders can be characterised based on role capacities to improve waste management and participation in continuous urban planning activities. Andric et al. (2012) note that as waste in the cities is generated in different forms so are the activities of stakeholders with responsibilities for ensuring that cities are clean and tidy. Contreras et al. (2008) describe the roles of stakeholders as:

*"being spectators or recipients of impacts to becoming part of or involved in the important role of designing, implementing and promotion of the waste management systems"* (Contreras et al., (2008), which can be either affected positively or negatively by waste management decisions. Researchers (e.g. Guerrero et al., 2013; Okumu and Nyenje, 2011; Kurian, 2006) suggest that the roles and activities (such as waste collectors, waste processors, waste transporters, waste sorters) of stakeholders vary depending on their institutions which include: (i) government agencies, (ii) local authorities, (iii) private enterprises, (iv) non-governmental organizations, (v) civil society organizations and (vi) households/residential. There are also secondary stakeholders who influence waste management and include: formal and informal agencies, financing institutions, educational and research institutions, political parties, farmers, health care centres, media, donor organizations and religious organizations.

### **3.6 CONCEPTUALISING ISWMM IN MINNA**

Adoption of integrated sustainable waste management model (ISWMM) has been reviewed by previous studies (Tuladhar, 2010; Vaccari and di Bella, 2012; Wilson et al., 2013). Wilson et al. (2013) examine, using the theoretical lens of ISWMM, how cities in developing countries tackle their waste problems. Reviewing the concepts of ISWMM, Wilson et al. show that ISWMM had been used in examining both governance aspects (e.g. inclusiveness of stakeholders and institutions and their policies) and physical components (e.g. collection and disposal) of waste operations. The authors add that countries that adopted ISWMM have recorded significant improvement in their municipal waste management performance, which includes 95% of collection coverage and controlled disposal in middle-income residents. Also, their studies show that informal sectors have recorded 20-30% increase in their recycling rates at no direct cost

to their cities. They conclude with their research evidence that application of ISWMM can help in developing a practical framework in managing waste problems while incorporating local needs and conditions of service beneficiaries.

Waste management in Minna requires the concept of ISWMM that provides a suitable scope for a proper understanding of waste disposal drivers; Minna system of waste management operations and roles of stakeholders acting on the system. The ISWMM has it that integrated waste management, which is an approach to attain environmental effectiveness, provides a structure for designing and continuously improving the waste management system. ISWMM provides a practical conceptual approach for combining socio-economic and environmental benefits in managing waste issues in developing countries (McDougall et al., 2008) who suggest that application of ISWMM would require: data collection on waste operations, including the planning of collection and 'good data' on effective roles of stakeholders to implement effective waste management systems. The synthesis of these provides a picture as complete as possible of whole waste operation system in Minna to assess various management actions and decisions. On this note, the concept of ISWMM for managing UWDS is used to plan and improve waste management systems in Minna.

Morrissey and Browne (2004) suggest that a comprehensive conceptual model is essential for managing waste issues in complex systems that tend to depend on financial and policy criteria solely. Extending the concept of ISWMM can assist in analysing how findings of this research can be considered in addressing the unofficial waste disposal sites (UWDS) in Minna. In doing this, a theme for the model focuses on an effective waste management model that integrates knowledge from understanding the attitudinal factors that influence the creation of UWDS, the roles of stakeholders and answering the question of what operations processes lead to the creation of UWDS. Garnett and Cooper (2014) argue that as municipal waste management becomes increasingly complex, there is an increased need for a concept that can integrate empirical knowledge as well as a greater understanding of roles of stakeholders from the public and private sectors within a defined institution setting. Chang et al. (2011) indicate that past several decades have witnessed a similar approach where existing

systems assessment is synthesized into a system broad approach to yield a comprehensive, effective waste management framework.

It is a theme of the ISWM Model applied in this research as an integrated structure which includes all pictures of systems analysis of unofficial waste disposal in Minna to facilitate waste management improvements. Previous studies (e.g. Klang et al., 2006; Finnveden et al., 2013; Zurbrugg et al., 2014; Salvia et al., 2015; Li et al., 2015) emphasized the importance of waste system analysis for application or development of an effective waste management model. For instance, Salvia et al. (2015) examine waste management through municipal urban planning by investigating key components, including behavior changing measures and effective stakeholder engagements. Similarly, Li et al. (2015) assess waste management in China by integrating an assessment of environmental and social health management with an emphasis on exploring stakeholders' opinions. Although these studies successfully incorporate an understanding of attitudinal elements of the waste operators and their roles in design models for managing municipal wastes, research indicates that some of the existing studies that designed waste management models have failed to consider all relevant stakeholders (Morrissey and Browne, 2004; Allesch and Brunner, 2014). Yau (2012) acknowledge that although the government, in general, plays a vital role in managing municipal waste, being overly dependent on government actions is not enough to achieve effective waste management. Yau (2012) suggests that local government involvement through public stakeholder engagement can help to achieve sustainable municipal waste management. Joseph (2006) indicates that incorporating a clear understanding of how the waste management system works and an in-depth analysis of its priority needs would help to provide a comprehensive waste management model. However, some studies (Jeswani, 2010; Eriksson and Bisailon, 2011) suggest that currently, there is no 'one solution fits it all' way to develop and synthesize all key elements needed to provide robust waste management models. Therefore, it is important to identify the factors influencing the creation of UWDSS and address the need to strategize on how to manage UWDSSs within the current practice. Extending an integrated sustainable waste management model (ISWMM) would help in a way that

accounts for overall concerns of managing UWDSs in Minna. Prioritizing key stakeholders' involvement, thus enabling comprehensive options for better decision-making for waste management is required. Jeswani (2010) states that the structure of the waste management model is dependent on its requirements and specific socio-economic factors. Hence, drawing from these suggestions, adopting a model in here is underpinned by the integration of findings from multiple research methods that explores the perception of key stakeholders, and detailed analysis at all stages of this research.

### **3.7 SUMMARY**

There are issues of the rapid growth of population, urbanization, rural-urban migration, which lead to high generation of waste in developing nations. Uncontrolled open dumpsites remain the major waste management option in developing countries, and most of these sites are operated as unofficial waste disposal sites. Aside from the inadequate policies and regulations, and technical issues, solid waste management is also strongly influenced by political, legal, socio-cultural, environmental, economic factors and available resources. The absence of the basic waste management activities of waste collection and proper disposal in most developing countries contribute to the creation of UWDSs within residential areas of urban cities. Weak policies and regulations coupled with limited government budget on waste management. The consequence of this limited budget has resulted in frequent disposal of waste on nearby vacant plots which developed to UWDSs. However, there are three elements of ISWMM that have to do with attitude, stakeholders' role and the operational aspect of waste management which need to be studied and relate with to minimise the creation of UWDS in Minna and developing countries. Therefore, it is essential to understand the roles of stakeholders by exploring the perception of the individuals who are directly or indirectly involved in the creation and management of dumpsites; understand the interaction between the stakeholders, the urban systems they live in and policies that affect their interaction.



## CHAPTER FOUR: RESEARCH METHODOLOGY

### 4.1 INTRODUCTION

This chapter presents the research methodology and methods used in this study to achieve the aims and objectives. It explains adopted research strategies and paradigms that pertain to assumptions on how this research was carried out. Reasons for the choice of methodological approach are also explained considering the expected outcome of the research. The research design involved 5 key components/aspects: (i) literature review; (ii) establishing the geo-spatial distribution of waste disposal sites in Minna, Nigeria; (iii) assessment of the public perception of waste management in Minna, Nigeria; (iv) assessment of stakeholders role in creation and management of dumpsites (including UWDSs) in Minna, Nigeria; (v) use ISWMM to relate findings and make recommendations and interventions for effective management of UWDSs within a formal management strategy.

Drawing from suggestions of Denzin and Lincoln (2011) and Creswell (2013), a concurrent design (see figure 4.1) was used in this study for data collection and analysis activities. Both quantitative, qualitative and geospatial data collection (survey – residents, interviews- stakeholders, and geo-spatial mapping-waste disposal sites mapping through field visits) were conducted simultaneously as it involves different participants. The concurrent research design was considered appropriate as it provides a systematic link to answering the research questions whilst achieving the research aim and objectives (section 1.2).

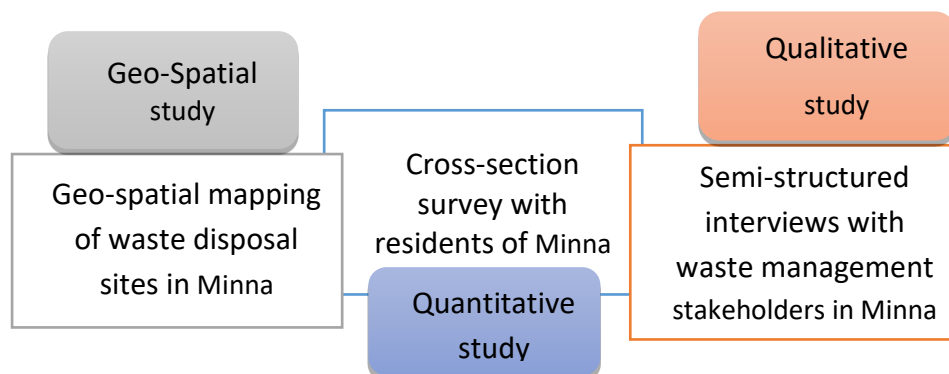


Figure 4.1: Concurrent study employ.

## 4.2 RESEARCH DESIGN

The process of research design often includes anticipating all phases of research in such a way that control is achieved (Blaikie, 2009). The research design for this study is a combination of both descriptive and explanatory elements. All research methods, strategies and processes were approached to investigate the 'factors that lead to the development of UWDSs' which answer the 'Where', 'What', 'Why', and 'How' questions (Thabane et al., 2010; Leiter and Maslach, 2003). The 'where' questions required answers that described the location and status of something (Blaikie, 2019). The 'what' questions required answers that described the state of a concept (Blaikie, 2019). For example, this research intends to answer the following 'what' questions which are concerned with knowledge: (i) what are the factors that lead to the development of UWDSs in developing countries? (ii) what is the public perception of the current waste management practice in Minna? and (iii) what is the role of the stakeholders in the creation and management of UWDSs in Minna? The 'where' questions are concerned with the location of sites and amenities. The why and how questions are linked to ISWMM and the types of interventions.

According to Creswell (2013), informing the research decision taken should be a philosophical assumption which, the researcher carries through the research design (inquiry procedures), methods of data collection, analysis and interpretation (figure 4.2). Therefore, the adopted research design in this study serves as a framework that directs how each stage has been conducted from the research aims and objective (section 1.2) to the concluding chapter (chapter 8).

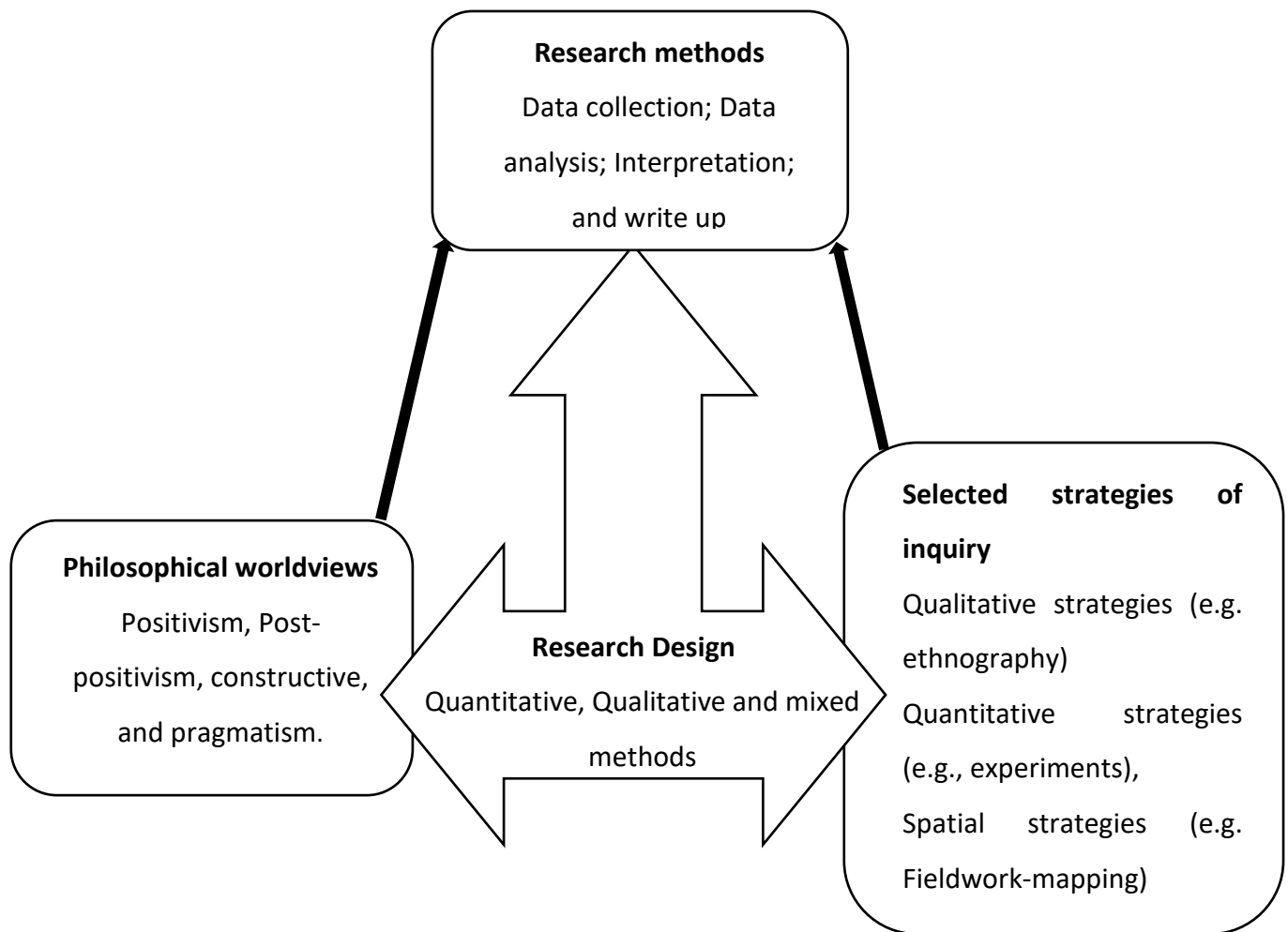


Figure 4.2: A framework of research design (Creswell 2013)

#### 4.2.1 Interpretive Paradigm

The pragmatic viewpoint in this study is a useful foundation that helps to gain an insight into unofficial waste disposal sites creation and their management. The fundamental philosophical assumptions of this research derive from the pragmatic paradigm. The four sets of philosophical assumptions that are most relevant to defining a paradigm in a research context which includes Axiology, Ontology, Epistemology, and Methodology are described in figure 4.3 and table 4.1. However, Bahari (2010) believes that the research philosophy involves thinking about epistemology and ontology which have important distinctions that will affect the methods in which a researcher thinks about the research process. Ontology on the other hand is associated with post-positivism (the one reality that can be known within a level of probability) and constructivism (the

multiple, socially constructed realities) provided for some debates in the research world (Mertens 2010; Creswell, 2013; Denzin and Lincoln, 2011).

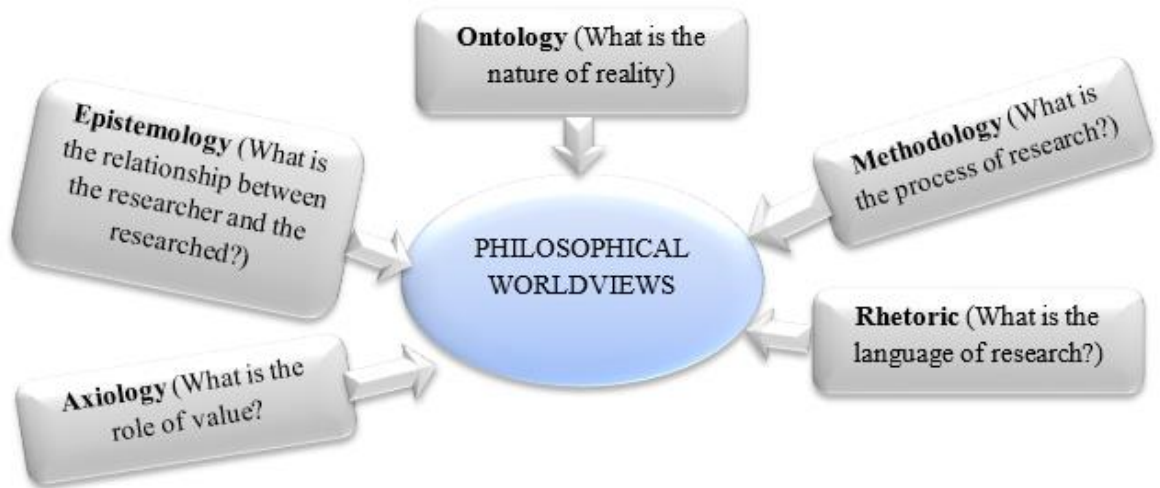


Figure 4.3: Philosophical paradigm (Mertens 2007)

Table 4.1: Philosophical paradigm

**Axiology: assumptions about ethics**

**Ethical considerations include respect for cultural norms of interaction; beneficence is**

**defined in terms of the promotion of human rights and increase in social justice.**

<b>Ontology: assumption about the nature of what exists; what is the reality</b>	Rejects cultural relativism and recognizes the influence of privilege in sensing what is real and consequences of accepting versions of reality. Multiple realities are shaped by social, political, cultural, economic, ethic, gender, disability and other values.
<b>Epistemology: assumptions about the nature of knowledge and the relationship between the researcher/evaluator and the stakeholders needed to achieve accurate knowledge</b>	The interactive link between researcher/evaluator and participants/co-researchers/ evaluators; knowledge is socially and historically situated; power and privilege are explicitly addressed; the development of a trusting relationship is critical.
<b>Methodology: assumptions about appropriate methods of systematic inquiry</b>	Inclusion of qualitative methods (dialogic) are critical; quantitative and mixed methods can be used; interactive link between the researcher/evaluator and participants in the definition of the focus and questions; methods would be adjusted to accommodate cultural complexity; power issues would be explicitly addressed; and contextual and historical factors are acknowledged, especially as they relate to discrimination and oppression.

Source: (Mertens 2007)

The reality of poor economic, social, political, etc. has contributed to the development of UWDSs and rendered the achievement of sustainable waste management difficult. As established in the literature (chapter 3), scholars refer to UWDSs as ‘indiscriminate

dumping of waste'. However, they are far beyond that, but heaps of unregistered and unregulated waste disposal sites are ignored by decision-makers. This, however, has resulted in the idea to be interpreted differently (multiple realities) by different stakeholders who include waste management authorities (e.g. waste managers, policy formulators and regulators, etc.), scavengers, and the public waste generators. For example, poor working relationships and poor communication among stakeholders result in working in isolation which renders some stakeholders being redundant and turn some to 'mini-gods'. 'Mini-gods' means that they have the final say and no one can challenge their decisions – being in charge or having control over all.

In respect to an epistemological approach (nature of knowledge), this research assumes that reality is achievable through effective communication and interaction between the waste management stakeholders and the public e.g. community leaders as community participation (Kassim and Ali, 2006) as discussed in subsequent chapters. Therefore, this research used the pragmatic world view considering that this will allow the use of different research methods to address the research problems in this study (section 1.2).

### **4.3 RESEARCH APPROACH**

According to Creswell and Plano-Clark (2011), four different paradigms are likely to guide mixed methods research: post positivism, constructivism, pragmatism and the participatory pragmatism (Creswell and Plano-Clark, 2011). A post-positivist world view is commonly associated with quantitative research while a constructivist world view is associated with qualitative research (Creswell and Plano-Clark 2011; Doyle et al., 2009). A combination of paradigms is used in mixed method research as suggested by Creswell and Plano-Clark (2011). Therefore, the choice of a philosophical standpoint depends on the kind/ nature of the work involved.

The epistemological and ontological assumptions for this research demand an approach that can capture adequate information. This could be aided by a quantitative approach because quantitative research provides a description of trends, attitudes, practices, or opinion of a population by studying a sample and making generalisations or claims about the population (Creswell, 2009). In addition, the quantitative study is associated with

the rational and objective measurement of observable phenomena (Ashley and Boyd, 2006). To assess and identified the socio-economic factors influencing the creation of UWDSs, public perception and attitudes in Minna were investigated. This was linked to waste collection from householders (where they existed) and the number of central waste collection points and unofficial waste disposal sites.

As well as collecting quantitative data from the Minna residents; this study also collected qualitative data. The qualitative research focused on understanding the meaning people had constructed for things to make sense of their world and their experiences. (Merriam, 2009). Denzin and Lincoln (2011) see qualitative research based on data collection as:

“interpretive, material practice designed to transform the world into a series of representations that include interviews, photographs, field notes, conversation, memos, and recordings to make the world visible”.

In addition, the phenomenon from the participant perspective, the meaning and interpretations of the participant based on their experiences is often the focus of qualitative researchers (Creswell 2013; Denzin and Lincoln, 2011). Therefore, this qualitative research approach is directed towards understanding subjective experience and practice.

Creswell (2013) identified five approaches to a qualitative inquiry which include Narrative, grounded theory, Ethnography, Phenomenology and Case study. In the case study approach, the researchers conduct a real-life in-depth study of a case (small group of persons, organizations or an individual) or multiple cases through observations, interviews, reports, documents and other sources (Creswell, 2013). The cases being investigated is the unit of analysis in a case study research. Cases are studied in their natural settings which result in an in-depth understanding of the case(s) (Creswell, 2013). Therefore, bearing in mind that this research intends to study waste management practice and to investigate the factors that lead to the development of UWDSs, a case study approach was employed as this could sufficiently address the research aims.

Finally, apart from collecting quantitative and qualitative data (public survey and semi-structured interviews), this study collected geospatial data. Li et al., (2005) suggest that a combination of GPS and GIS provide the researcher with the internal capability for rapid and effective site characterization, which is typically utilized in environmental management to monitor and control adverse environmental impacts. To establish the geo-spatial distribution of all waste disposal locations in Minna, these were mapped, and their relative sizes calculated. This was achieved through site visits where a Garmin 76 handheld GPS receiver was used to record the location of the waste sites. The footprint (extent) of the unofficial waste sites was recorded using four points at the further limits of the site (figure 4.4) as determined using the criteria for the boundaries of UWDS. The yellow point indicates an appropriate start point to map for accurate size, while the red point indicates inappropriate as it is transient. In contrast, the official CWCPs which comprised of collection bins were only recorded as a single point as these comprised of one, two or three bins. To ensure that all waste disposal sites, both official and unofficial, were identified and recorded, residents were interviewed. This allowed the determination of location as well as relevant historical data (e.g. how long it has been in use) associated with the site.





Figure 4.4: UWDS measurement for accurate size (Yellow defined edge of UWDS and Red littering/transient zone and not part of UWDS) (Author, April 2017)

This combination of all approaches (quantitative, qualitative and geospatial approach) provided a more robust research outcome than the constituent methods could offer in isolation (Morgan, 1998; Denzin and Lincoln, 2011). Therefore, a mixed-methods approach was found appropriate for this study.

#### **4.4 THEORETICAL LENSES OF ISWMM**

Literatures reviewed expatiate on the fundamental concepts of this research, which involves waste management and the creation of dumpsites in developing countries. The literature review provided the basis for the research study to determine its nature. The literature reviewed helped in understanding the subject under investigation and the problems and identification of the research gap. Therefore, each component of the study was derived from the literature reviewed for the basis.

As described in section 4.2, the research design for this study is analysed basically through quantitative, qualitative and spatial methods. In research like this, in which descriptive and interpretive approaches are utilized, the researcher analyses, interprets and theorizes the investigating topic in relation to a model or framework. Therefore, the operational challenges with current waste management roles and practices in Minna were explored (drawn from findings in chapter five, six and seven) to understand which elements of ISWMM would be appropriate to relate and incorporate into the study to address the challenges.

A brief explanation of the strategies/process of each component of the study (stated in 4.1) to achieve the aims of this study are discussed below.

#### **4.6 PARTICIPANTS RECRUITMENT AND SAMPLING STRATEGY/PROCESS**

A public survey was carried out as part of the study; the residents were randomly selected across the ten waste collection districts (listed in chapter two) as key waste generators, to assess the public perception on current waste management practice in

Minna. The survey questions were focused on waste collection activities to identify the socio-economic factors influencing the creation of UWDSs in Minna.

Key stakeholders were carefully selected from the state government, state government agency and the local community leaders for in-depth interviews. These would determine their role in the creation and management of waste disposal sites in Minna (including UWDSs). Therefore, waste disposal sites in Minna were visited to determine their spatial distribution and proximity to residents.

#### **4.6.1 Geo-Spatial mapping process**

Vine et al. (1997) define GIS: “as a powerful mapping and analysis technology that allows large quantities of information to be viewed and analysed within the geographic context”.

GIS together with correct database and spectacular roles, can integrate data from different sources and carry out a detailed analysis, putting into consideration location variables and social and economic variables as importance (Parker and Campbell 1998). GIS as software can analyse environmental data, also specialize in assessment and mapping out areas that are exposed to environmental hazard (Briggs and Elliott 1994). It is used as a decision support tool, simplifying the search for suitable sites selections for specific purpose because it can extract and classify spatial features (Nakakawa and Ogao 2007). GIS was considered suitable for this study because, over the years, GIS has been used as a decision support tool for planning and modelling of various systems covering social, economic and technical aspects by coordination of complex spatial and non-spatial data (Akbari et al., 2008). Some developing countries such as Nigeria has little or no documentation about spatial variation of disease incidence as waterborne disease is a problem, but with the use of GIS techniques investigation was carried out on the spatial variation of waterborne disease in Ile-Ife, Nigeria which was a success and an achievement (Olajuyigbe et al., 2013). In 2010 Mahamid and Thawaba used GIS as a tool to aid a decision-making process in selection of a suitable landfill site that would have less impact on the environment and human health in Palestine. Therefore, GIS was

used in this study to establish the geo-spatial distribution of waste disposal sites (including UWDSs) in Minna.

The first step in the mapping exercise was to locate dumpsites, which further need to be categorised into UWDS, CWCP or Government-regulated landfill site. CWCP were identified with the support of NISEPA officials and were also recognised by the number of drums (2 and above) or a skip also known as bunker, while the government regulated site is situated in another community (Tayi Village) at the outskirts of Minna. Meanwhile, figure 4.5 presents the criteria for inclusion of UWDSs in the study as the length of time the UWDS has existed for (at least 5 years or more) and the size of the site (in terms of volume or density of waste pile). The length of time (identified during mapping from the residents around sites) was applicable where such information exists, but in the absence of such information, close observation of the size and activities on-site was made to be mapped as UWDS (based on volume or density of waste). Any UWDS less than 7 m<sup>2</sup> defined earlier by the boundary definition (section 4.3) was considered too small for inclusion - transient. This is because these sites were not used as the main disposal site for residential waste and may be removed after a short time. Transient or litter piles are scattered waste or small indiscriminate dumped waste that can easily be gathered together by local community members to remove or burned. It was therefore appropriate for the research to ensure that the sites mapped were more permanent so size (larger than 7 m<sup>2</sup>) and period of use (at least 5 years and above) were used. This avoided incorporating sites that may not be found after a few months. There were no standard shapes of most dumpsites; however, all were elevated above ground level. Since the dumpsites were all different, to determine the size of each one, a flowchart was used as shown in figure 4.5.

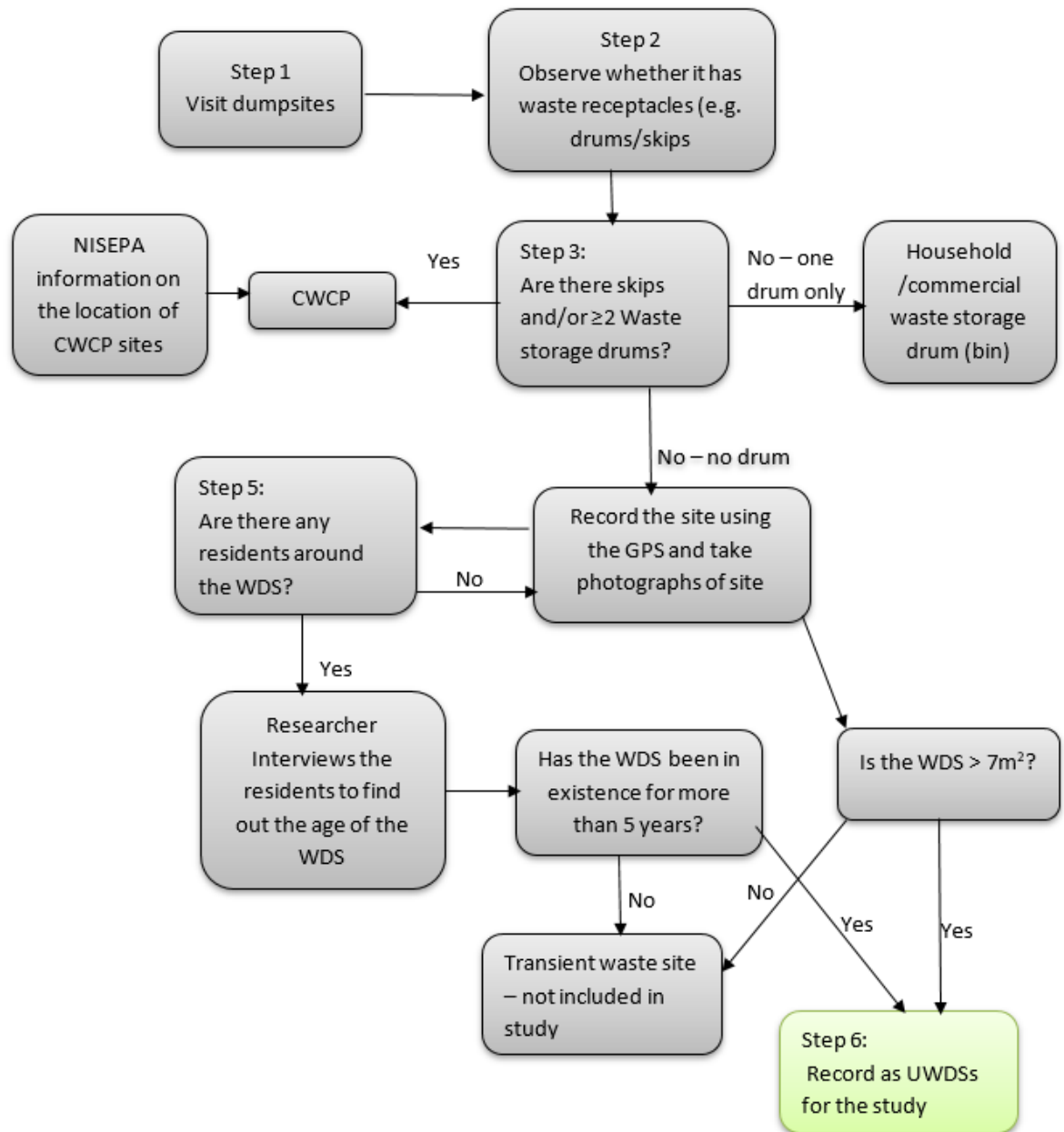


Figure 4.5: Procedures for identification of UWDSs

The data collection team included a representative from NISEPA who identified the officially recognised CWCPs as well as some known UWDSs. Also, the attributes of the UWDSs such as the approximate years it has been in existence were recorded along with their coordinate's values which were integrated into GIS software.

#### **4.6.1.1 Geospatial data analysis**

The coordinates of the dumpsites were plotted as points in Quantum GIS software (QGIS). The map was projected to the World Geodetic System (WGS 84) datum to enable the overlay of other data. The dumpsites' coordinates were joined to form polygon by which shapefile was created. The plotted dumpsites polygon vectors were converted to points (the centre of each site) to enable further analysis such as buffering to be done on them.

The waste collection districts (WCD) and road networks were digitised from the Minna google earth image of 2017 in QGIS based on the NISEPA description/list (the ten waste collection districts list). The ten districts were digitized and the attribute table (the names of each) created as well as applying different colours to distinguish each district.

Buffering is a zone created around a map feature measured in units of distance or time, which is useful for proximity analysis (Peng et al., 2003). Buffering in this study was employed to generate zones of a given distance (e.g. 100-200m, 200-300m, 300-400m and above 400m) around a feature (e.g. distance from a CWCP to the nearest UWDS) by locating its boundaries at a specified distance (as shown in figure 5.6a). This method was employed to establish proximity of the UWDSs to CWCPs and other relevant features (e.g. road networks) by creating rings around the site (in metres). The specified distances (e.g. 100-200m, 200-300m, etc.) were used considering walking time of a typical person with waste to an official site (CWCP). This analysis was considered important as it gives a better understanding of the potential reasons for the location of UWDSs. The spatial analysis was also used to help validate responses provided by residents as to why they dump their waste in UWDSs. Proximity analysis was undertaken to calculate the distance from UWDSs to access roads in the study area, and to determine the relationship between the distance from the road and the number of UWDSs.

Before performing both attribute and spatial query, the created shapefiles were overlaid in GIS. Overlaying spatial analysis operation in GIS is used for superimposing multiple layers of datasets representing different themes in a common coordinate

system together for analysing or identifying the relationship of each layer. The overlaid layers were waste collection districts, central waste collection points, unofficial waste disposal sites and road networks into the same database. Queries were carried out on the data to create new spatial data set such as the unofficial waste disposal sites that fall within or beyond a distance from the central waste collection points.

#### **4.6.2 Public survey strategy/process**

Researchers (e.g. Mueller-Wickop et al., 2013; Ambrose and Anstey (2010) critically outline the essentials of a good survey and make recommendations for best practice in designing a questionnaire and the administration. The questionnaire was designed for self or guided completion and worded to be brief, easy to read and understand; without bias or ambiguity (See appendix 1). The study utilizes a single cross-sectional survey design and a self-administered questionnaire in collecting data from the public (households) to explore public feelings, perspective, experience, motivations, attitudes, etc. on waste management in Minna. Bowling (2005) states the quality of data collection can be defined in terms of survey response rates, questionnaire item response rates, the accuracy of responses, absence of bias, and completeness of the information obtained from respondents. Therefore, for quality response rate, householders were randomly selected using a door-to-door sampling approach.

As stated in Thabane, et al. (2010) on the popular African proverb of the Ashanti people in Ghana that says, *“You never test the depth of a river with both feet”*. This is because the main target of pilot studies is to assess the quality of the data of the study to avoid potentially disastrous consequences of embarking on the large study, which could potentially impact the whole research effort (Thabane, et al. 2010). Although pilot studies can be time-consuming, frustrating, and fraught with unanticipated problems, it is advisable to deal with them before investing a great deal of time, money and effort in the full study as stated by Van Teijlingen et al. (2001). Approximately 10% of the questionnaire designed was pilot tested using the households in one district (1 out of ten districts) of the study area. This was done to clarify issues identified by the public before the full questionnaire study. The questionnaire pilot study was conducted in

Maitumbi district with 10 questionnaires. Maitumbi district was selected because it is one of the slum areas among others in Minna. The pilot was conducted to establish if questionnaires were well designed and able to gather all the required data (Thabane, et al., 2010; Van and Hundley 2002). Feedback provided by the respondents of the pilot survey led to some questions being reframed leading to a reduction of the time to complete the questionnaire from 10 minutes to 7 minutes and 250 copies were sent to the field for the main survey (See appendix 1 for survey questions).

The final questionnaire survey was administered to randomly selected householders (n = 250) of Minna residents using a direct door stepping administration approach within the 10 districts (n = 25 questionnaires per district) of Minna. A simple random sampling was carried out to select 25 participants in each district to ensure proportional representation of the respondents from the ten districts within the city. This proportion of 234 residents in Minna accounts for 0.1% of the total population of Minna (that was estimated at approximately 300,000 residents in 2015 by the Population). The case study description and population are discussed in the descriptive chapter (chapter 2 of this thesis). The questionnaire was designed for household only in the study area, and few or none have internet access; coupled with the poor postal services in Nigeria, the use of a direct door stepping questionnaire administration approach was employed (Read et al., 2009). However, the research team hired assistants (5 final year student from Federal University of Minna) who were familiar with the environment to assist in the administration of the questionnaire to the local communities within the ten NISEPA districts in the study area. A total of 234 surveys were completed and returned to the researcher for analysis which gave the required spread over each district.

#### ***4.6.2.1 Public Survey Data Analysis***

Data generated from the questionnaire was analysed using Bristol Online Survey (BOS). To assist with analysis, the paper versions of the survey were transferred to the Bristol Online Survey (BOS) program. A descriptive statistic is used to describe the important characteristics of the participants and their responses. Demographic characteristics (e.g. age, academic qualifications, etc.) of questionnaire participants were generated and

examined in relation to their attitudes and perceptions in managing dumpsites in Minna. The characteristics were analysed to extract and interpret descriptive patterns and inferential statistics between demographic variables. In doing this, frequency analysis such as central tendency was drawn for the descriptive statistics. In addition, cross-tabulation was also applied to contrast commonalities and differences of how attitudes and perception of participants vary across their characteristic demographics and variables.

#### **4.6.3 Stakeholders interviews**

##### ***4.6.3.1 Stakeholder identification***

In this qualitative research element, a “Snowball Sampling Approach” for finding research subjects (stakeholders) was employed. The snowball approach involved initial identification of one subject who in turn gave the researcher the name of another subject, who in turn provides the name of a third, and so on until data saturation was achieved (Sadle et al., 2010; Atkinson and Flint, 2001; Sandelowski, 1995). The recruitment of stakeholders included identifying participants from waste management authorities.

Identification of stakeholders commenced with the State Ministry of Environment (Niger State Ministry of Environment) who are the policy formulators and are involved in managing waste in Minna. The Ministry was requested to identify other subjects that are relevant to the study and this referral system continued until data saturation was achieved. The stakeholders recruited for this study include State Government Ministry (n=2), State Government Agency (n=3), Private Contractors (n=3), Community leaders (n= 3) and scavengers/landfill guard (n=2). The stakeholders identified were considered suitable participants for the study because they are involved in waste management practices in Minna.

There are no specific procedures for determining sample size in a qualitative study (Patton 2015). Sample sizes are usually between 4 and 40 participations (Holloway and Wheeler, 2010), who add that a sample size of 6-8 and 14-20 may be adequate for



homogenous and heterogeneous groups respectively. Between 12 and 14 participants recruited for interviews is considered data saturation based on the experience of the interviewees and scope of research problem under study (Holloway and Wheeler 2010). A total of 13 stakeholders took part in the study. All the identified stakeholders are approached with an introductory letter (written by supervisors), introducing the researcher and the study purpose. Acceptance letters were returned to the researcher showing interest and giving assurances of participation. The key stakeholders were further contacted via emails and telephone to arrange for an interview on a convenient date and time chosen by the participant. All interviewees were provided with a participant information sheet and consent form for approval. Therefore, recruitment of participants in this study continued until a total of 13 participants were recruited.

#### ***4.6.3.2 Semi-structured interview***

Draft interview questions were designed based on literature, policy and regulation documents obtained from the Niger State Ministry of Environment and National Environment Regulation and Enforcement Agency (NESREA) Minna branch. The interview questions were piloted with supervisors (Dr Karl Williams through the telephone while Dr Chris Lowe face to face) and a selected number of stakeholders in Minna. A final set of interview questions was produced, and participants were interviewed for approximately 45 minutes to an hour dependent on responses.

A semi-structured interview was conducted to obtain in-depth information on waste management practice in Minna from the participants with a focus on the creation and management of UWDSs. The study employed telephone and face-to-face meetings to enable the interviewing of a range of participants in the city at their pace of time. However, semi-structured interviews often contain open-end questions and discussions which may diverge from the interview guide. Therefore, it is generally best to audio-record interviews and later transcribe these records for analysis because it is difficult to focus on conducting an interview and jotting notes (Turner III, 2010). The semi-structured interviews were conducted using prepared questions (see appendix 2). On certain occasions, note taking and audio/tape recording were simultaneously carried

out during the interviews. In cases where the interviewees could not express themselves in English, the researcher used the local language, local vernacular and Hausa language to communicate which was then translated to English during transcription.

Three different interview guides were used in the study to ensure that participants were interviewed in accordance with their experience and role. The draft interview guide for the qualitative study was designed based on literature, policy and regulation documents received from policy formulators (State Ministry of Environment) and agency (National Environmental Standard and Regulation Enforcement Agency - NESREA, Minna chapter) on environmental sanitation. This was designed for state government ministry; state government agency (ies) and community leaders as stakeholders involved in managing waste in Minna. Interview guides designed for each group of participants were around the following areas: Organizational role in waste management; Policy and regulations pertaining to waste management; Waste collection and disposal activities; Formation of unofficial and official waste disposal sites; and general views from the participant based on the waste management system in Minna.

At the stage when a participant agreed to take part in the study, arrangements were made for the interview which was by telephone or face-to-face. An in-depth semi-structured interview was conducted with the Participant from January to April 2017. At the beginning of each interview, a relaxed atmosphere is created for the interview by engaging with the participant in an informal discussion briefly. Even though, an introductory letter and information sheet were sent to the participants before time to be aware of what the interview entails, and the confidentiality handling of any information obtained from them, the participant were still reminded of the purpose of the interview, how long the interview was expected to last and assured of confidentiality at the start of the interview. However, all the identified stakeholders are approached with an introductory letter, introducing the researcher and the study purpose.

Acceptance letters were returned to the researcher showing interest and giving assurances of participation before arrangements were made for the interview. The

participants were asked if the interview should be recorded and none of them objected to recording their interview. Some of the interviews (5 participants) were conducted face to face during the geo-spatial mapping exercise that took place from March to May 2017. Since the study employed a snowball approach, the researcher was accompanied by waste management authority (referrer) to some of the community leaders' residents/office for the interview to be conducted for security reasons. Interestingly, some of the participants (e.g. Community leaders, scavengers, etc.) had issues with speaking English, hence the local dialect was used for the interview, but the researcher luckily understood the language of the participants and there was no need for an interpreter except for one participant (community leader). Therefore, all interviews were recorded using an audio digital recording device alongside with Samsung telephone recorders for backup.

All interviews were scheduled to be completed within an hour (maximum duration). Where this was exceeded, permission was sought from participants to continue the interview and they could freely accept or decline to continue the interview, although only a couple of interviews exceeded an hour. Gratitude was shown at the end of each interview by the researcher to the participants for their time and contributions (information) made in the study. The duration of the conducted interview was between 20 minutes to 65 minutes. At the beginning of this study (design stage), it was anticipated that about 10 interviews would be enough to reach data saturation. However, 13 participants participated in the interview conducted. It is of no doubt that data saturation was achieved when further interviews did not yield any new information, and this was perceived at about the 9<sup>th</sup> interview. Meanwhile, the interview with the remaining participant continued as they have previously agreed to be interviewed. All interviews were recorded and transcribed verbatim before analysis using Nvivo 11 to facilitate data management and analysis.

#### ***4.6.3.3 Semi-structured interview data analysis***

The data collected during the interview is analysed and thematically coded using N-Vivo 11 software. The rationale for choosing this method of analysis is because it has been

established among studies of a similar nature thereby helping ensure that the analyses will be repetitive, reliable and valid. Ritchie et al. (2003) recommended three key stages of interviews analysis as qualitative data analysis: data management, descriptive accounts and explanatory accounts, which are further broken down into four iterative or linear processes in this study;

- i. Transcription,
- ii. Coding or indexing,
- iii. Identification of common themes,
- iv. Generalize from the themes about the phenomenon in question and interpret findings.

Drawing from Ritchie's (2003) recommendation, first, the researcher carried out interviews and transcriptions simultaneously which enabled the researcher to become familiar with collated data. Secondly, the next process was identifying themes and concepts as they arose from the transcripts, which Fereday and Muir-Cochrane (2008) referred to as thematic analysis. As it was done in this study, the thematic analysis employed in the data analysis adopted template styles which were carried out through manual and software-based coding – Nvivo 11.

Thematic analysis approach enables the researcher to populate the list of codes linked to levels of themes, which was based on research questions and objectives. Specifically, the coding of themes was underpinned by the integrated waste management model. For instance, the interviewees names and their organisation names were coded. This was done to ensure the confidentiality of the participants, their organisation, roles and information.

The participant identity was coded for confidentiality which will emerge with themes based as they relate to research questions and constructs of a theoretical model. Each of the participants was labelled with codes to link their response to themes and codes. The researcher identified common themes and linked them with responses coded from participants and linked to research questions. As each interviewee was expected to respond to all research questions, the research questions were populated in a tabular form showing key themes that were linked to respective interviewees. In doing this, the

frequency of the themes, how they occur and how they differ across respective interviewees were mapped and analyzed. See table 4.2 below showing nodes of themes with their respective source and number of times the nodes are referenced from the transcripts.

Table 4.2: Nodes showing transcripts themes (Stakeholders interview analysis on nvivo)

Nodes			
Name	Sources	References	
Barriers to effective waste management		7	21
Challenges of waste management in Minna		11	86
Lack of planning and structure		7	11
Collaboration among stakeholders		11	115
Benefit of collaboration among stakeholders		6	13
community engagement		4	14
Factors that hinder effective collaboration among stakeholders		7	12
Lack of Public Involvement		4	6
Lack of stakeholders involvement		5	10
Roles of stakeholders in waste management		7	26
Stakeholders contribution to improve WM		7	18
Corruption		3	8
Politics, Economics and Social cultural diversities		6	14
Equipments and Facilities		8	28
insufficient Equipment and Facilities		4	10
Source of Equipment		4	6
Factors that lead to development of unofficial waste disposal		7	43
Strategies to Mitigate unofficial WDS		5	16
Monitoring and Maintenance		9	39
Records of WMA		4	9
NISEPA grouping of Minna to districts		1	1
NISEPA routes for waste collection		0	0
Policies and regulations		9	31
Involvement in Policy Making		3	3
Policy implementation		2	5
Weak policies and regulations		5	8
Public Complaints		7	21

Public Education and Awareness on Waste Management		8	41
Lack of awareness		3	4
Public education and awareness		6	20
Public Ignorance		5	11
Resources		7	28
Funding		3	6
Insufficient resources		5	10
Lack of funding		4	11
Stakeholders involved in waste management Minna		3	7
Community leaders in Minna		0	0
Contractor 1		0	0
Contractor 2		0	0
Contractor 3		0	0
NESREA		0	0
NISEPA		0	0
State Ministry of Environment		0	0
Success factors of waste management in Minna		6	36
Planning and Strategies		6	19
Waste disposal site selection		5	25
Factors for siting waste disposal facility		1	1
Inappropriate siting of waste facility		4	11
Rationale for choosing a WDF		1	1
Waste management collection and disposal practices		12	159
Accessibility to Waste		6	11
Factors that influence effective waste collection servic		0	0

<input type="radio"/>	Accessibility to Waste		6	11
<input type="radio"/>	Factors that influence effective waste collection servic		0	0
<input type="radio"/>	Informal waste collector's activities		1	2
<input type="radio"/>	Poor waste collection services		2	2
<input type="radio"/>	Poor waste disposal practice		9	19
<input type="radio"/>	Public attitude to waste disposal		8	18
<input type="radio"/>	Scavengers Activities		4	7
<input type="radio"/>	Waste collection charges		6	15
<input type="radio"/>	Waste treatment		2	4
<input type="radio"/>	Waste Management in Minna		9	26
<input type="radio"/>	Waste management Personel		7	19
<input type="radio"/>	Contracts and agreements		3	5
<input type="radio"/>	Criteria for staff salary		3	7
<input type="radio"/>	Staff recruitment		2	4
<input type="radio"/>	Staff training		0	0

In some cases, where themes were not related to research questions, such themes were considered separately. The final phase involved assigning meaning to themes and cross-referencing between the research questions and emerging codes. This underpins the scope of the research interpretation.

#### 4.7 CONCEPTUALIZING THE RESEARCH FINDINGS

This is done by examining the research findings to determine what aspect of ISWMM would be most effective at enhancing better decision-making in managing UWDSs in Minna. Extending the scope of ISWMM is to facilitate the understanding and management of UWDSs and addresses all aspects of waste management challenges, including both attitudinal, operational, and socio-economic aspects, such as policy and enforcement measures and regulations. Existing leading stakeholders and waste management practices in Minna, particularly the roles and practices of NISEPA, were reviewed and examined to determine what aspects of their roles need improvement. Next, existing waste operations that lead to the creation of UWDSs were examined to determine their impacts and dysfunctionalities. However, addressing their dysfunctionalities was a key focus for the model (ISWMM) application. Also, operational challenges with current waste management roles and practices in Minna were explored



and considered (drawn from findings discussed in chapter five, six and seven) to understand which elements (of ISWMM) would be appropriate to incorporate into addressing the challenges.

#### **4.8 ETHICS**

Ethical approval for this study was sought from the UCLan Science, Technology, Engineering, Medicine and Health (STEMH) Ethics committee, which was granted for the period of five years (See appendix 3). The ethics were approved by STEMH for the study to be conducted on the bases that participants are not exposed to any risk and are directly involved in managing waste in the study area.

Participants were provided with a Participant Information Sheet outlining the research aim and significance; implication for participating in the research; and how data will be handled. Participant confidentiality was explained in the information sheet and also discussed with participants prior to their participation in the study. Participants who agreed to take part in the study were provided with a consent form and a signed written consent obtained (acceptance letter). Consent forms were sent in advance to those participants who were interviewed over the telephone to sign and return, while those participants whose interviews were conducted face-to-face signed at the beginning of the interview. None of the participants objected to the content of the consent form or withdrew their consent. All information collected including digitalised interview transcripts was made anonymous and stored in a password protected drive of the University network. To maintain anonymity codes were assigned to all participants. All paper documents related to this research including interview transcripts and consent forms were handled confidentially and kept under lock and key.

In line with the University of Central Lancashire policy, a risk assessment was carried out before the start of the study. The risk to participants related to breach of confidentiality, data security and anonymity. In minimising risk to the researcher, all data collection was to be conducted during the day time and not in hidden areas.

## **CHAPTER FIVE: GEO-SPATIAL DISTRIBUTION AND DESCRIPTION OF WASTE DISPOSAL SITES IN MINNA**

### **5.1. INTRODUCTION**

This chapter addresses one of the primary objectives of this research which is to establish the geo-spatial distribution of waste disposal sites (including UWDSs and CWCPs) and continue to explore the factors influencing their location in Minna.

Drawing from previous studies reviewed in chapter three, the Integrated Sustainable Waste Management Model (ISWMM) suggests that environmental and socio-economic factors influence the distribution of waste disposal sites. This chapter focuses on the environmental themes which include the nature of the dumpsites, their location and distance of dumpsites from primary, secondary and tertiary roads. Prioritising the relevance of these factors helps to provide a thorough understanding of their influence on the distribution of dumpsites across the ten waste collection districts within the two Local Government Areas of Minna.

The data collected on the waste disposal sites includes the following variables: size in square metres, waste composition (by observation), features (e.g. road networks), age (where it was possible to determine), and classification of sites as either CWCP or UWDS. Also, detailed photographic records were obtained for almost all of the sites.

### **5.2 GEO-SPATIAL DISTRIBUTION OF WASTE DISPOSAL SITES IN DISTRICTS OF MINNA**

The two local government areas in Minna viz. Chanchaga and Bosso, are divided into ten waste collection districts by the Niger State Environmental Agency to ease the administration of waste management operations and services. Chanchaga consists of six waste collection districts, while Bosso comprises of four waste collection districts. The classification of the ten waste collection districts and how the districts are interlinked with the two local governments are depicted in figure 5.1. A full description of these districts is provided in chapter two of this thesis.

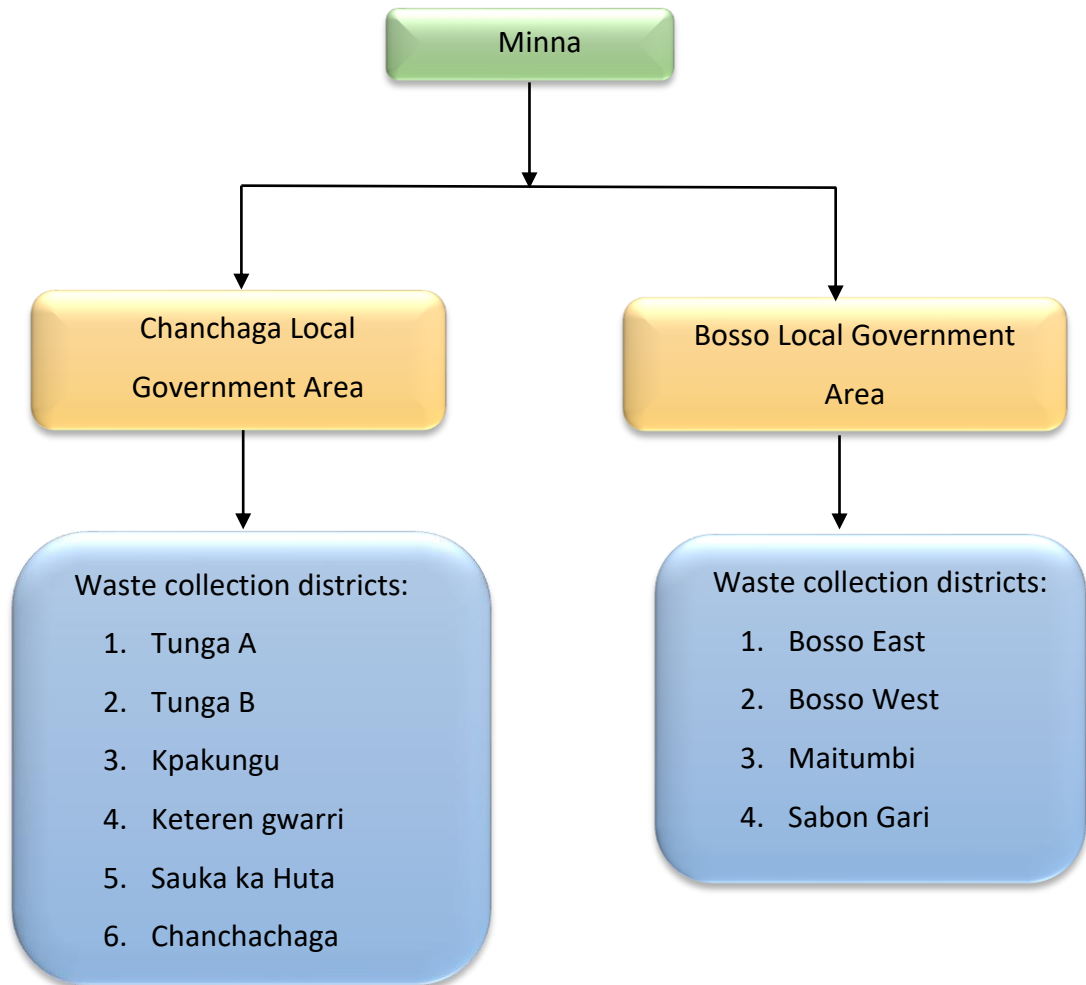


Figure 5.1: Local government areas and waste collection districts

In total, 186 waste disposal sites were identified across the ten waste collection districts, comprising 141 UWDSs and 45 CWCPs. The geo-spatial mapping methodology and criteria used for identifying and locating both UWDS and CWCPs as well as a description of “typical” CWCPs with an average of three stationary waste drums (shown in figure 5.2) or a skip also known as bunker are described in Chapter Four.



Figure 5.2: CWCPs sited along the primary and secondary roads (Author, May 2017)

### 5.2.1 General Description of UWDSs/CWCPs

Figure 5.3 illustrates the mixed waste composition of a typical UWDS containing both household and commercial waste. There were cases where gutters, railway tracks, and streams in the proximity of UWDSs were also used for disposal of waste, particularly in residential areas and social centres (e.g. schools, mosques, and shopping malls). Animals grazing were a common observation on most UWDSs across districts, due to the high amount of discarded organic (mostly vegetable) matter in the waste. At some sites, abandoned/unfinished buildings were converted to UWDSs (figure 5.3D). In most cases, it was observed that the UWDSs were patronised by ‘informal waste collectors’ (individuals or groups of people who offer waste collection services to residents), who used the sites to sort and dispose of collected materials.

‘Waste scavengers’ (figure 5.3B) also used the UWDSs for sifting through the waste for recyclable materials and other residents scavenge the waste for organic matter which is used as fertiliser (figure 5.3C) to grow crops.





Waste dumped in open lands (UWDS) within residential areas (A) and scavengers scavenging for recyclables (B)



C: Residents scavenging for manure      D: Uncompleted building converted to a UWDS

Figure 5.3: Examples of UWDS within residential areas (Author, April 2017)

Table 5.1: Waste disposal sites information in the ten Waste Collection Districts in Minna

DISTRICT	DISTRICT AREA (km <sup>2</sup> )	NUMBER OF CWCPs	CWCP PER KM <sup>2</sup> OF DISTRICT AREA	NUMBER OF UWDSs	UWDS PER KM <sup>2</sup> OF DISTRICT AREA	TOTAL UWDSs AREA (m <sup>2</sup> )
Bosso West	15.61	6	0	15	1	3,693
Bosso East	5.45	2	0	16	3	4,663
Maitumbi	20.69	11	1	14	1	9,133
Sabon Gari	3.55	6	2	4	1	5,399
Kpakungu	21.24	5	0	41	2	15,512
Sauka Ka Huta	16.61	4	0	24	1	19,291
Keteren Gwari	3.14	1	0	1	0	358
Tunga A	3.41	2	1	10	3	4,931
Tunga B	4.37	2	1	6	1	3,644
Chanchaga	16.99	6	0	10	1	3,486
Total	111.06	45	5	141	14	70,110

Table 5.1 provides the size in km<sup>2</sup> of the ten waste collection districts with their respective numbers of UWDSs, CWCPs and the total area covered by UWDSs. In total UWDSs covered an area of 70,110 m<sup>2</sup>. Relating the waste disposal sites (UWDSs and CWCPs) location with the districts sizes in table 5.1 shows that most of the waste collection districts (six in total), have zero CWCP within a KM<sup>2</sup>. Meanwhile, almost every district, except Keteren Gwari has at least one UWDS within a KM<sup>2</sup>. Therefore, Sabon Gari has the highest number of CWCP (2 sites) based on district size while Bosso East and Tunga A has the highest UWDSs per KM<sup>2</sup> of district size (Table 5.1).

All the CWCPs are located on primary and secondary roads (except in Tunga B where some sites are located next to tertiary road), whereas the majority of UWDSs are located on tertiary roads as illustrated in Figure 5.4. Only 17 UWDSs are located on primary and secondary roads. However, there are differences between the districts. For example, in Kpakungu all 41 UWDS are located on tertiary roads. In contrast, in Bosso West and Bosso East, each has 5 UWDSs located on the primary and secondary roads (A description of the road network in Minna is provided in section 5.2.2).

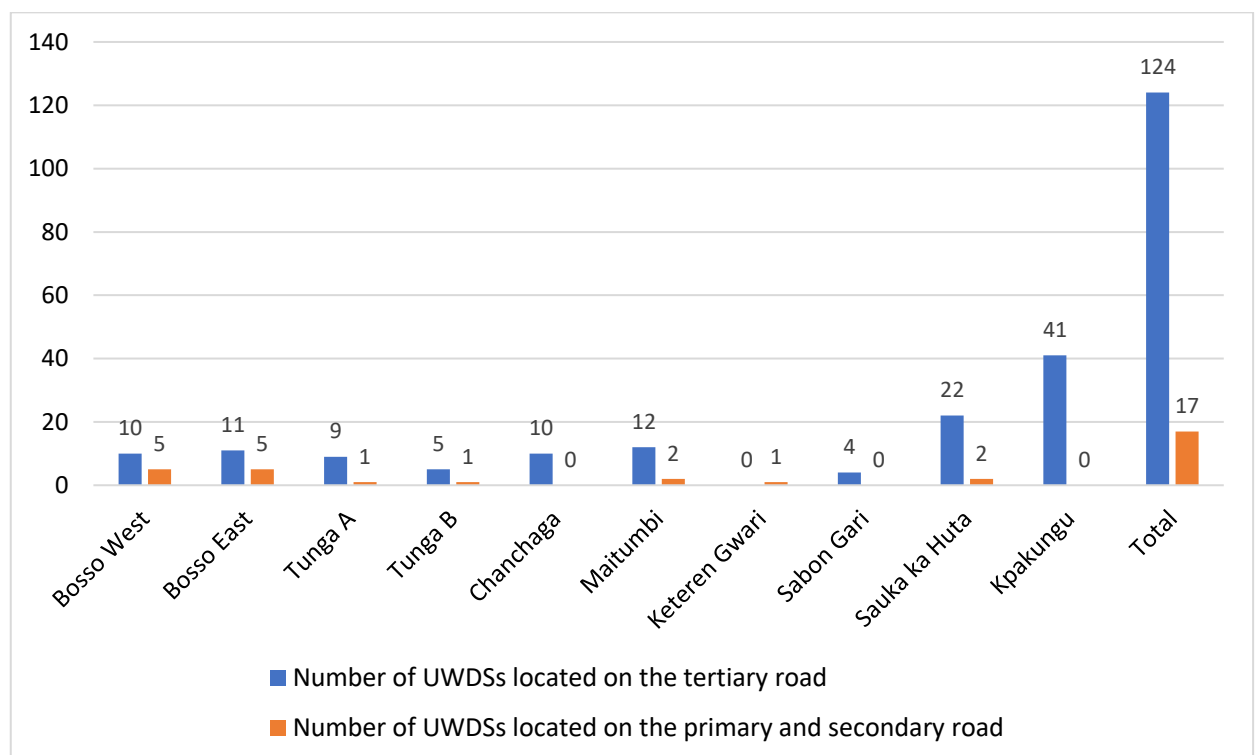


Figure 5.4: Number of UWDSs located on primary, secondary and tertiary roads across districts in Minna.



The size range of the UWDSs is shown in figure 5.5 with the majority (103 or 73%) of UWDSs ranging from 8 - 500 m<sup>2</sup> while only 4 (3%) UWDSs are above 2000m<sup>2</sup>.

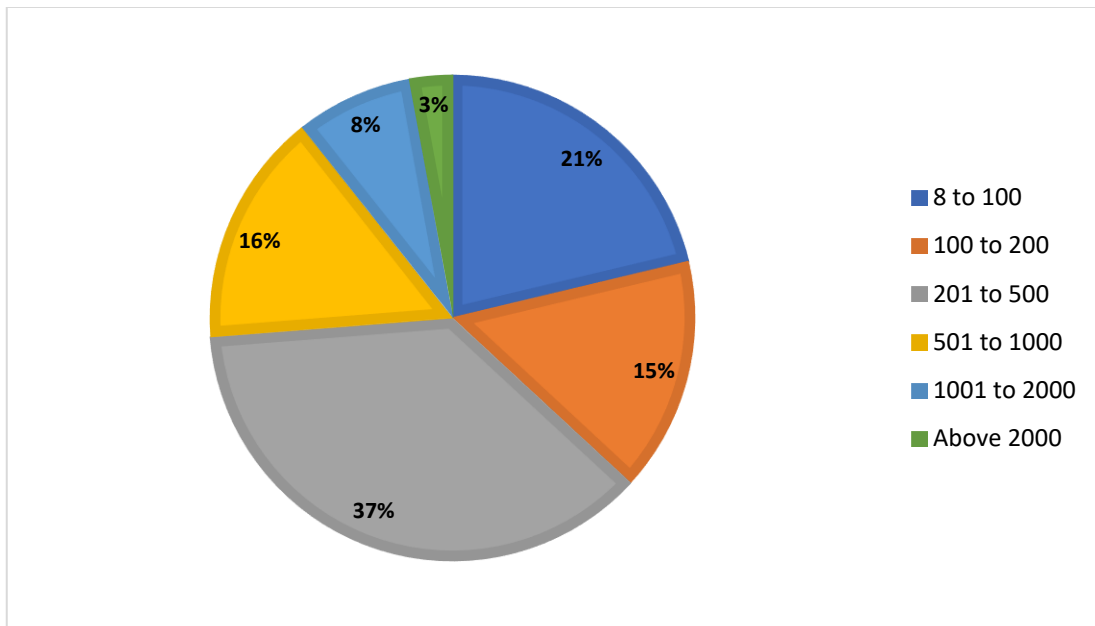


Figure 5.5: UWDS size distribution (m<sup>2</sup>)

## 5.2.2 Brief description of the road network in Minna

### 5.2.2.1 Primary Roads

Primary roads are the main roads between towns and cities and are usually wider to accommodate more traffic. They often contain stretches of dual carriageway to provide significant traffic movement between centres of population and economic activity on a national and regional level. These routes are prioritised for upgrading to near-motorway standards and are built to a higher standard than secondary roads. This is equivalent to 'A' roads in the UK.

### 5.2.2.2 Secondary Roads

Secondary roads are ring roads which take traffic away from towns and centres. These roads are not alternative routes in case of a blocked primary road but may be used as one. In other words, secondary roads are not defined as alternatives to primary routes, although they often link similar places. They can contain high-speed stretches, but these are not as frequent as on a Primary Route. Secondary roads/routes do not have as many

Heavy Good Vehicles (HGVs) and usually go through towns and villages rather than bypass them. This type of road is equivalent to 'B' roads in the UK.

### **5.2.2.3 Tertiary Roads**

These are smaller roads intended to connect unclassified roads with primary and secondary roads. Tertiary roads are those roads providing access to properties and through routes within residential areas. This is equivalent to classified, unnumbered (C Roads) in the UK.

### **5.2.3 Spatial distribution of UWDSs, CWCP in relation to the road network in Minna**

In analysing the distribution of waste disposal sites, 96% of CWCPs are located along primary and secondary roads (linked to ease of collection by NISEPA contractors), while 86% of UWDSs are located on tertiary roads.

Analysis of the road network suggests that Bosso West, Tunga A and B, Keteren Gwari, Chanchaga, and parts of Sauka ka Huta and Maitumbi are more planned districts because they have a high proportion of primary and secondary roads. Meanwhile, Kpakungu and part of Sauka ka Huta have the poorest road networks in the ten waste collection districts in Minna due to unplanned settlements. It is suggested that the quality of the road network is a contributory factor in the development of UWDS. For example, Kpakungu (41 UWDS) and Sauka ka Huta district (24 UWDS) have the highest number of UWDSs and the poorest road network. However, these districts have no CWCPs and few UWDSs per km<sup>2</sup> of the district size (table 5.1). Therefore, Kpakungu and sauca ka huta waste collection districts are do not have the highest number of UWDS per km<sup>2</sup> of the districts size but Bosso East and Tunga A have the higher portion (3 UWDSs per km<sup>2</sup>).

This study finding reveals that district size is not the sole factor influencing the number of CWCP or UWDSs as there are no defined criteria for grouping or dividing the districts as well as siting CWCPs in Minna. For example, Kpakungu and Maitumbi districts are the biggest waste collection districts (21.24 km<sup>2</sup> and 20.69 km<sup>2</sup>) in Minna, with Kpakungu having 41 UWDSs and 5 CWCP, while Maitumbi has 14 UWDSs and 11 CWCP (see section

5.3). Therefore, based on the sizes of districts and the number of CWCPs per km<sup>2</sup> (table 5.1), it can be concluded that districts size was not a determinant for the number of CWCPs to be sited in a district.

Analysis of the district data shows that some of the UWDSs are accessible with trucks. For example, 17 UWDSs were found located along primary and secondary roads across districts which can be accessed and evacuated alongside with the CWCPs. This is because all CWCPs (except 2 CWCPs in Tunga B) are located along primary and secondary roads across districts to ease collection. Therefore, the location of CWCPs being on primary and secondary roads is considered a contributory factor for the development of UWDSs within residential areas in Minna.

#### 5.2.4 Proximity of UWDSs to the nearest road network in Minna

Spatial analysis of the data was used to determine distance from UWDSs to the nearest accessible (by vehicle) road network. To evaluate how accessible, this could be in terms of waste collection. The result in figure 5.6 shows that 50% (70) of UWDSs are within 20 m of an access road with only 2 UWDSs located more than 80 m from a road. Although it can be argued that 'being within 20 m may not necessarily mean access in some cases', however, more than 90% of the UWDSs were accessed with a four-wheel-drive vehicle during the mapping exercise (see district analysis in section 5.3). This finding validates NISEPA's claim of a lack of accessible roads in some of the waste collection districts.

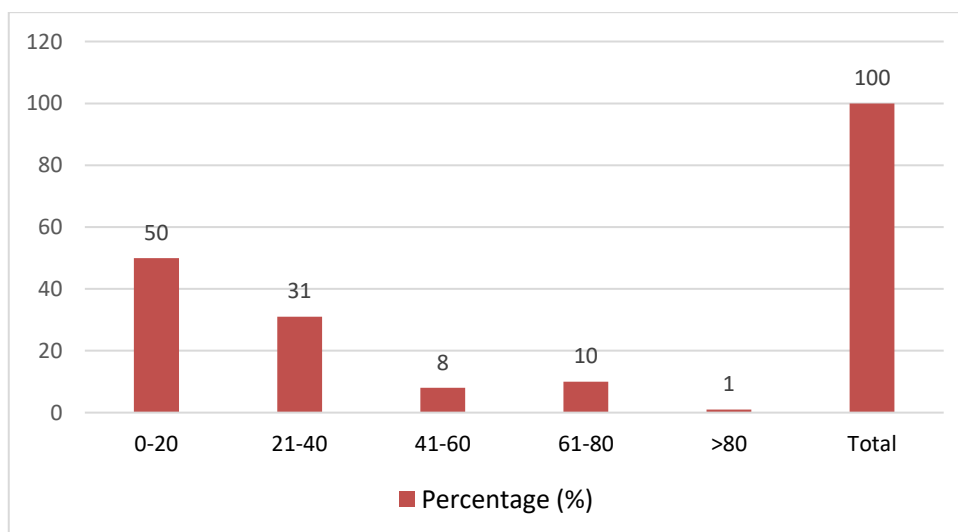


Figure 5.6: Distance of UWDSs to an access road (m).

It was observed that the number of UWDSs decreased with an increase in distance from accessible roads, though not a continuous form of decreasing because there were fewer (8%) UWDSs above 20 m – 40 m compared to the UWDSs above 60m - 80m with 10%, but only 1% of UWDS was found in a distance above 80m (figure 5.6).

### **5.2.5 Proximity of UWDSs to CWCP**

Figure 5.7a shows the buffer rings generated around the CWCPs used to count the numbers of UWDSs that are within a proximity of CWCPs, which is overlaid on the WCD, Google Earth and road networks in Minna. This was used to determine if there be any relationship between the location of CWCPs and the development of UWDSs, as it is assumed that the location or accessibility of the CWCPs should encourage the people to dump their waste in the CWCPs instead of creating UWDSs (effect of the locations of CWCPs in the development of UWDSs). Different distance bands around the CWCPs were generated in metres(m) and different colours are used to depict each distance band in figure 7.5a. Green refers to the distance between 0 m - 100 m, red for 101 m – 200 m, blue for 201 m – 300 m and orange for 301 m – 400 m of CWCPs. Any UWDSs outside this range is considered above 400 m.

Figure 5.7b shows the spatial distributions of UWDSs points located within the buffer distance band of figure 5.7a. The colour red represents the points (UWDSs) located within 0 m – 100 m, blue within 101 m – 200 m, green within 201 m – 300 m, yellow within 301 m-400 m and pink for UWDSs located above 400 m from any CWCPs. It can be observed from the map in figure 5.7b that UWDSs above 400 m (in pink) from a CWCP are mostly found in Kpakungu Waste Collection Districts (WCD) while those within 0m – 400 m are primarily found in Bssso East and Bosso West with other districts having none within 0 m – 100 m of CWCP (figure 5.7b). Therefore, the spatial distribution of UWDSs in figure 5.7b shows that there are fewer UWDSs within 100 m of CWCPs and more UWDSs above 400m from a CWCP.

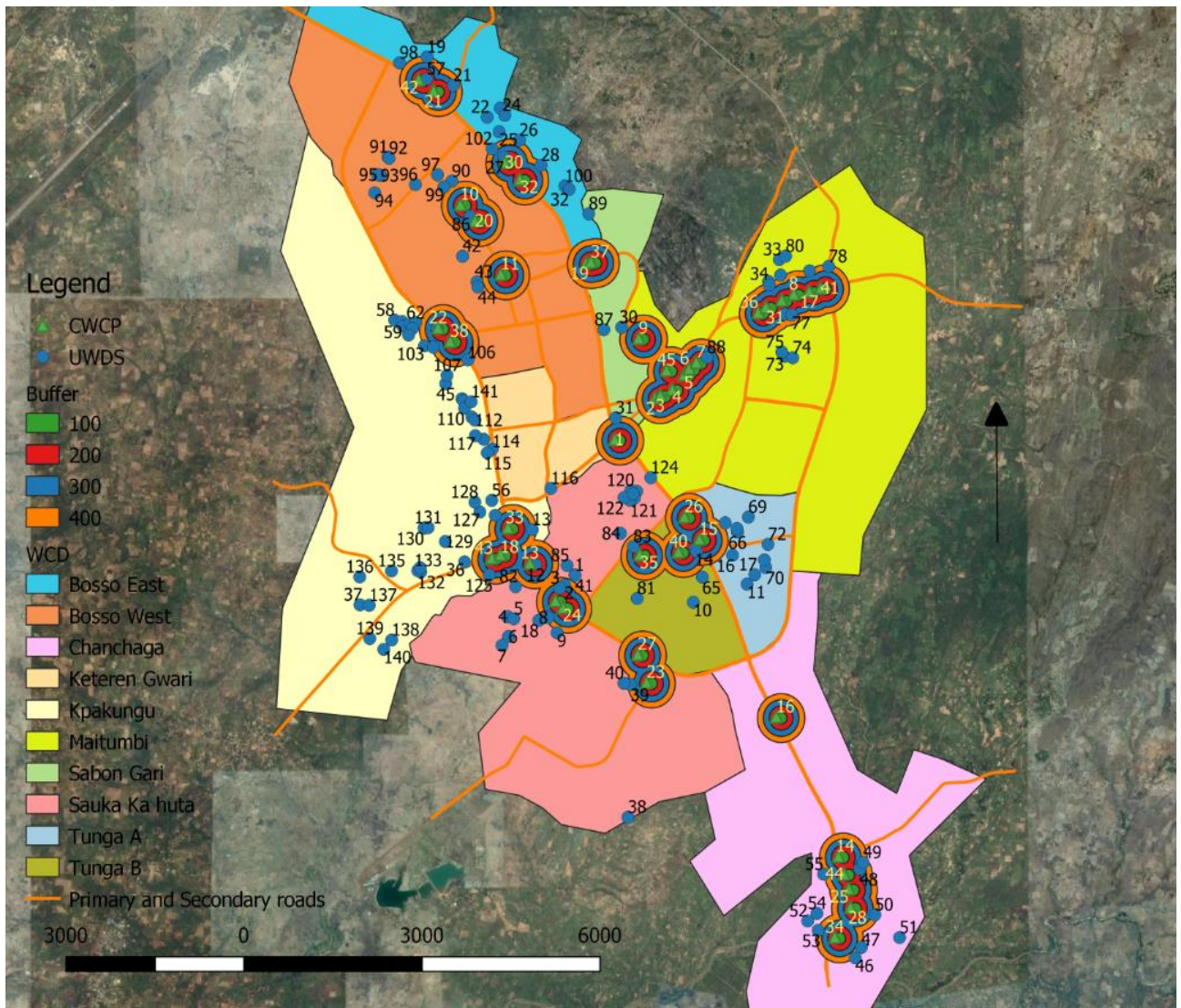


Figure 5.7 (a): Measuring the proximity of UWDSs to CWCPs using buffers.

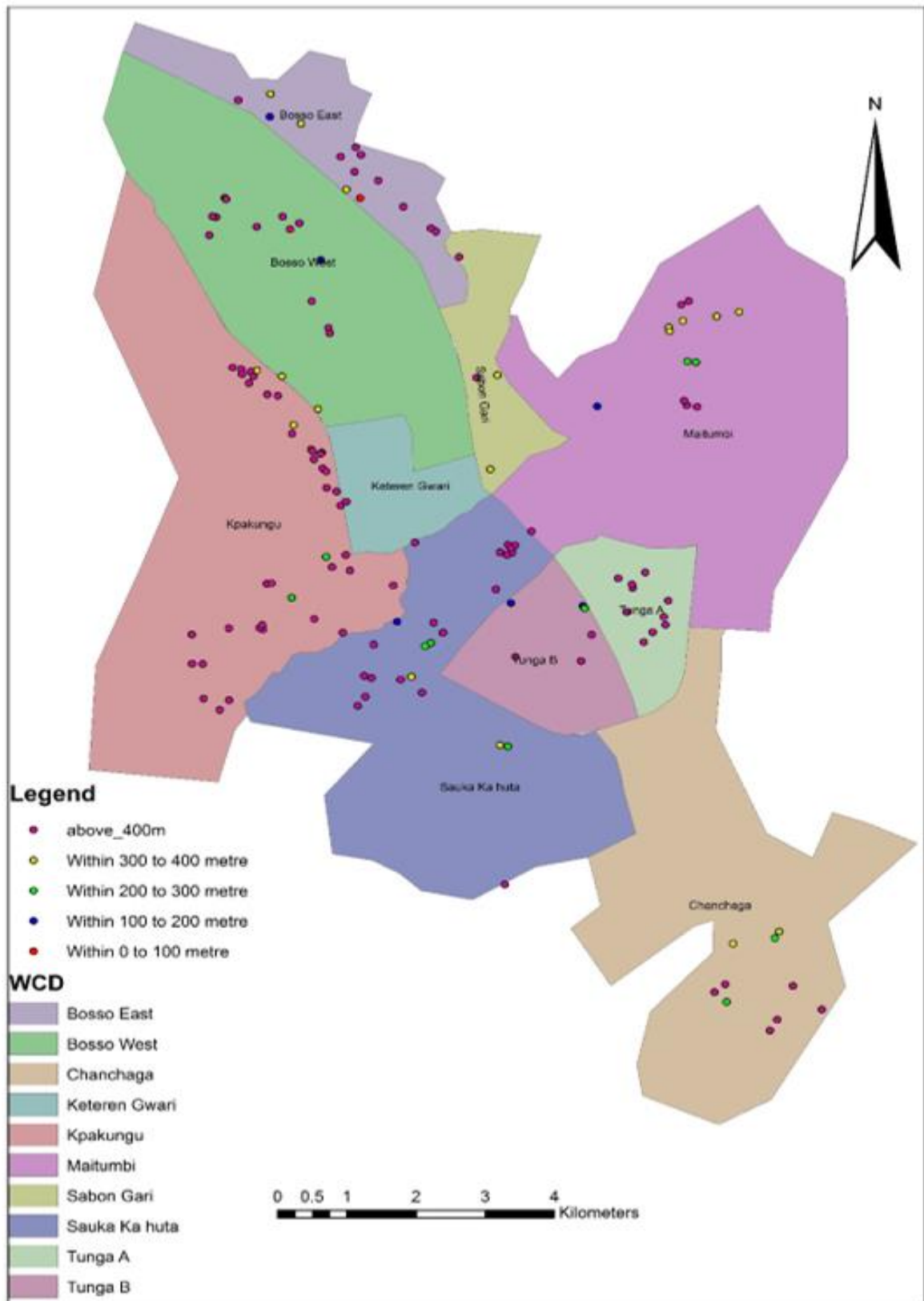


Figure 5.7 (b): Spatial Distributions of UWDSs based on distances from CWCP

Table 5.2 shows the number of UWDSs that fall both within buffer zones (distance) from CWCPs as well as within each waste collection district (WCD). Just like in figure 5.7b, 73% of UWDSs (103 out of 141) were found at a distance above 400 m from a CWCP, while only 2 UWDS were within 0-100 m. Table 5.2 also shows that 36(35%) of 103 of UWDSs located above 400m from a CWCP are found in Kpakungu while Keteren Gwari has the least number 1(1%). On the other hand, there is a smaller number of UWDSs within 100 m from a CWCP with only Bosso west and Bosso East having 1% site each, making 2% in total (table 5.2 and figure 5.7). However, the table also shows a significant relationship between the location of UWDSs from CWCP; the farther the CWCP from the UWDSs, the more the number of UWDSs. Therefore, the spatial distributions of UWDSs based on distances band ( 0-100m, 100m-200m, etc.) is evidence that the location of the CWCPs influences the creation of UWDSs. Again, this is because the CWCPs are positioned along primary and secondary roads, coupled with the fact that they are not evenly distributed across districts (Figure 5.7a).

Table 5.2: Distance from UWDS to the nearest CWCP within waste collection districts in Minna

Districts	Unofficial Waste Dumpsites					No of UWDSs	No of CWC P
	400m and above	300m -400m	200m-300m	100m-200m	0m - 100m		
Bosso West	12	2	0	1	1	16	6
Bosso East	9	3	0	2	1	15	2
Kpakungu	36	3	2	0	0	41	5
Sabon Gari	2	2	0	0	0	4	6
Keteren Gwari	1	0	0	0	0	1	1
Maitumbi	6	5	2	1	0	14	11
Tunga A	10	0	0	0	0	10	2
Tunga B	3	0	1	2	0	6	2
Sauka ka Huta	18	2	3	1	0	24	4
Chanchaga	6	2	2	0	0	10	6
<b>Total</b>	<b>103</b>	<b>19</b>	<b>10</b>	<b>7</b>	<b>2</b>	<b>141</b>	<b>45</b>

In this study, residential buildings were not mapped as this was not the focus of the study. However, the presence of tertiary roads was used to characterise residential areas. Comparing the relationship between the distance from a CWCP to the nearest UWDS in table 5.2 shows that about 73% of the UWDSs are more than 400m away from a CWCP; and the average distance of 735.72 m to access the nearest CWCP is evidence that the location of the CWCP is a contributory factor to the development of UWDS. Also, relating the distance between the UWDSs to the nearest accessible road network shows 50% of UWDSs fall within 20m of an access road. Therefore, the majority of these UWDSs (at least 50%) could be evacuated being situated on access roads.



### **5.2.6 Effect of the location of CWCP on the development of UWDSs**

As stated earlier, 88% of UWDSs are located within residential areas (characterised by tertiary roads), and 96% of the CWCPs are located along primary and secondary roads with the majority clustered in one place across districts (see figure 5.8-in green), although one of the reasons for the CWCP being in one area or clustered in one place may be because there is unavailability/limited space for NISEPA to station their drums (bins) along primary and secondary roads.

The UWDSs are almost exclusively within residential areas, and they are servicing the residents for whom the CWCPs are too far away. The fact that the CWCP in Minna is not evenly distributed across the ten waste collection districts, nor are they distributed according to district size, confirms a lack of criteria for allocating the CWCP by the waste management authority. However, for effective waste collection, utilising CWCP, there is a need for widespread coverage for Minna (figure 5.8). Therefore, the location of the CWCPs may be due to some practical considerations, ease of access, or an association with historical practices.

So, when comparing the distance between UWDSs to the nearest CWCP; the number of UWDSs (141), CWCP (45), and their distribution within each district (not evenly), it is evident that there are factors responsible for the development of UWDSs in Minna. Therefore, in the remaining part of this chapter, a detailed breakdown of each district is described so that some of the connections and differences can be drawn out.

### 5.3 GEO-SPATIAL DISTRIBUTION ANALYSIS OF WASTE DISPOSAL SITES IN THE TEN WASTE COLLECTION DISTRICTS IN MINNA

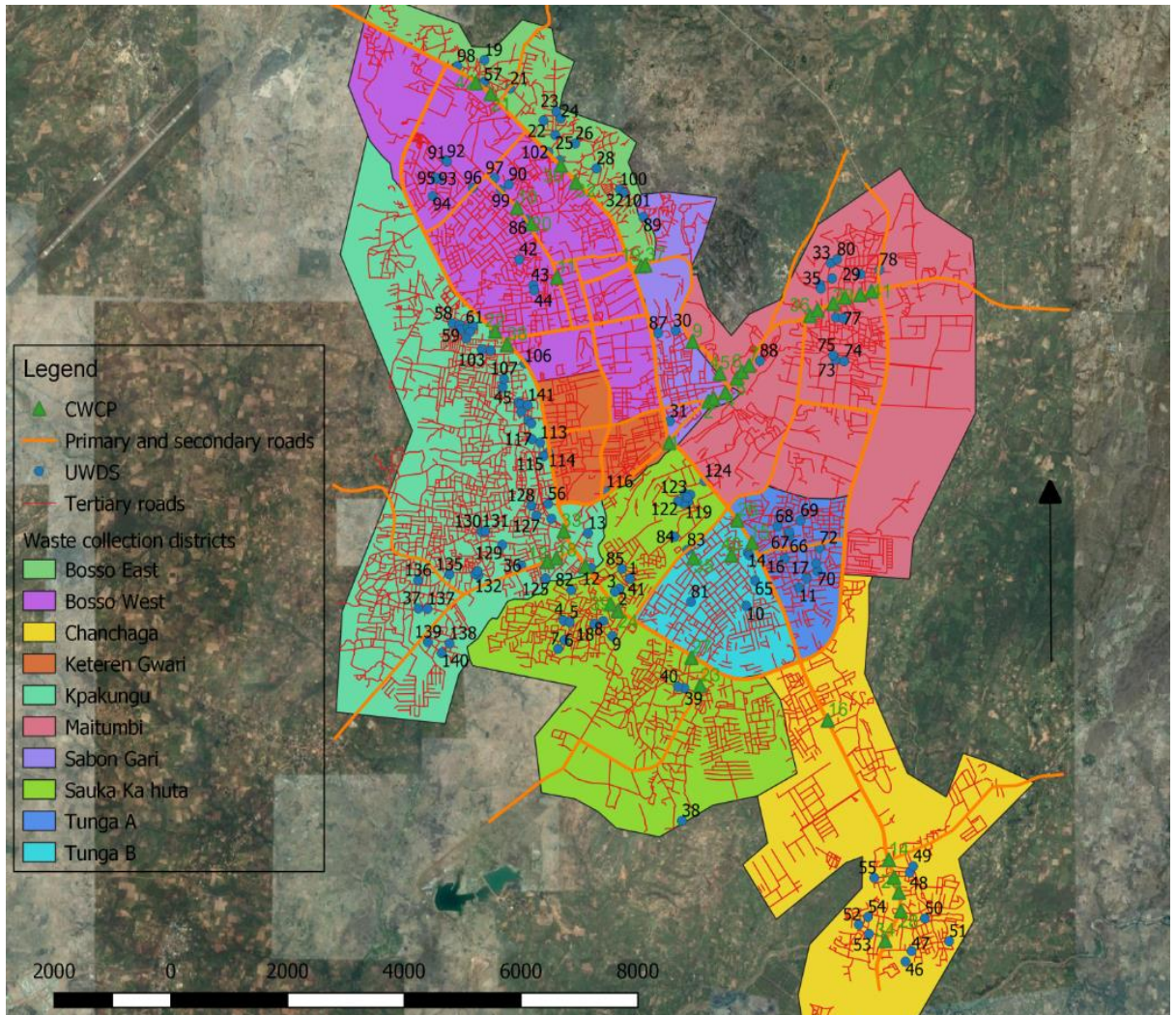


Figure 5.8: Road network, waste collection districts, UWDSs (blue) and CWCP (green) in Minna

#### 5.3.1 Geospatial distribution analysis of waste disposal sites in Bosso West District

Bosso West covers an area of 15.61 km<sup>2</sup> and is bounded by two-major dual carriage roads (primary roads), the Western by-pass to the West and Minna-zungeru road to the East.

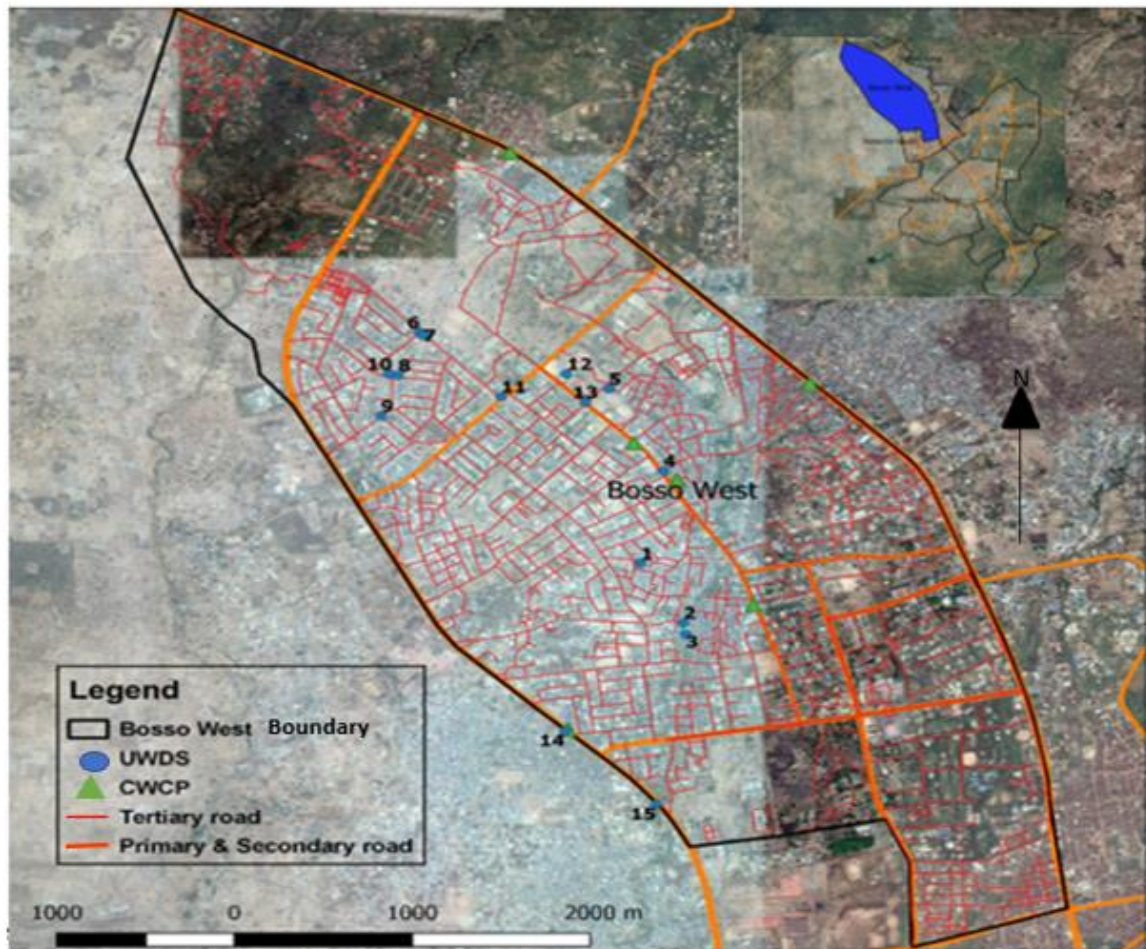


Figure 5.9: Map of Bosso West waste collection district showing the location of UWDSs, CWCPs and road networks

The 6 CWCPs mapped in Bosso West are all located on primary and secondary roads. In total there are 15 UWDSs in Bosso West with 67% (10 out of 15) of the UWDSs located on tertiary roads. The southern and eastern region of Bosso West District show an excellent road network, which could guarantee effective household waste collection services, and this is evident with the absence of UWDSs and CWCPs in the area.

Figure 5.9 shows clusters of both the CWCPs and UWDSs located in the central region of Bosso West. There is an absence of UWDSs and CWCPs within the northern region, where the main government centres in Minna are located. An effective waste management service has been provided by NISEPA to cover this area which includes the Minna Police Headquarters, Government Secretariat, Secretary to the State Government Office, and the Federal University of Technology Minna Bosso Campus.



Similarly, the southern region is home to key business and commercial centres which include: Yayi Hotels Limited, Total filling station, Forte oil filling station, Hajaratu filling station), Nna'iyé Memorial Plaza, Abunamu Plaza, Nana Shopping Plaza, Ikon Allah Shopping Store, A S Tofa Shopping Mall, Fodio Plaza, and Logic Gate Plaza. There is an absence of both UWDSs and CWCPs in this business dominated region which may be further evidence that there is a working and effective waste management system in this area. In other words, the business centres may have private or government waste management services in operation that ensure that business centres and environs are cleared and clean from any rubbish and prevent the formation of UWDSs. Meanwhile, the central region of Bosso West is predominantly residential with more UWDSs and CWCPs which may be evidence that the door-to-door waste management services are poor in the area.

The exact population of Bosso West District is not known, however, according to the Nigeria National Bureau of Statistics in 2018, the projected population of Bosso (both Bosso West and east) is 79,115. Satellite imagery (through GIS) of Bosso West shows the central region to be a predominantly densely populated residential area. This is evident from the clustered tertiary road network (figure 5.9). In contrast, the northern and southern regions have fewer residential settlements, less clustered tertiary roads; and are this is predominantly government reserved areas (GRA), business and commercial areas.

Figure 5.10 shows one of the UWDSs in Bosso West (site 1) with an informal waste collector discarding waste collected from residents. The activities of the informal waste collectors and their position in the waste management industry in Minna are discussed in chapter seven (qualitative interviews).



Figure 5.10: UWDS (site1) in Bosso West district (Author, April 2017)

### ***5.3.1.1 Sizes of Unofficial Waste Disposal Sites in Bosso West***

The geospatial map of Bosso West district depicts that there are 5 UWDSs located along primary and secondary roads, while 10 UWDSs are located on tertiary roads (table 5.3).

Table 5.3: Sizes of UWDSs and road location in Bosso West

Site reference number	Area (m <sup>2</sup> )	Location (Roads)
1	968	Tertiary
2	723	Tertiary
3	315	Tertiary
5	449	Tertiary
6	535	Tertiary
7	92	Tertiary
8	111	Tertiary
9	78	Tertiary
10	78	Tertiary
12	78	Tertiary
Average	342.7	
4	44	Primary and Secondary
11	78	Primary and Secondary
13	78	Primary and Secondary
14	39	Primary and Secondary
15	27	Primary and Secondary
Average	53.2	

The variation in the proportions of UWDSs may have been influenced by densely populated areas. The fact that the majority of CWCPs are located along primary and secondary roads may have contributed to the fewer number of UWDSs located on primary and secondary roads, as well as average influence area of the sizes of UWDSs located on the primary and secondary roads.



### 5.3.2 Spatial distribution analysis of waste disposal sites in Bosso East District

Bosso East is one of the waste collection districts in Bosso local government area of Minna. It is the second smallest waste collection district in the Bosso local government area and is located at the north-east of Minna as shown in figure 5.11.

Bosso East has a district area of 5.45 km<sup>2</sup> with 16 UWDSs and 2 CWCPs of which the 16 UWDSs cover 4,663 m<sup>2</sup>. Out of the 16 UWDSs, 11 are located on tertiary roads while five are located on primary and secondary roads as shown in figure 5.11.

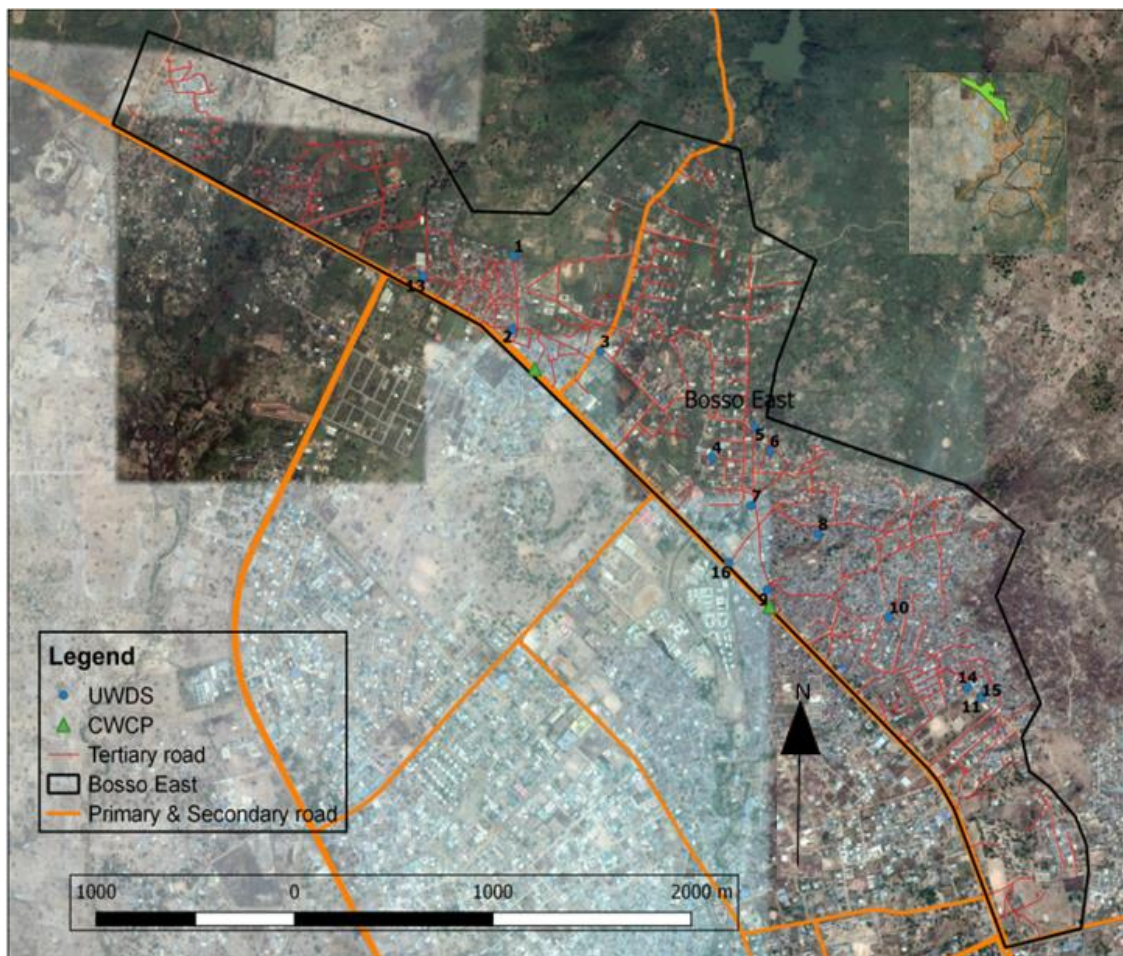


Figure 5.11: Map of Bosso East showing the location of UWDSs, CWCPs and road networks.

The extensive tertiary road network indicates restricted access for NISEPA trucks into predominantly residential areas of Bosso East District. This poor road network may have

led to siting of CWCPs only on the primary and secondary roads which makes it easier and more accessible for NISEPA trucks.

The Eastern region of the district is predominantly residential areas with features such as faith centres (churches and mosques) and local business centres such as restaurants and convenience shops. In contrast, the Northwest, as well as Southern regions of Bosso East, contain predominantly schools, markets, and leisure centres. For example, Bosso Market and Water Board are in the Northwest, Ahmadu Bahago secondary school and Muslim playground are in the southern part of the district.

The average area of the UWDSs located on tertiary roads in Bosso East is 307.54 m<sup>2</sup> while the average area of UWDS located on primary and secondary roads is 256 m<sup>2</sup> (table 5.4). It is suggested that the location of CWCPs along the primary and secondary roads may have influenced the resident's decision to create UWDSs (5 sites) along primary and secondary roads assuming that the waste will be collected alongside with the CWCP.

#### ***5.3.2.1 Sizes of Unofficial Waste Disposal Sites in Bosso East***

Table 5.4 presents the sizes of the UWDSs in the waste collection district.



Table 5.4: Size of UWDSs and Road Location in Bosso East

<b>Identity codes</b>	<b>Area (m<sup>2</sup>)</b>	<b>Locations (Roads)</b>
1	247	Tertiary
4	270	Tertiary
5	316	Tertiary
6	638	Tertiary
7	353	Tertiary
8	168	Tertiary
10	268	Tertiary
11	170	Tertiary
12	482	Tertiary
14	393	Tertiary
15	78	Tertiary
Average	307.54	
2	443	Primary and Secondary
3	170	Primary and Secondary
9	380	Primary and Secondary
13	209	Primary and Secondary
16	78	Primary and Secondary
Average	256	

There is an uneven variation in area size of the UWDSs across the district. Some of this variation in the size of UWDSs is influenced by the location of residential property – either on the primary and secondary roads or tertiary roads. The fact that all CWCPs are located along the primary and secondary roads reduces the number of UWDSs located on primary and secondary roads but influences their size. Therefore, the fewer number of CWCPs in Bosso East may have influenced the number of UWDSs developed along the primary and secondary roads but lead to an increase in the area size of the same UWDSs.

### 5.3.3 Geospatial distribution analysis of waste disposal sites in Maitumbi District

Maitumbi is the second largest waste collection district after Kpakungu with a district area of 20.69 km<sup>2</sup>. It is in the East of Minna with 14 UWDSs and 11 CWCPs, of which the 14 UWDSs cover an area of 9,133 m<sup>2</sup>. All the 11 CWCPs are located along primary and secondary roads in the West and Northwest of the district. The UWDSs are located on tertiary roads with a majority (12 out of 14) being in the Northwest of the district (figure 5.12). All CWCPs and the majority of UWDSs are clustered in the Northwest region, evidence that the Northwest of the district is a predominantly residential area. In contrast, the Northeast and Southeast of the district show absence of CWCP and UWDS. However, there are good road networks in these areas compared with the Northwest (figure 5.12). During fieldwork, residents reported that some of the UWDSs were initially CWCPs sited by NISEPA, but later abandoned and the residents kept patronising the sites which were informally managed by burning of waste.

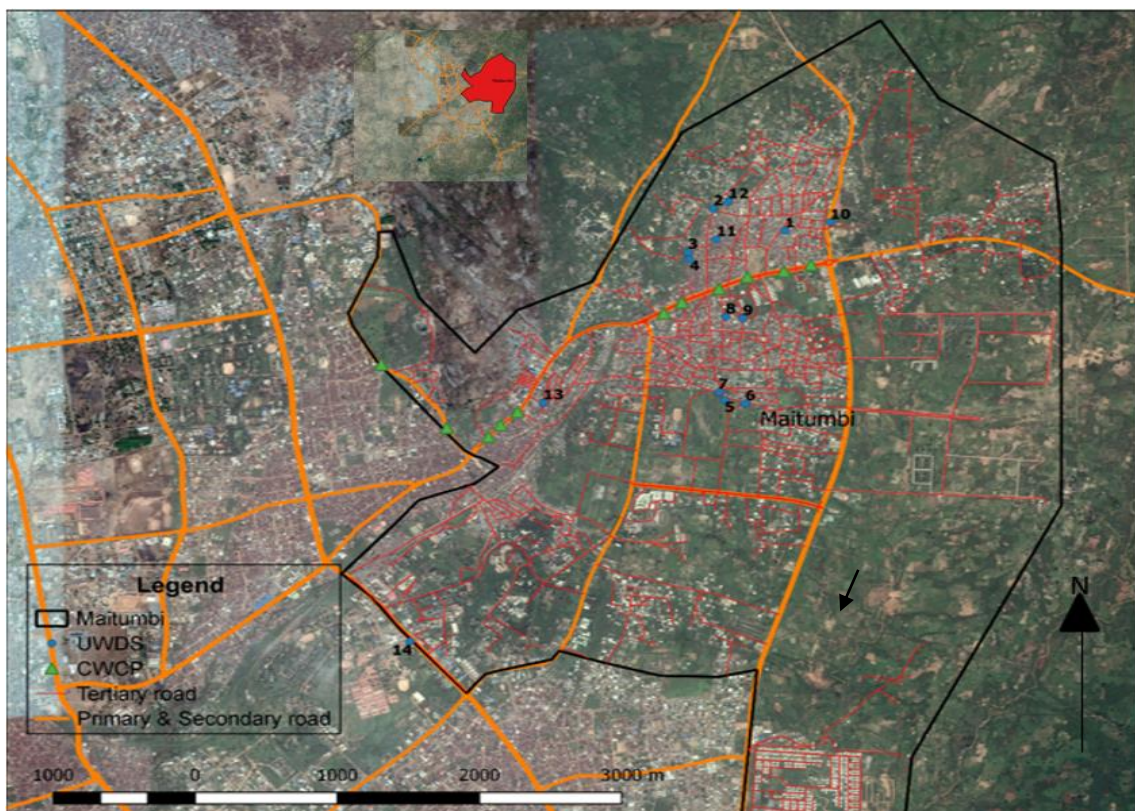


Figure 5.12: Map of Maitumbi waste collection district showing the location of UWDSs, CWCPs and Road Networks

The central region of the district is a government reserved area without both CWCP and UWDS. There are frequent and effective waste collection services in the central region of Maitumbi district, either from government agencies or private and informal waste collectors. Maitumbi is predominantly occupied by social service centres and administrative centres, including El- Amin International School, Joint Admissions and Matriculation Board (JAMB) office, Nigeria Television Authority (NTA) Minna office, Maitumbi Hospital, faith centres and superstores. Interestingly, M.I Wushishi estate with 500 houses is in the Southern region of Maitumbi district with good road networks but no CWCP and UWDS. However, the Estate (M.I Wushishi) is being served by private waste collectors, assigned by NISEPA as part of effective waste collection strategies (see figure 5.13). This strategy of assigning the private waste collectors to the estate residents could be related to the class of people (high-income earners) living in the estate, considering the housing plan with the access road network. Therefore, this could be the reason for the absence of UWDSs and CWCPs within and around the M.I Wushishi Estate.



Figure 5.13: The entrance to M I Wushishi Housing Estate Minna - 500 houses



The geospatial map of Maitumbi district shows a clustered tertiary road network. Both UWDSs and CWCPs in the Northwest are evidence that the region is densely populated. On the other hand, the road networks in the Northeast, Central and Southern region, has fewer residential settlements (based on road network) and an absence of both UWDSs and CWCPs, which is evidence that those areas are predominantly government reserved regions, with business and educational centres.

Figure 5.14 shows one of the UWDS with scavengers on-site (site 8), sifting for recyclables and heaps of waste that shows activities of farmer-residents who scavenge for manure in Maitumbi district. The near-by residents confirm that scavenging for fertiliser/manure by residents/farmers is the dominant practice as they suggest that it is the cheapest and easily obtainable fertiliser and the best for growing crops.



Figure 5.14: UWDS (site 8) in Maitumbi District (Author, April 2017)

### 5.3.3.1 Sizes of Unofficial Waste Disposal Sites in Maitumbi

Tables 5.5a and 5.5b show a total of 14 UWDSs located in Maitumbi waste collection district, with 12 located on the tertiary roads and 2 located along primary and secondary roads. The average area covered by the UWDSs located on primary and secondary roads is 547.5m, which is smaller than the average of 669.83 m<sup>2</sup> covered by the UWDSs located on tertiary roads.

Table 5.5: Sizes of UWDSs located on the tertiary roads and along primary and secondary roads in Maitumbi.

<b>Identity codes</b>	<b>Area (m<sup>2</sup>)</b>	<b>Location (Roads)</b>
1	870	Tertiary
2	1085	Tertiary
3	1995	Tertiary
4	493	Tertiary
5	406	Tertiary
6	284	Tertiary
7	188	Tertiary
8	1728	Tertiary
9	361	Tertiary
11	357	Tertiary
12	228	Tertiary
13	43	Tertiary
Average	669.83	
10	1068	Primary and Secondary
14	27	Primary and Secondary
Average	547.5	

For the fact that almost all (13 out of 14) UWDSs are in the West and Northwest regions of the district where all CWCPs are sited is evidence that the location of the CWCPs being on primary and secondary roads influences residents' perceptions to create UWDSs in

proximity to CWCPs. This proximity of waste disposal sites (both UWDSs and CWCPs) may have influenced the average size of the UWDSs located along primary and secondary roads. For instance, in table 5.5, the average area of 12 UWDSs located on the tertiary roads (669.83 m<sup>2</sup>) is almost the same size as the average area of 2 UWDSs located along primary and secondary roads (547 m<sup>2</sup>). This is because, the location of the CWCPs on the primary and secondary roads may have influenced the residents' expectations and perceptions on waste management in the district, which incites the creation of UWDSs nearness to the CWCPs with certainty that the waste will be collected by the authority (Table 5.5). Therefore, situating the CWCP on primary and secondary roads may have reduced the number of UWDSs located along the primary and secondary roads but influences the sizes of UWDS located along primary and secondary.

#### **5.3.4 Geospatial distribution analysis of waste disposal sites in Sabon Gari District**

Sabon Gari district is the third smallest waste collection district after Tunga A and Keteren Gwari. The waste collection district is in the East-centre of Minna (figure 5.15) with an area size of 3.55 km<sup>2</sup>. There are 4 UWDSs and 6 CWCPs in the waste collection district, of which the 4 UWDSs cover an area of 5,399 m<sup>2</sup>. The 4 UWDSs are located on tertiary roads while the 6 CWCPs are located along primary and secondary roads. There are 4 CWCPs clustered in the south and two CWCPs in the North while the 4 UWDSs are distributed across the district, with one at the North, two at the central region and one at the southern region of the district.

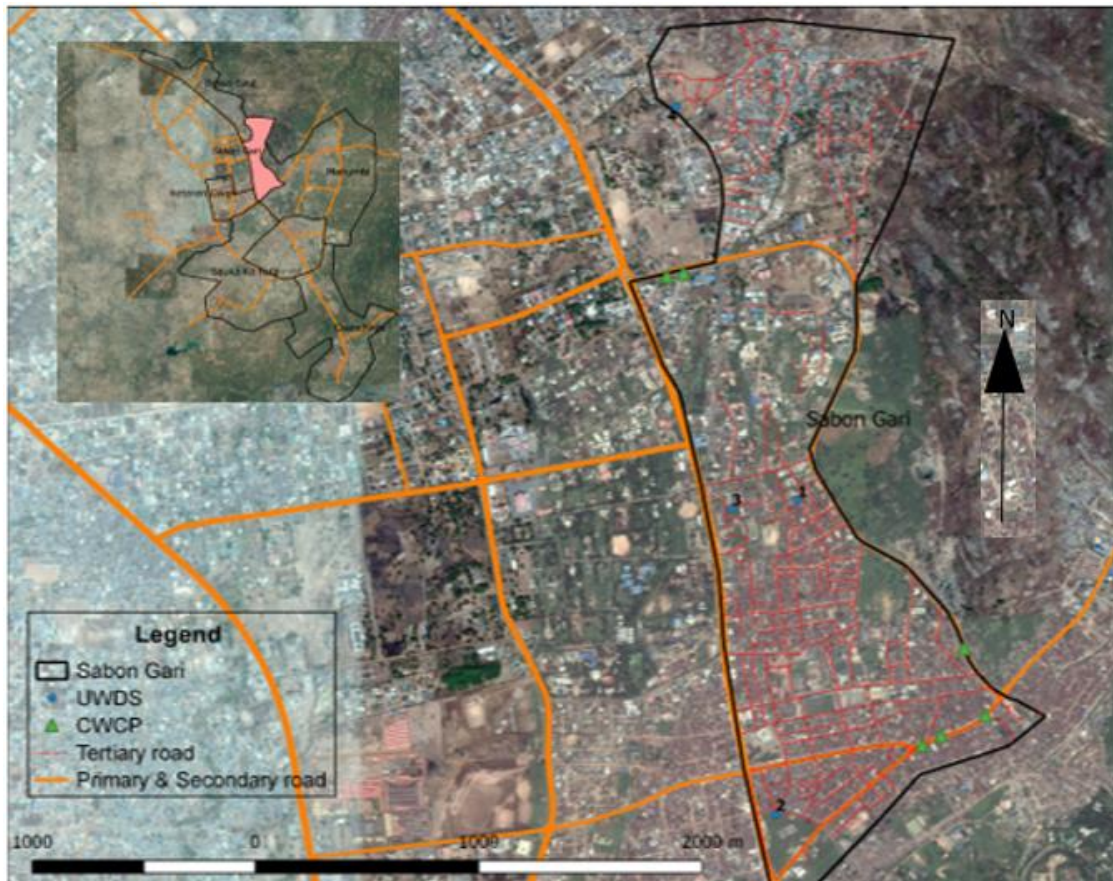


Figure 5.15: Map of Sabon Gari waste collection district showing the location of UWDSs, CWCPs and Road Networks

Chanchaga Local Government (LG) Secretariat is located at the Southern part of Sabon Gari District. The geospatial map of the district shows that the southern region of the district is predominantly residential with a defined road network. Also, the southern region has some business and social centres such as banks, churches, central mosque, supermarkets, clinic, volleyball court and schools. Similarly, the North and Central part of the district is a home for business centres such as stores, shops, plaza, bakery, abattoir, filling stations, and faith centres (e.g. Minna Central Eid Praying ground, and churches).

Figure 5.16 is a UWDS (site one on the district map) located in proximity to a secondary school with residents scavenging for organic matter. The residents on-site are farmers who confirm that the organic matter is free, accessible, grows crops faster and gives good produce. They added that:



"Considering the economic situation in Nigeria, things are very hard. With the recession in the country, there is no money to purchase the right farming mechanism in the market, so we decided to go locally".

The land used for waste disposal is owned by the school. The principal lamented on how they have tried to stop people from dumping waste on the site, but all efforts were aborted as they cannot police the site after school hours.



Figure 5.16: UWDS close to a school with residents/farmers scavenging waste for an organic matter for fertiliser and cows grazing on site (Author, April 2017).

Similarly, a UWDS in Sabon Gari district (site 2 on the map) is located at the centre of a mini-market called "Orange Market" with cows also feeding on the site (figure 5.17). The shop owners confirm that the animals are brought to the site almost every day to feed. Also, the site is managed by burning to reduce the size, but the fire must be controlled to avoid extending to their adjacent wooden shops.





Figure 5.17: Cows grazing on a UWDS at Orange Market (Author, March 2017)

#### **5.3.4.1 Size of Unofficial Waste Disposal Sites in Sabon Gari**

The area sizes of the UWDSs located on tertiary roads in the waste collection district with an average size of 1,349.75m<sup>2</sup> are presented in table 5.6.

Table 5.6: Sizes of UWDSs and roads location in Sabon Gari

<b>Identity codes</b>	<b>Area (m<sup>2</sup>)</b>	<b>Location (Roads)</b>
1	171	Tertiary
2	3230	Tertiary
3	1448	Tertiary
4	550	Tertiary
Average	1,349.75	

### 5.3.5 Geospatial distribution analysis of waste disposal sites in Kpakungu District

Kpakungu is one of the six waste collection districts in Chanchaga local government area of Minna and the largest waste collection district as shown in table 5.7. Kpakungu waste collection district is in the Western region of Minna as shown in figure 5.18.

There are 41 UWDSs and five CWCPs in Kpakungu covering an area of 21.24 km<sup>2</sup> of which the 41 UWDSs covered an area of 15,515 m<sup>2</sup>. All 41 UWDSs in this district are located on tertiary roads while the CWCPs are sited along primary and secondary roads. The average area of UWDSs in Kpakungu is 378.34 m<sup>2</sup> as shown in table 5.7. Figure 5.18 shows the map of Kpakungu District depicting 41 UWDSs (in blue) located along the Southeast through to the Eastern region and the Northeast region. The location of the UWDSs in Kpakungu District shows a systematic way of waste disposal practice. For example, observations show that the UWDSs are clustered on one side of the district which are located towards the primary and secondary roads. It can be suggested that the interior residents take their waste close to an access road expecting evacuation by the authority. Also, the residents may have been encouraged to take their waste to the access roads (primary and secondary road) considering that the waste collection trucks cannot access the interior parts of the district due to their crooked roads (figure 5.18). Therefore, the fewer number of CWCPs and their location being on primary and secondary roads, coupled with the crooked road network may have influenced the creation of the 41 UWDSs in the district.

Interestingly, Talba Estate is in the Southern region of Kpakungu Waste Collection District with 500 houses. The estate is well planned with good access roads which guarantee effective waste collection services in the area (see figure 5.19). In figure 5.18, the south of the district has no UWDS which is potential evidence of effective waste collection services. This is because private waste contractors oversee waste collection services in the estate and the residents pay for their services. This is discussed in detail in chapter seven (stakeholders' interview).

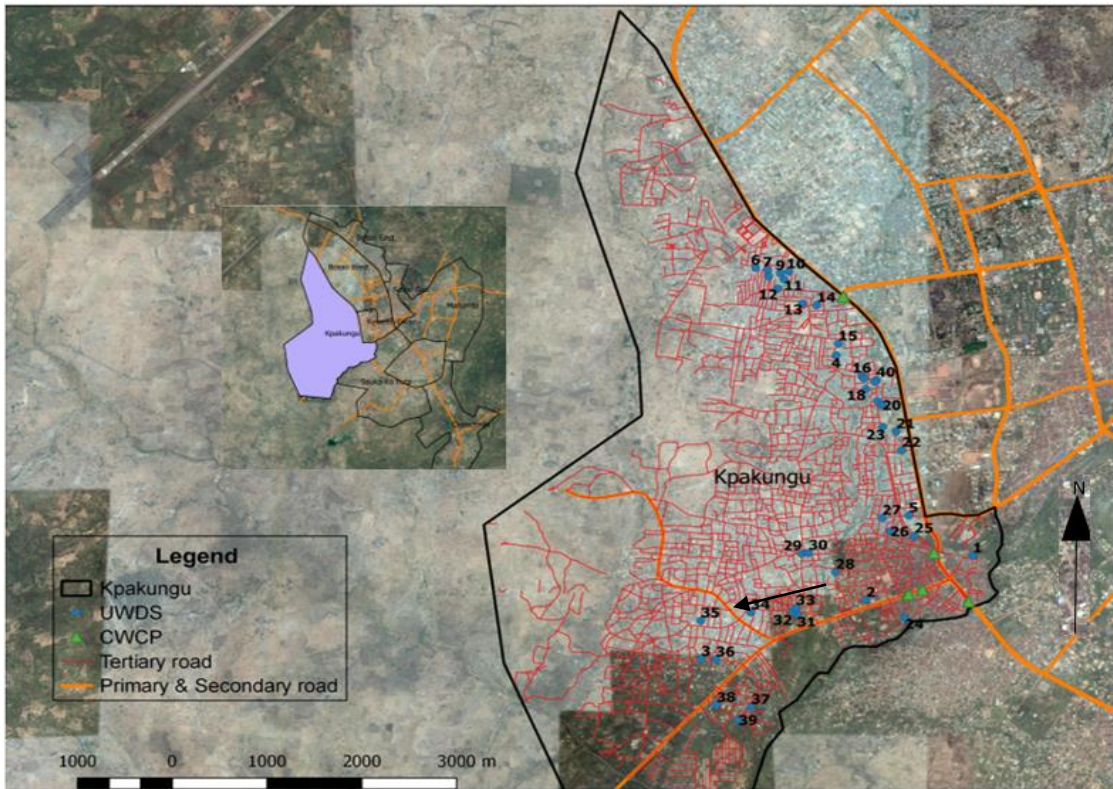


Figure 5.18: Map of Kpakungu waste collection district showing the location of UWDSs, CWCPs and Road Networks



Figure 5.19: A cross-sectional view of Talba Estate Minna (500 houses)

Kpakungu is predominantly a residential area, and from the satellite imagery of the district, it has some old settlements which are evident from the poor road network. The



few business centres in Kpakungu are located along primary and secondary roads. For example, Oado filling station, A A Rano filling station, shops, and schools (mostly Islamic schools), Gurara Hotel, and faith centres (Church and Mosque) are all along primary and secondary roads. As a district with old settlements, it can be classified as a deprived area where the residents have access to few or no basic social amenities within the district. For example, information gathered from the residents of Kpakungu during fieldwork suggests that residents are exposed to air-borne diseases caused by emissions from the UWDSs located around their houses.

Figure 5.20 shows a UWDS (site 24 on the district map) located within the residential area of Kpakungu with proximity to a CWCP. The site is a heap of UWDS that was developed by the residents in Kpakungu and has been managed by burning to reduce size and control odour.



Figure 5.20: UWDS (site 24) in Kpakungu District (Author, April 2017)

#### ***5.3.5.1 Sizes of Unofficial Waste Disposal Sites in Kpakungu***

The sizes of the 41 UWDSs are presented in table 5.7

Table 5.7: Sizes of UWDSs and road location in Kpakungu

<b>Identity</b>	<b>Area (m<sup>2</sup>)</b>	<b>Location (Roads)</b>
1	5368	Tertiary
2	866	Tertiary
3	911	Tertiary
4	323	Tertiary
5	72	Tertiary
6	166	Tertiary
7	326	Tertiary
8	414	Tertiary
9	514	Tertiary
10	130	Tertiary
11	1168	Tertiary
12	399	Tertiary
13	94	Tertiary
14	60	Tertiary
15	52	Tertiary
16	270	Tertiary
17	142	Tertiary
18	312	Tertiary
19	58	Tertiary
20	123	Tertiary
21	303	Tertiary
22	26	Tertiary
23	24	Tertiary
24	230	Tertiary
25	219	Tertiary
26	850	Tertiary
27	470	Tertiary
28	286	Tertiary

29	178	Tertiary
30	157	Tertiary
31	213	Tertiary
32	264	Tertiary
33	112	Tertiary
34	80	Tertiary
35	195	Tertiary
36	197	Tertiary
37	47	Tertiary
38	26	Tertiary
39	22	Tertiary
40	21	Tertiary
41	21	Tertiary
Average	378.34	

### 5.3.6 Geospatial distribution analysis of waste disposal sites in Sauka Ka Huta District

The geo-spatial mapping of waste disposal sites shows that there are 24 UWDSs and 4 CWCPs in Sauka ka Huta district of which the 24 UWDSs cover an area of 19,291 m<sup>2</sup>. The waste collection district is the fourth largest district and located in the South/Centre of Minna with a total area size of 16.61 km<sup>2</sup>. It is evident from the map shown in figure 5.21 that the majority (22 sites) of UWDSs are located on tertiary roads while the 2 UWDSs and the 4 CWCPs are located along the primary and secondary roads. The CWCPs are not randomly distributed across the district as there are two sites in the Southern region and two in the East-Central region. A number of UWDSs are clustered around the CWCPs, except at the North-East part of the district where there are 6 clustered UWDSs with no CWCP (figure 5.21).

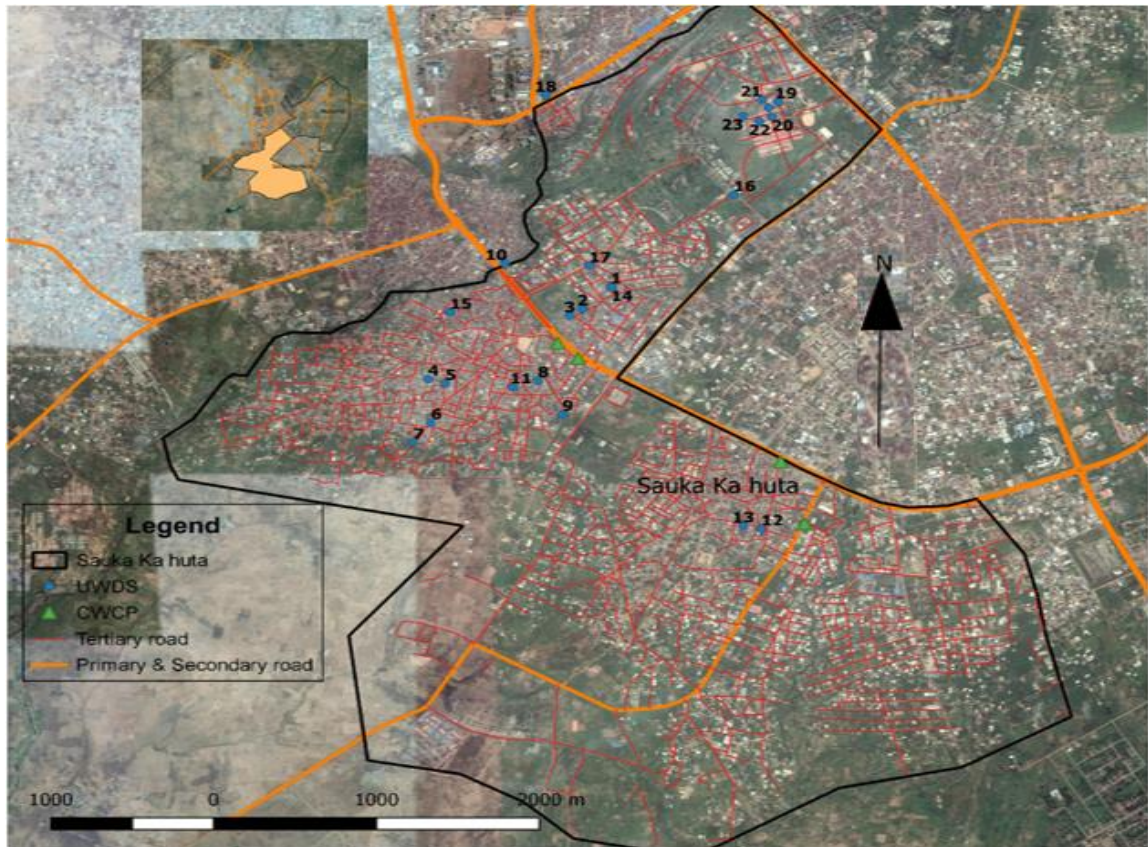


Figure 5.21: Map of Sauka ka Huta waste collection district showing the location of UWDSs, CWCPs and Road Networks

The North-Eastern region of the district is home to key business centres with many banks such as United Bank for Africa (UBA), Unity Bank, Union Bank, Fidelity Bank, First Bank and Central Bank of Nigeria. Meanwhile, the Western and Southern regions of the district are predominantly residential, with the Western region being seen and referred to as an ancient region due to poor planning/layout which results in the poor road network. In contrast, the East-Central region of the district has residential settlements and some essential features such as the Federal University of Technology Minna Guesthouse, Sauka ka Huta Fadiya Guest House, Ibrahim Badamasi Babangida Mall, Ministry of Land and Housing Lodge, the Central Mosque and Churches.

There is an existing cultural practice of using uncompleted buildings for immediate disposal of waste in Sauka ka Huta. For example, figure 5.22 (site 14 in the district map) is a UWDS within a residential area of Sauka ka Huta District. Residents around the



building confirm how it is a regular occurrence in Minna for residents to convert any uncompleted/unfinished building to a UWDS without any consent from the owner.



Figure 5.22: UWDS (site14) in Sauka ka Huta District (Author, April 2017)

#### ***5.3.6.1 Sizes of Unofficial Waste Disposal Sites in Sauka ka Huta***

The sizes of UWDSs located in Sauka ka Huta are presented in table 5.8. The average size of the UWDSs located on tertiary roads is 847.73 m<sup>2</sup> which is greater than the average area of UWDSs - 320.5 m<sup>2</sup> – located on primary and secondary roads. However, the availability of the CWCPs on primary and secondary roads may have reduced the number of UWDSs located along primary and secondary roads.



Table 5.8: Sizes of UWDSs located on the tertiary roads in Suaka Ka Huta

<b>Identity</b>	<b>Area (m<sup>2</sup>)</b>	<b>Location (Roads)</b>
1	3328	Tertiary
2	659	Tertiary
3	808	Tertiary
4	509	Tertiary
5	567	Tertiary
6	242	Tertiary
7	175	Tertiary
8	368	Tertiary
9	883	Tertiary
11	1345	Tertiary
12	1170	Tertiary
13	558	Tertiary
14	4016	Tertiary
15	512	Tertiary
16	156	Tertiary
17	802	Tertiary
19	728	Tertiary
20	160	Tertiary
21	278	Tertiary
22	215	Tertiary
23	1102	Tertiary
24	71	Tertiary
Average	847.73	
10	308	Primary and Secondary
18	333	Primary and Secondary
Average	320.5	

### 5.3.7 Geospatial distribution analysis of waste disposal sites in Keteren Gwari district

Keteren Gwari is the smallest waste collection district in the Chanchaga local government area Minna with an area of 3.14 km<sup>2</sup>. It is in the West-centre of Minna as shown in figure 5.23. There is only 1 UWDS and 1 CWCP of which the 1 UWDS covers an area of 358 m<sup>2</sup>. Both UWDS and CWCP are located on primary and secondary roads. The CWCP is in the East and the UWDS in the West of the district.

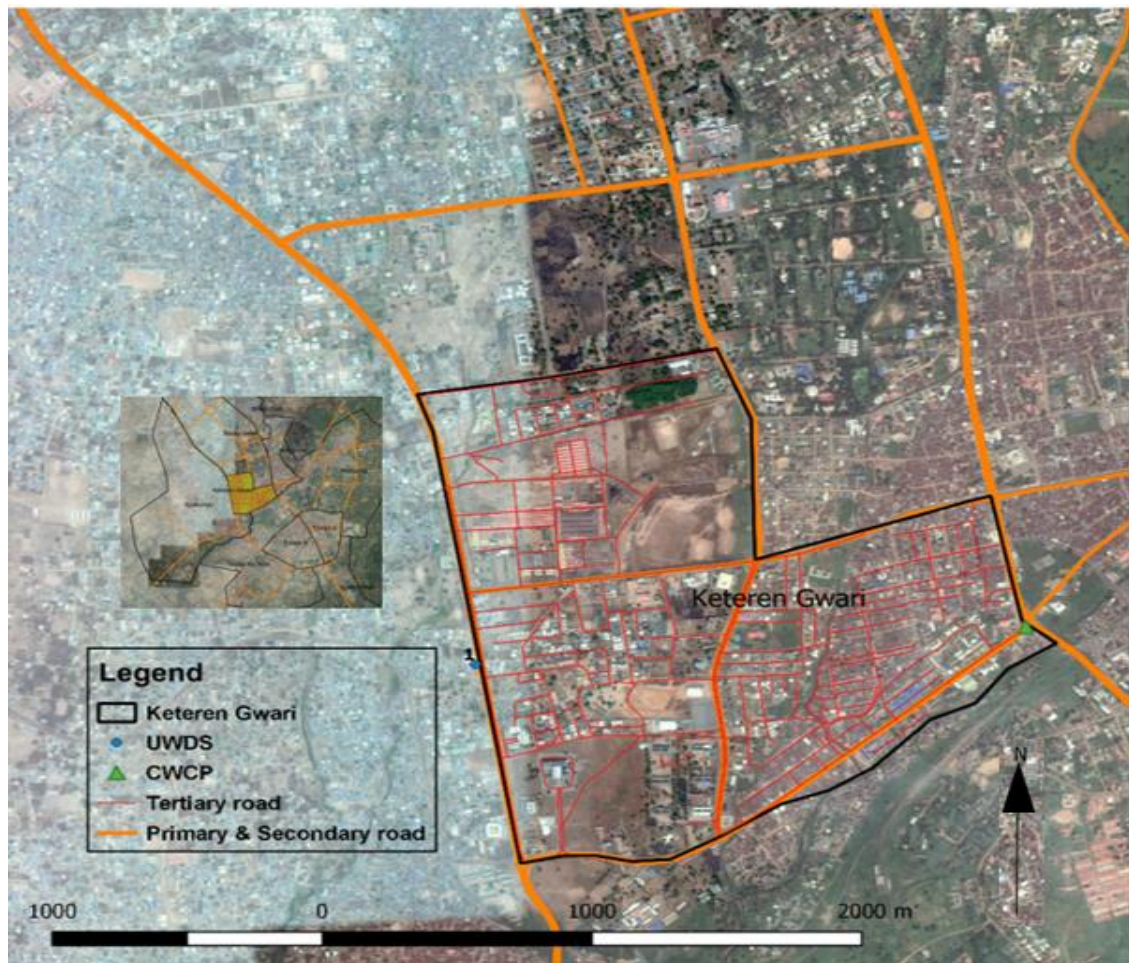


Figure 5.23: Map of Keteren Gwari Waste Collection District showing the location of UWDSs, CWCPs and Road Networks

Keteren Gwari has a good road network providing accessibility into the district. It is suggested that the absence of both UWDSs and CWCPs in the south and north of Keteren Gwari result from these being government reserved areas (GRA) which may have attracted some attention by the government agency. An effective waste

management service has been provided by NISEPA to cover these government administrative centres including the Niger State Board of Internal Revenue, Federal High Court, Niger State Development Board and Maryam Babangida Children Centre.

The South-Central region is a predominantly residential area, it is expected that there should be UWDSs, but none were recorded. The Eastern region of the district is a business centre which includes petrol stations, shopping complexes, guest houses, banking centres, faith centres and hospitals (e.g. the General Hospital Minna). Most of the business centres in this region are well-planned and built with secured fences and gates which may have resulted in the absence of UWDSs in the region. Similarly, the northern region is predominantly shopping centres and it is presumed that they have been receiving waste collection services from government waste collectors.

However, there is no restriction on residents dumping waste across the boundary of other districts. Therefore, waste generated from Keteren Gwari may be disposed of in neighbouring districts such as Sauka ka Huta and Kpakungu districts which may be partially responsible for the high number of UWDSs in these neighbouring districts.

Table 5.9: The size of UWDS and road location in Keteren Gwari

<b>Identity codes</b>	<b>Area (m<sup>2</sup>)</b>	<b>Locations (Roads)</b>
1	358	Primary and Secondary

### **5.3.8 Geospatial distribution analysis of waste disposal sites in Tunga A District**

Tunga A is one of the six waste collection districts in Chanchaga local government area. The district is in the centre of Minna with an area of 3.41 km<sup>2</sup>. There are 10 UWDSs and 2 CWCPs in the district, of which the 10 UWDSs covered an area 4,931 m<sup>2</sup>. All UWDS found in Tunga A were located on tertiary roads with the two CWCPs located along a primary road in the North-west. Six out of the 10 UWDSs are clustered in the central region while four UWDS are in the North-central part as shown in figure 5.24.

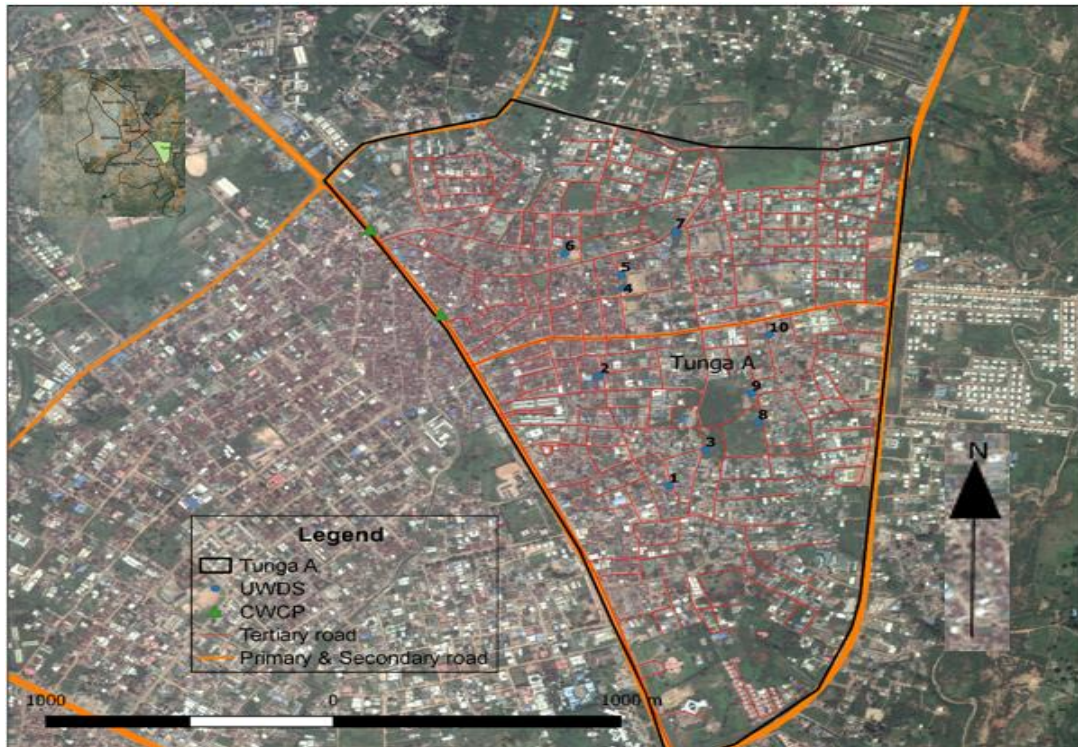


Figure 5.24: Map of Tunga A waste collection district showing the location of UWDs, CWCPs and Road Networks

There is a relatively good road network that provides access into the district. The waste collection district has two CWCPs and ten UWDs. However, the absence of UWDs and CWPCs in the Northern region can be linked to business and commercial centres such as banks, healthcare centres, hotels, parks, civic centres, shopping malls, youth play centres and faith centres located in this area. The population of the district is not known, but from the district map, it can be observed that the Western and Northwest region of the district is densely populated with clustered settlements (evidence from satellite imagery).



Table 5.10: Sizes of UWDSs and road location in Tunga A

Identity codes	Area (m <sup>2</sup> )	Location (Roads)
1	246	Tertiary
2	410	Tertiary
3	695	Tertiary
4	186	Tertiary
5	48	Tertiary
6	636	Tertiary
7	420	Tertiary
8	420	Tertiary
9	1596	Tertiary
10	274	Tertiary
Average	493.1	

Table 5.10 shows the size of UWDSs located on tertiary roads and the average size which is 493.1 m<sup>2</sup>. Figure 5.25 shows a UWDS located within the residential area of Tunga A and bounded by a wall. The site is being managed by the residents through burning to control the size and prevent litter from getting into their compounds (confirmed by the residents).



Figure 5.25: UWDS in Tunga A Waste Collection District (Author, April 2017)

### 5.3.9 Geospatial distribution analysis of waste disposal sites in Tunga B district

Tunga B has a district area of 4.37 km<sup>2</sup> and is one of the waste collection districts in Chanchaga local government areas of Minna. The waste collection district is in the centre of Minna with 6 UWDSs and 2 CWCPs of which the 6 UWDSs cover an area of 3,644m<sup>2</sup>. Figure 5.26 shows the location of the 6 UWDSs with 1 site located along a secondary road. The two CWCPs are located on tertiary roads suggesting that the district has an accessible road network. The good road network in Tunga B may have resulted in more effective waste management services from the agencies; hence there are only a six UWDSs in the district. There are 3 UWDSs located at the Northern region of the district with the 2 CWCP, compare with the Western, Eastern and Central regions that have one UWDS each with none at the Southern region of the district. However, Tunga B has one (1) CWCP and one (1) UWDS per KM<sup>2</sup> of the district size. Therefore, the location of the CWCPs and the good access roads (including tertiary, primary and secondary roads) in the district (1 per km<sup>2</sup>) is evident by the few UWDSs.

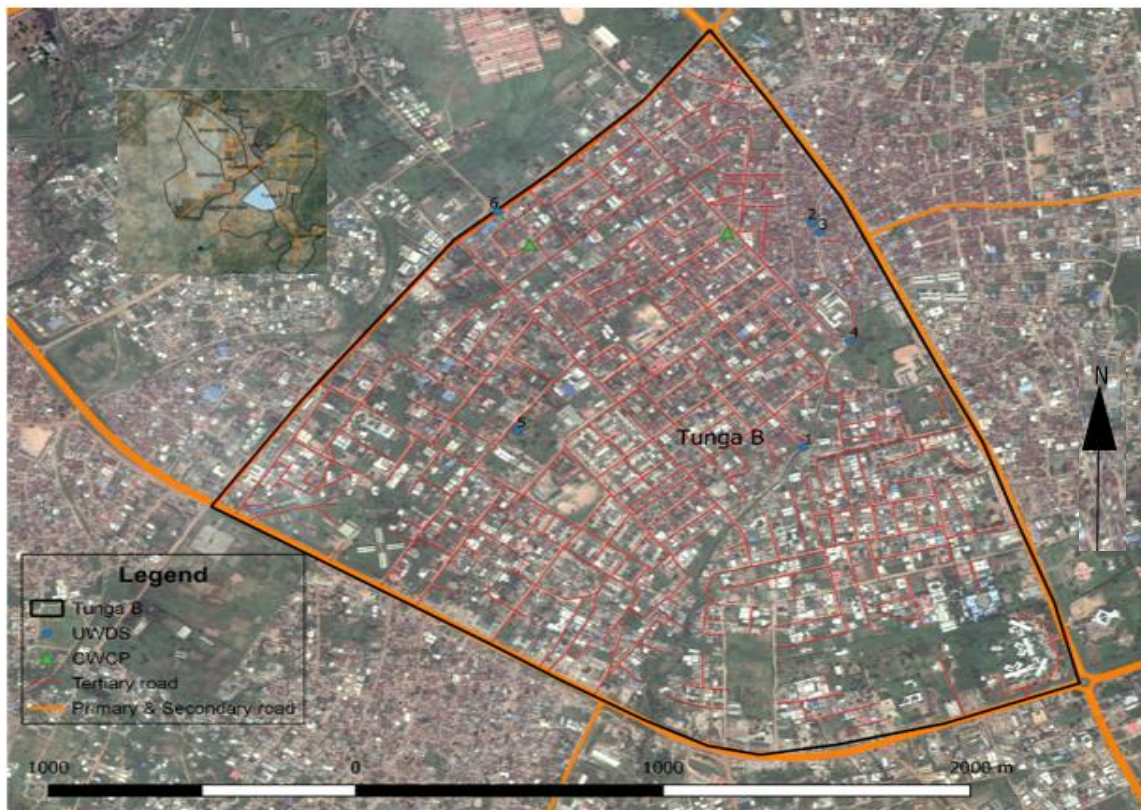


Figure 5.26: Map of Tunga A waste collection district showing the location of UWDSs, CWCPs and Road Networks

The Central and the Northern regions of the district are predominantly residential compared with the Western, Southern and Eastern regions which have business centres and government reserved areas. For instance, the south region of Tunga B has the Niger State Secretariat, complexes, hotels, shopping malls and petrol stations. Similarly, the western region of the district has the Niger State College of Education, hotels, industrial centres like Coca Cola, and banking business centres. Likewise, there are some banking headquarters, hotels and petrol stations located in the eastern region of the district.



Figure 5.27: A photo of a UWDS (site 2) in Tunga B District (Author, April 2017)

Figure 5.27 is a UWDS in Tunga B sharing a boundary with a residential area and drainage system. Based on observations, the UWDS is few metres away from Minna School of Midwifery. The UWDS may have a mixed waste of both residential and clinical waste due to proximity to the medical school. Information gathered from the residents around the site shows that young people in the district often volunteer to provide waste management services by moving the disposed waste from the drainage systems to avoid blockages that may result in future flooding. However, these voluntary services are offered by young people. NISEPA do not complement their efforts by evacuating the waste removed from the drains.

The size of the UWDS located on tertiary roads and the average area (694 m<sup>2</sup>) is shown in table 5.11 as well as the size of the UWDS located along a secondary road (174 m<sup>2</sup>).



Table 5.11: Sizes of UWDSs located on the tertiary roads in Tunga B

Identity codes	Area (m <sup>2</sup> )	Location (Roads)
1	396	Tertiary
2	1142	Tertiary
3	1738	Tertiary
4	186	Tertiary
5	8	Tertiary
Average	694	
6	174	Secondary

### 5.3.10: Geospatial distribution analysis of waste disposal sites in Chanchaga district

The Waste Collection District of Chanchaga has an area of 16.99 km<sup>2</sup> and is in the southern part of Minna. It has 10 UWDSs and 6 CWCPs, of which the 10 UWDSs cover 3,486 m<sup>2</sup>. All the six CWPCs in Chanchaga are located along primary and secondary roads while all UWDSs are located on tertiary roads. There are clusters of both CWCPs and UWDSs located in the Southern region with none in the Western and Eastern region and only 1 CWCP located in the Northern region. The south region of the waste collection district is a predominantly residential area with a few faith centres, schools, petrol stations and hotels. The absence of both UWDSs and CWCP at the western region of the district may be associated with its use as a military zone as well as government reserved area which may have been receiving effective waste management services. Some of the key government centres in this district include military barracks, Army Day Secondary School, Federal Government College Staff School and Minna Golf Club Court. In the northern region, there are fewer residential settlements, with Minna College of Education as the main social centre in the region.



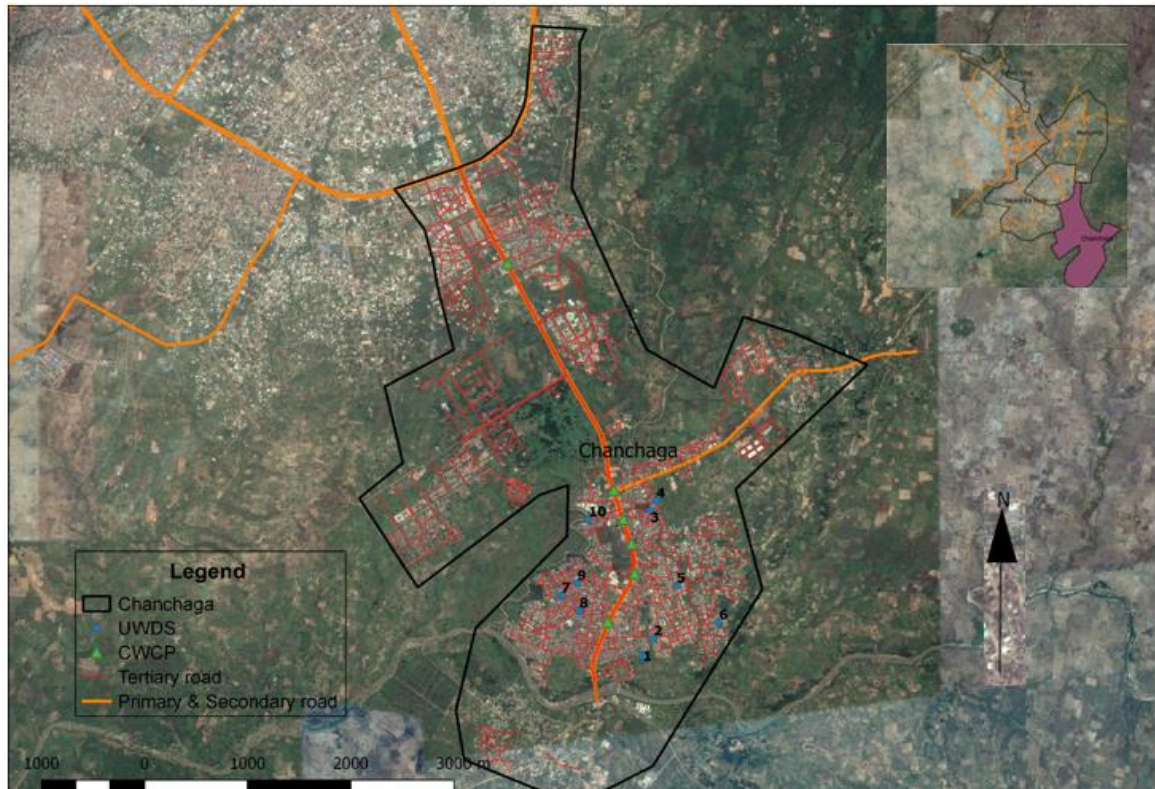


Figure 5.28: Map of Chanchaga waste collection district showing the location of UWDSs, CWCPs and Road Networks

Although the population in Chanchaga is not known, the clustered tertiary road network in the southern region indicates a high population density.

Table 5.12 shows the size of UWDSs located on tertiary roads and the average area.

Table 5.12: Sizes of UWDSs and road location in Chanchaga

<b>Identity codes</b>	<b>Area (m<sup>2</sup>)</b>	<b>Locations (Roads)</b>
1	754	Tertiary
2	420	Tertiary
3	483	Tertiary
4	180	Tertiary
5	407	Tertiary
6	280	Tertiary
7	426	Tertiary
8	38	Tertiary
9	232	Tertiary
10	266	Tertiary
Average	348.6	Tertiary

Site 1 on the district map (754 m<sup>2</sup>) is a UWDS situated on a stream of water where resident farmers grow greens, vegetables (e.g. tomatoes) and many other crops. The UWDS (figure 5.29) is a footpath where the heap of waste serves as a bridge to cross the stream to the other side of the community. Also, it can be assumed that the resident farmers use the waste to block stream water which is channelled into their farmlands to water their crops. Therefore, the development of this UWDS can be considered as purposeful, because the site serves as a bridge, footpath, water blockage to water the crops, and as organic matter for the crops.



Figure 5.29: A photo of a UWDS (site 1) in Chanchaga District (Author, April 2017).

#### **5.4 SUMMARY**

This chapter has provided a comprehensive analysis of the geospatial distribution of 141 UWDSs and 45 CWCP located across the ten waste collection districts, clustered in the two local government areas in Minna. One of the main factors influencing the distribution of UWDSs is the road network. However, there are also other factors influencing the development of UWDSs that are specifically related to the area which include:

- Availability of central waste collection points and their strategic locations,
- The population of residents and classification of the district,
- Nature of residential settlements,
- Accessibility of road networks,
- Waste management services operating in the districts – business or informal,

For instance, the siting of the CWCPs only on primary and secondary roads can be linked to poor road networks and inaccessibility of many tertiary roads. Also, the insufficient waste collection trucks affect NISEPA waste operation services and result in the emphasis on collection of waste from the CWCPs. On the other hand, in direct

contradiction, in the southern region of Bosso district where there is an excellent network of roads, there are neither available CWCPs nor UWDSs in the area. These indicate that the residents in this area might be using informal waste collectors (paid and collection agencies for waste collection), or there are NISEPA door-to-door services available to the residents. Another typical example is Keteren Gwari Waste Collection District which has 1 UWDS, 1 CWCP and an excellent network of roads.

Figure 5.9 shows that there are issues associated with the siting of the CWCPs across districts. For example:

- 1) The CWCPs are not evenly distributed across districts;
- 2) They are majorly clustered across districts;
- 3) They are generally sited on primary and secondary roads.

It is suggested that the distribution is associated with practical considerations related to vehicle access, historical practices, and ease of collection.

Further findings will be provided in chapter six to complement analysis in this chapter while answering emerging questions concerning the relative disparity in the influence of these factors in the development of UWDS across the ten waste collection districts.

## **CHAPTER SIX: PUBLIC ATTITUDE AND PERCEPTION OF WASTE COLLECTION AND DISPOSAL IN MINNA**

### **6.1 INTRODUCTION**

This chapter presents the findings from the household survey conducted to complement the geo-spatial mapping reported in chapter five. The study investigates the public perception of their local waste management and if their attitudes influence the development of UWDSs. A comparison is made of the causes for the development of UWDSs across the ten defined waste collection districts in Minna.

This chapter initially summarizes the relevant key findings from chapter five and then provides the demographic characteristics of the survey respondents and analyses the influence of demographics on the perceptions of respondents. The chapter also presents a data analysis of the respondents' views on waste collection and disposal practices in Minna. The methodology for this study is presented in Chapter Four.

### **6.2 RELEVANT FINDINGS FROM CHAPTER FIVE**

The geo-spatial mapping of waste disposal sites conducted across the ten waste collection districts identified road network type, location of CWCP, and the availability of waste management services operating in districts as key factors influencing the formation of UWDSs. One of the key findings was that the CWCPs were not evenly distributed, and in many cases were clustered together and sited along primary and secondary roads – most likely because of ease of access and collection.

### **6.3 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS**

A total of 250-questionnaires was distributed in this study and 234 were completed and returned; hence, there was a high response rate of 93.6%. Table 6.1 presents a summary of the demographic characteristics of respondents. In this research, male residents were the major respondents (n=157; 68.6%) who came forward to supply data or information on family perceptions regarding their household's waste collection and disposal. It was recorded that 28.6% of the respondents were aged between 26 to 30 years and 23.95% were between 31 to 35 years of age, which indicates that a reasonable

number of the respondents are of working age. It is shown from the survey that 79.9% had tertiary/higher education as their highest qualification followed by secondary education (n=40; 17.1%). The survey was designed for the residents of Minna only, and it was recorded that 98% of the respondents have been living in Minna for at least one year. The study reveals that the majority (n=98; 42.1%) of respondents are either self-employed, a civil servant (n=42; 18%) or an employee in a private company (n=36; 15.5%).

Table 6.1: Respondent Demographics

<b>Demographic</b>	<b>Number of respondents</b>	<b>Percentage (%)</b>
<b>Gender</b>		
<b>Male</b>	157	68.6
<b>Female</b>	72	31.4
<b>N=229</b>		
<b>Age group (years)</b>		
<b>18-25</b>	36	15.4
<b>26-30</b>	67	28.6
<b>31-35</b>	56	23.9
<b>36-40</b>	39	16.7
<b>41-45</b>	23	9.8
<b>46-50</b>	9	3.8
<b>51-55</b>	2	0.9
<b>56-60</b>	1	0.4
<b>60+</b>	1	0.4
<b>Educational qualification</b>		
<b>Primary</b>	7	3
<b>Secondary</b>	40	17.1
<b>Tertiary/HE (i.e. above A level)</b>	187	79.9
<b>mN=234</b>		

<b>Occupation</b>		
<b>Civil servant</b>	42	18
<b>Unemployed</b>	21	9
<b>Self-employed</b>	98	42.1
<b>Work with a private company</b>	36	15.5
<b>Retired</b>	3	1.3
<b>Student</b>	33	14.2
<b>No response</b>	1	
<b>N=234</b>		
<b>Years of living in Minna</b>		
<b>&lt;1 year</b>	5	2.1
<b>1-5 years</b>	36	15.5
<b>6-10 years</b>	64	27.5
<b>11-20 years</b>	68	29.2
<b>21-30 years</b>	47	20.2
<b>&gt;30 years</b>	13	5.6

#### **6.4 RESPONDENTS VIEWS/PERCEPTIONS OF WASTE COLLECTION AND DISPOSAL IN MINNA**

Findings from this study reveal the perceptions/views of Minna residents on waste collection and disposal practices. By assessing the perceptions of residents, some of the key factors leading to the development may be identified.

##### **6.4.1 Provision and cost of residents' waste storage containers**

Figure 6.1 presents different types of bin used for waste storage in Minna. This includes (a) metal drums (NISEPA recommended bin), (b) plastic baskets, (c) plastic bags, (d) plastic wheeled bins and other waste containers that may be insignificant to capture (figure 6.1). Plastic baskets (b) are mostly used indoor alongside plastic bags (c) which are cheaper but not durable. However, plastic bags are disposed of once used with the



waste while plastic baskets are emptied and reused until broken. This could be the reason for 33.5% of the respondents using a plastic basket and 23.2% using plastic bags (figure 6.1 and figure 6.2). Meanwhile, the plastic wheeled bins (d) have a lid and are kept outside; they are durable but expensive (N20,000 sold in the market), so only a few residents use them (4.5%).



Figure 6.1: Types of waste storage bins used by residents of Minna

Figure 6.1A was the metal drum bin recommended by the government as the official waste storage bin for residents. The metal drums are durable, have a large capacity of



approximately 250 litres, and are kept outside homes. However, the major disadvantage associated with a metal drum is that they rust easily; and are of low quality for waste storage. The government official metal drums are provided by the local authority and sold at N3,000 each (official price) to the public for waste storage. However, the findings from this study reveal that there is a wide disparity in the amount paid for metal drums with some provided at no cost (Table 6.2). This could be the reason for 61.6% of the respondents' using other types of bins (figure 6.1 and figure 6.2) instead of the official metal drum bin approved by the Government or the wheelie bin, being too expensive in price.

Waste collection is influenced by NISEPA only collecting waste stored in metal drums, wheeled bins or plastic baskets. Meanwhile the black bin bags, being small, are not expected to be put outside for the waste collectors to pick up because they will be ignored and left on the street. So, residents having the right bin type, but not living along NISEPA waste collection routes, would not have their waste collected by NISEPA. This is because NISEPA have their waste collection scheduled routes (see appendix 4) which did not cover all the wards/districts. This could be associated with a shortage of waste collection trucks, waste collection staff, etc. as reported by some of the respondents. Therefore, waste is only collected from households with appropriate bins and on NISEPA waste collection routes.

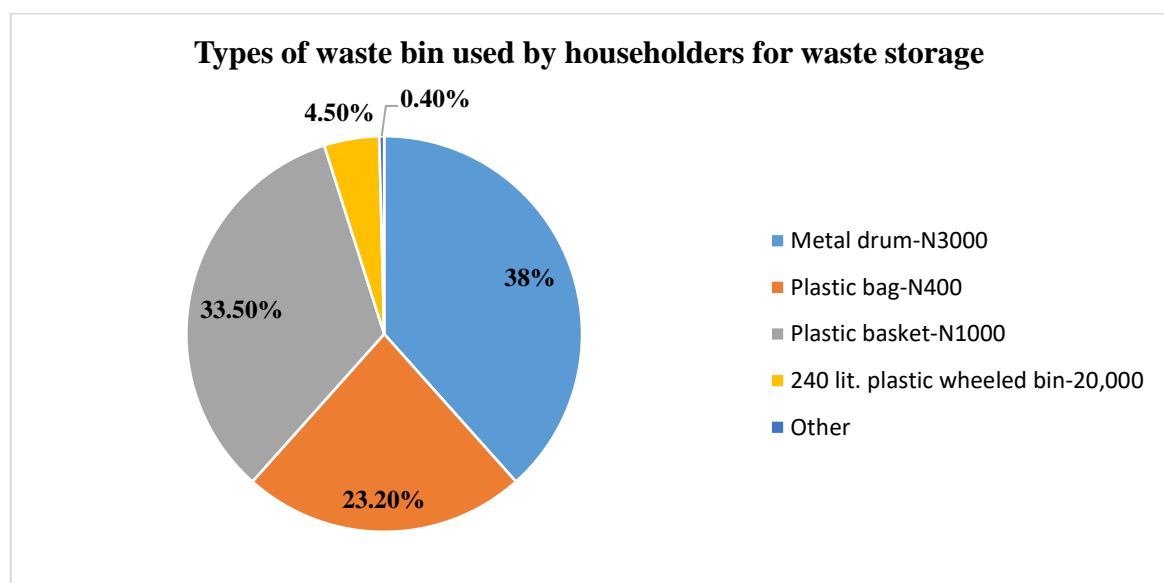


Figure 6.2: Type of waste bin used by householders for waste storage

Table 6.2: Different prices of the approved waste bin purchase by residents in NISEPA ten (10) waste collection district

Districts														
Naira (N)	2	4	5	1	1	2	2	2	3	3	4	4	5	F
	0	0	0	0	5	0	5	7	0	5	0	5	0	r
	0	0	0	0	0	0	0	0	0	0	0	0	0	e
				0	0	0	0	0	0	0	0	0	0	e
Bosso West				1				1	2				1	1
Bosso East			1			1			1					4
Maitumbi			1					1	5					1
Sabon Gari	1					1	1	1	4					
Kpakungu						2			1					2
Sauka ka Huta								1	3					3
Keteren gwari						2		2	1			1		3
Tunga A			2	1		1		1	1	1				
Tunga B								1	5					
Chanchaga		1		2	1	2	2							

The results in figure 6.2 and table 6.2 clearly show disparities in the price of the official bin (metal drum), and this could be a factor in some areas deterring people from purchasing bins from the waste management authority. For example, the majority (55.2%) of respondents reported that the bin was too expensive which could be linked to the disparity in price of the official bin. Meanwhile some of the respondents gave their reasons for not purchasing the government recommended bin as too big (13.5%), low quality (13.5%), too small (0.61%) and other reasons (17.20%). (See figure 6.3).

The disparity in price can be considered as a sign of potential corruption, which will be discussed in detail in chapter seven. Also, this could be linked to some areas in Minna containing government structures/government reserved areas (e.g. Keteren Gwari, the southern region of Bosso West, etc.) which are receiving effective waste management services, in the absence of UWDSs and CWCPs. This may be an example of the practical consideration (special attention or treatment) given to some areas, or it is associated

with traditional practices of affluent people being given priority treatment due to class bias.

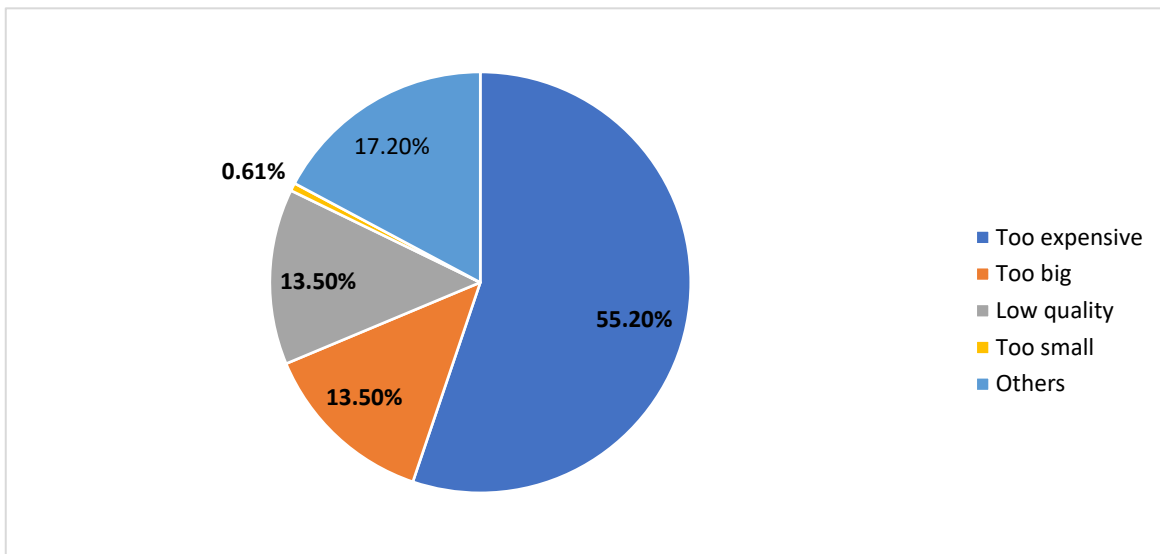


Figure 6.3: Reasons for not purchasing the official bin (metal drum)

It was observed during the study that businesses also purchase different types of bins (see figure 6.1 above) for their waste storage. However, the businesses (e.g. shops, stores, mall, plaza, etc.) located along the major roads (both primary and secondary roads) tend to use the CWCPs within their proximity.



Figure 6.4: Official waste bins approved in the case study area for waste storage (Author, May 2017)

#### 6.4.2 Waste collection services in Minna

Figure 6.5 shows that most respondents (42.7%) either never have their waste collected by NISEPA or it is rarely collected (41%). This suggests that collection services are often irregular and infrequent in areas where the authority may claim to have a regular collection service (see figure 6.5 and appendix 4). Although the survey was not conducted based on NISEPA specified waste collection routes, however, NISEPA waste collection scheduled documentation is evidence (see appendix 4) that there are disparities in rendering services to the people. This is because NISEPA waste collection documentation shows that some regions within districts receive waste collection services 6 times a week (Monday - Saturday) while others have only three times a week on average (see appendix 4). It suggests that those areas receiving services daily (Monday – Saturday) as reported by NISEPA are those living along primary and secondary roads as these could be associated with the fact that the waste collection trucks operate majorly on primary and secondary roads where the CWCPs are sited. Therefore, based on NISEPA waste collection schedule documentation and the waste collection services reported by respondents in figure 6.5, it is evident that there are some limitations associated with waste management services operating in Minna (e.g. waste collection).

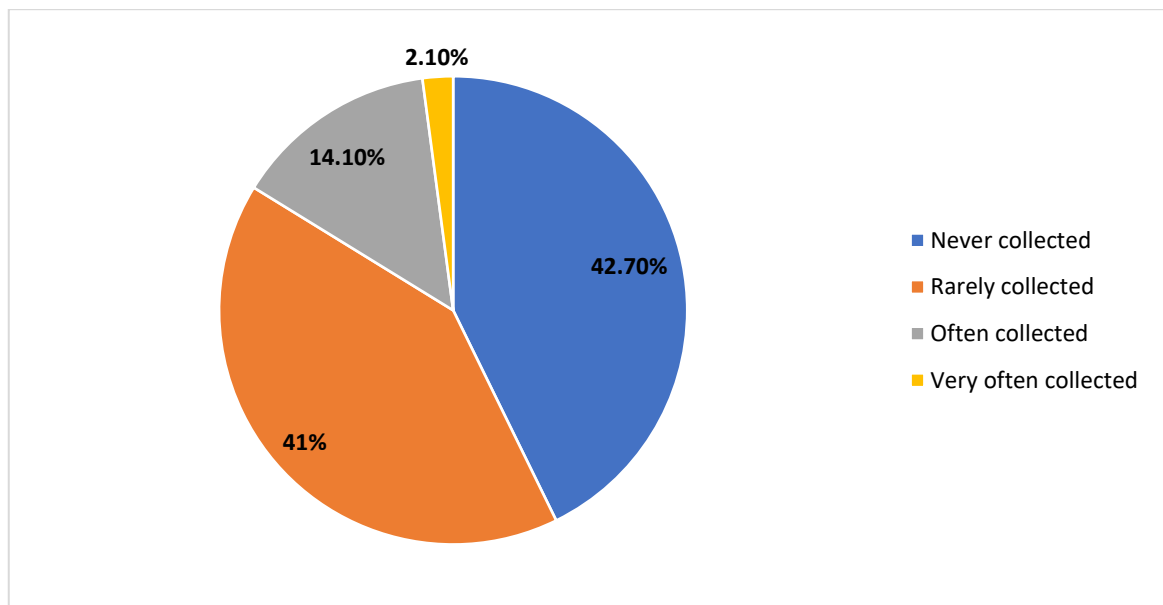


Figure 6.5: Frequency of waste collection services received by residents of Minna

There is an existing waste collection schedule across the ten waste collection districts in Minna. In some cases, residents are aware of the scheduled dates for their waste collection, while some of the residents remain unsure. Being unaware of the scheduled dates for waste collection may lead to residents using UWDSs and burning of waste, as the respondents may miss the dates/times to take out their waste to the designated area for collection and be at distance from a CWCP.

Figure 6.6 presents the frequency of scheduled waste collection with the highest (39.20%) being once a week followed by two times a week (31.50%) and the least (0.90%) being four times a week. A quarter (25.40%) of respondents reported that they have no idea of when their waste was scheduled to be collected, thus highlighting a potential lack of consistency in the service, lack of information and communication.

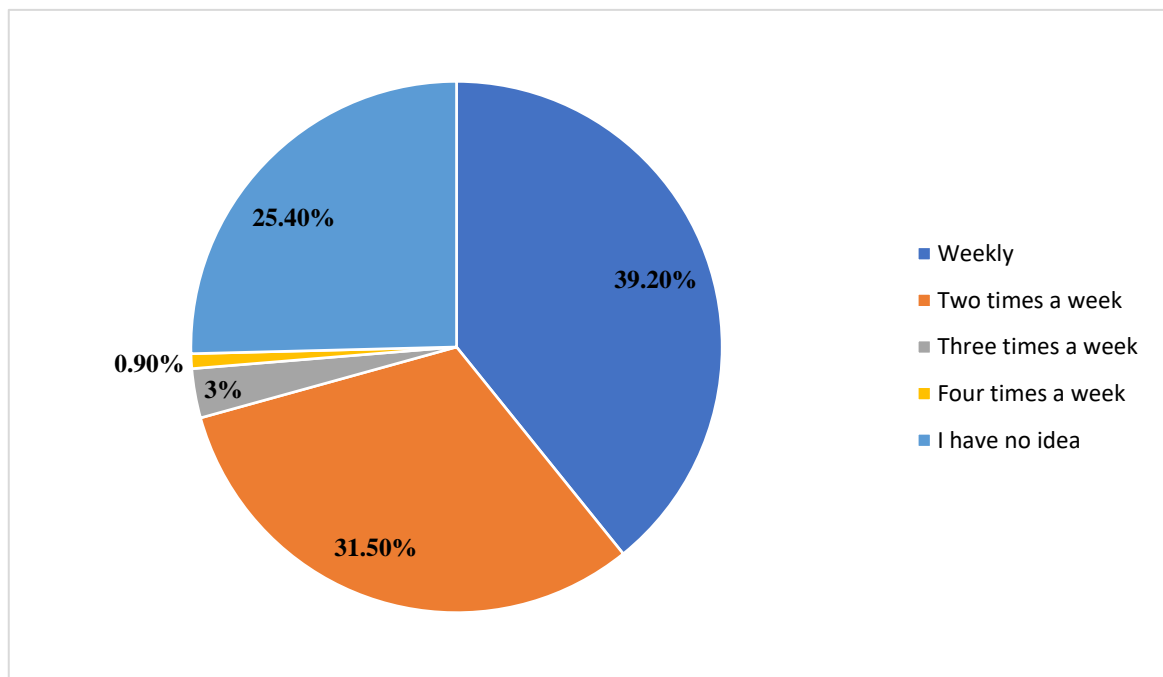


Figure 6.6: Frequency of waste collection schedule understood by residents in Minna

NISEPA waste collection schedule documentation reviewed in this study shows that waste collection services vary in each district and differ between regions within districts. The reasons for this variation may include accessibility, government reserved areas, or class of residents living in certain areas, being high or low-income earners, etc as established in chapter five. Therefore, it can be suggested that the waste collection

scheduled reported by residents in figure 6.6 agreed with the NISEPA waste collection scheduled documentation in table 6.3 as there are variations in services (see table 6.3 and Appendix 4).

A descriptive analysis was done to determine the average number of times residents' waste was scheduled to be collected and the average number of times it was collected. NISEPA waste collection schedule document was studied, which shows that, on average, waste collection service frequency is three times per week, except Tunga B which recorded an average of two times per week (see table 6.3). Meanwhile, the frequency of waste expected/perceived to be collected in table 6.3 by residents shows an average of two times (2.32) times per week (table 6.3). Also, the average number of times waste was collected is also two times (1.94) per week (table 6.3). Therefore, both the waste expected collection scheduled days and the actual waste collection services received are almost identical.

Although the actual collections services may be low, in some cases the rate of actual collection services received may be higher than the collection scheduled understood by the residents (table 6.3). However, based on the number of UWDSs found per district, Kpakungu waste collection district has 41 UWDSs as shown in section 5.2.1 of chapter five as the highest, followed by Sauka ka Huta (24 UWDSs) among other districts. So, in terms of number of UWDSs per km<sup>2</sup> of district size, Bosso East and Tunga A recorded the highest number of UWDSs, three (3) sites each, followed by Kpakungu district with two sites and the rest of the districts has one UWDS each (Table 5.1 of chapter 5).

Table 6.3: Comparison between districts and waste collection services

COLLECTION SERVICES: The frequency of waste collection services per week			
Districts	Collection Rate per week stated by NISEPA	Rate of waste collection understood by residents (Mean)	Rate of waste collection reported by residents (Mean)
Bosso East	3 times	2.22	1.73
Bosso West	3 times	2.05	2
Chanchaga	3 times	1.38	2.59
Keteren Gwari	3 times	2.95	1.76
Kpakungu	3 times	2.76	2.14
Maitumbi	3 times	1.44	2.11
Sabon Gari	3 times	2.3	2.04
Sauka ka Huta	3 times	2.8	1.96
Tunga A.	3 times	2.72	1.6
Tunga B.	2 times	2.2	1.55
Overall average		Overall average = 2.32	Overall average = 1.94

Again, Keteren Gwari recorded the lowest number of UWDS (1) and 0 UWDS per km<sup>2</sup> of districts size in chapter five, and surprisingly, 60% of the respondents reported they did not receive waste collection services from their homes (table 6.4). However, this affirmed the assumption made in chapter five that the absence of UWDSs in Keteren Gwari district may be because the residents are using private/informal waste collectors or dumping their waste at the neighbouring districts making them have more UWDSs (e.g. Kpakungu 41 and Sauka Ka Huta 24 sites). On the contrary, Chanchaga district has the highest number of respondents who received waste collection services from their homes (70.80% respondents) while 29.20% reported that they did not receive one, and there are ten UWDSs in the district of which only one (1) site is per km<sup>2</sup> of the district size.

In the geo-spatial mapping chapter, Maitumbi district has a unique case of 14 UWDSs and 11 CWCPs. Meanwhile, there is only one CWCP and one UWDS per km<sup>2</sup> of the district size (table 5.1 in chapter 5). On the other hand, this study reports that 50% of the respondents receive waste collection services from their homes (door to door collection). However, Table 6.4 shows the ten waste collection districts and the percentage of the respondents' responses to waste collection services received. Therefore, it may be concluded that ineffective and infrequent waste collection services across the waste collection districts in Minna is a contributory factor to the development of UWDSs.

Table 6.4: Waste collection services from home (door to door collection)

Is the waste collected from your home by NISEPA?		
Districts	N	% of door to door collection services
Bosso East	22	54.5
Bosso West	21	33.3
Chanchaga	24	70.80
Keteren Gwari	25	40
Kpakungu	25	40
Maitumbi	22	50
Sabon Gari	25	52
Sauka ka Huta	20	65
Tunga A.	22	45.50
Tunga B.	23	43.50
Overall	229	49.46

When residential waste was not collected and disposed of appropriately, residents tend to manage it in their own way; either burning the waste, dumping at a UWDS or taking to a designated CWCP as shown in chapter five. Public opinion on the effectiveness of waste management in Minna reveals that 37.2% of respondents report fair waste management services in their area (figure 6.7). Meanwhile, 32.9% of the respondents report poor waste collection services and 15.80% indicate very poor services (figure 6.7).



The poor and very poor waste management services reported by residents in figure 6.6 can be linked to those reported as never collected in figure 6.5.

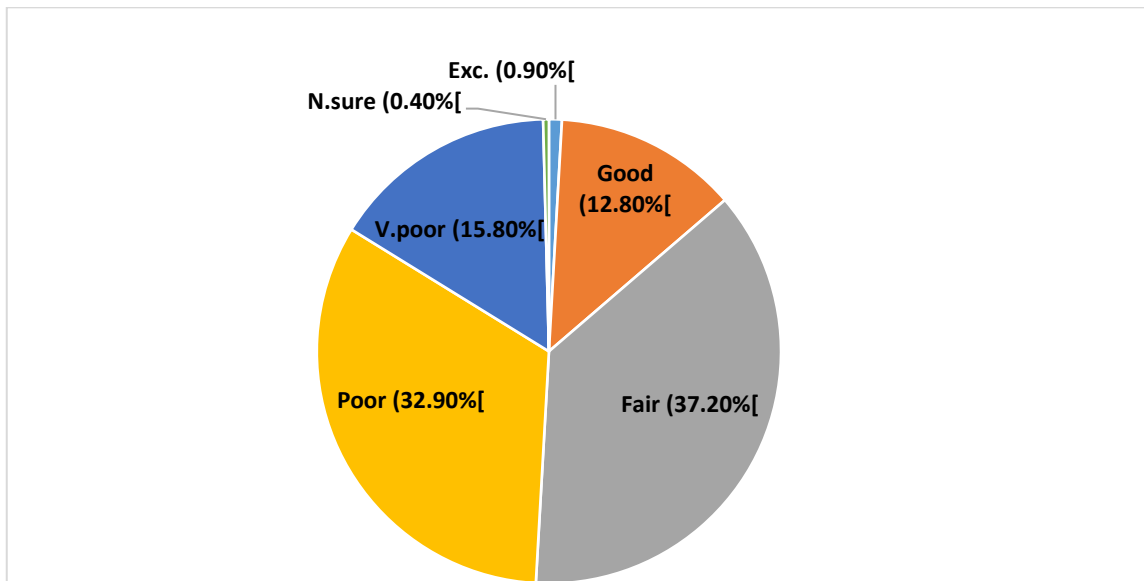


Figure 6.7: Respondent response to the effectiveness of waste management in Minna.

Table 6.5: The relationship between districts and respondents' perception of the effectiveness of waste management in their area.

District	Excellent/ Good (%)	Fair (%)	Poor/Very poor (%)	N
Bosso East	13.6	45.5	40.9	22
Bosso West	18.2	27.3	54.5	22
Chanchaga	37.5	29.2	33.3	24
Keteren Gwari	24	20	56	25
Kpakungu	8.3	37.5	54.2	24
Maitumbi	31.8	36.4	31.8	22
Sabon Gari	37.5	20.8	41.7	24
Sauka ka Huta	42.9	38.1	19	21
Tunga A.	27.3	27.3	45.5	22
Tunga B.	17.4	39.1	43.5	23
Total	25.8	31.9	42.4	229

From table 6.5, the respondents' perception of waste management in their area records 42.4% of the services being poor/very poor and 31.9% fair. However, the frequency of waste collection may directly relate to UWDSs formation and use.

### 6.4.3 Waste disposal practices in Minna

33.5% of respondents indicate that they use unofficial open spaces to dispose of their waste, while 22% indicate that they burn their waste, as well as 12.3% who dump their waste in rivers and streams or drains. Also, 10.1% report that they dispose of their waste through informal means (e.g. pay and collect agencies or individual waste collection) which may end up in open spaces (e.g. see section 5.3.1 in chapter 5). In proportion, up to 78% of the waste is disposed of through unofficial waste operation methods. Only 22% of respondents use central waste collection point services, as shown in figure 6.8. Therefore, more household use other options of waste disposal methods in the absence of CWCP (due to distance) and government door to door collection services (figure 6.8).

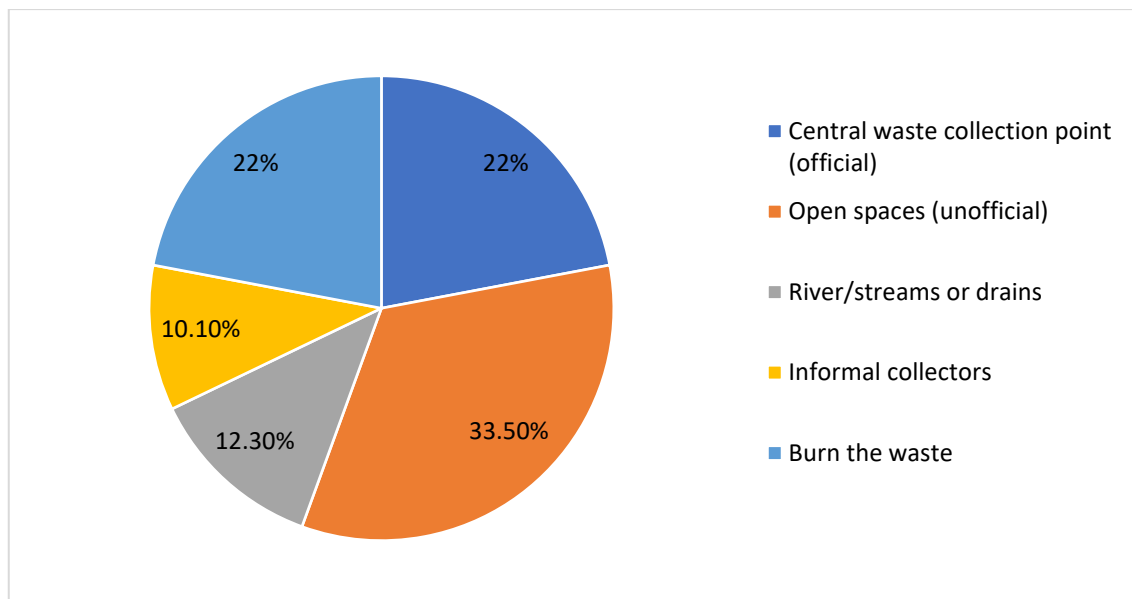


Figure 6.8: Waste disposal options used by householders in Minna

Householders gather their waste and burn it in the backyard or in front of their houses (figure 6.9). Respondents of this study gave their reasons (in figure 6.10) for burning their waste including lack of government waste collection and disposal services, and infrequent collection services. The burning of waste was considered a cheap and easy

way of disposing of waste by 22% of the respondents. Babayemi and Dauda (2009) posited that:

*“Several Nigerians have considered it a cheap way of disposing of their solid waste by setting the mixed waste on fire in a little corner in their backyard or a very open place. Even mountains of mixed solid waste in so-called designated places are set on fire; thick and dark smoke from burning plastic components have been seen spiralling up into the sky causing serious environmental pollution”.*

For example, figure 6.9 shows a UWDS mapped with thick and dark smoke from burning tyres in proximity to a public motor park (public transport motor station) and residential in Minna.



Figure 6.9: Tyre burnt on a UWDS amidst residential areas and waste burnt at the backyard in Minna (Author, April 2017).

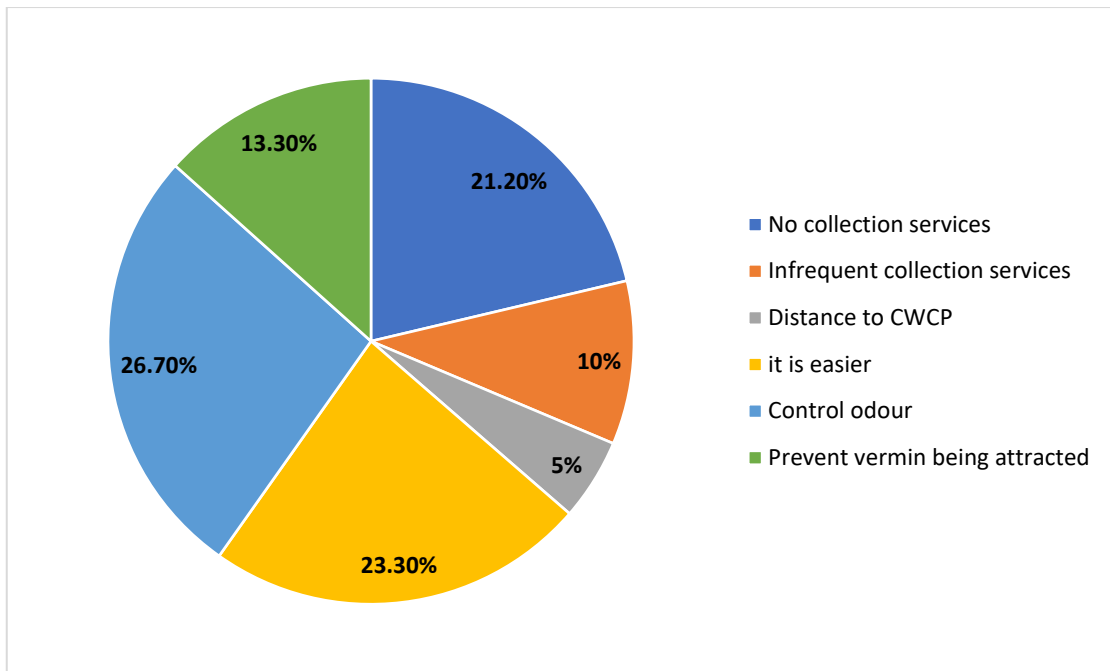


Figure 6.10: Reasons for burning waste by residents of Minna

It was observed that some of the UWDSs are used as communal defecation sites for residents considering that most houses only have latrines (pit toilets) in their homes with only a few having water closet systems. Consequently, in some cases where a dumpsite is by a window or in front of a house, the residents are automatically deprived of proper ventilation and the health impact of siting a UWDS by someone's window cannot be quantified.

The respondents point out some issues surrounding the creation of UWDSs and burning of waste such as *"government do what they like; government do not care about the public; government work at will"*, and so on. Such statements are evident of 'work alone', which means that the public are not informed, and they know little or nothing about the current state of waste management because they only see things happen. Therefore, public education and awareness would be required to communicate waste management activities and changes to the general public.

#### 6.4.4 Location of CWCPs and their proximity to residents

To answer the question of how far the waste disposal sites are from the residents, the researcher asked residents to report the estimated time it takes them to walk to the point where they disposed of their waste. This is because, in the Nigeria context, it is easier to ask the public to estimate time rather than distance. Result in Table 6.6 shows that a significant number of residents (65.9%) took up to ten minutes to reach an unofficial site.

Table 6.6: Time taken for householders to access waste disposal sites

Proximity of site to residents (per time by walk)	Proximity to UWDS	Proximity to CWCP (official sites)
1 minute – 10 minutes	65.9% respondents	46.3% respondents
11 minutes – 30 minutes	24.6% respondents	30.5% respondents
31 minutes – 1 hour	5.0% respondents	20.2% respondents
1 hour – 2 hours	3.4% respondents	2.5% respondents
More than 2 hours	1.1% respondents	0.5% respondents
Total number of respondents	179 respondents	203 respondents

More people are closer to a UWDS than a CWCP. For example, 65.9% of the respondents in table 6.6 get to the nearest UWDS within ten minutes by walking while 46.3% take the same ten minutes to reach the nearest CWCP. Also, 24.6% of the respondents take 11-30 minutes to reach the nearest UWDS and 30.5% of the respondents take 11-30 minutes to reach the nearest CWCP. However, from table 6.6, it was observed that CWCPs are far from the place of residence of many respondents as about a quarter of respondents' report that they walk for over 30 minutes to their nearest CWCPs. Therefore, the location and distance of the CWCPs to residents may be a contributory factor to the development of UWDSs within residential areas.

Although walking speed can vary greatly depending on several factors such as weight, age, load carried, culture, effort, surface, and fitness, in this case, it is expected that the residents going to the CWCPs are carrying their waste with them, which may be heavy and slow their speed of walking to the site. Therefore, for the fact that a reasonable number (43 out of 45) of CWCPs are located along primary and secondary roads means it is a contributory factor to the formation of UWDSs within residential areas.

#### **6.4.5 Public knowledge on waste management in Minna**

Waste management in Minna was free at the time of this survey, except in planned estates where the resident pays N1,000 per household for their waste collection and disposal service, although there are plans to implement payment (N1,000 per household) for waste management services to all residents of Minna soon. Nevertheless, this study enquires from the residents on their willingness to start paying for waste management services that have been free from inception. The study findings reveal that 75.5% (n=173) of the respondents indicate an interest/willingness to start paying for their waste collection and disposal services for effective waste management. However, 84.2% of the respondents are willing to pay N500 (£1 equivalent) per month, while only 12.6% (n=23) respondents indicated that they would pay N1,000 (£2 equivalent) per month to improve the waste management services in Minna. Therefore, for the new plan to implement payment (N1,000) for waste collection and disposal services in Minna, it can be suggested, based on this study, that N500 will be perceptible for the resident to comply or afford.

Although there is no difference in the respondents' perceptions of waste management services (in table 6.7), the willingness to pay for their services in each district may be linked to the effectiveness of the current collection services received within a district (experiences with the service) and the class of people (low or high-income earners) living within an area of a district (e.g. estate). For example, Maitumbi Waste Collection District recorded the lowest percentage of the respondents willing to pay for waste management services (60%), which may be linked to the presence of primary and secondary roads in the district (see chapter 5) and M.I Wushishi Estate (one of the large

estates with 500,000 houses), compared with Sabon Gari District which has 100% of the respondents willing to pay.

Table 6.7: Relationship between districts and respondents' willingness to pay for waste management services.

District	N	% of respondents willing to pay
Bosso East	21	90.5
Bosso West	22	72.7
Chanchaga	21	71.4
Keteren Gwari	25	88
Kpakungu	25	88
Maitumbi	23	60
Sabon Gari	24	100
Sauka ka Huta	18	94.4
Tunga A.	21	71.4
Tunga B.	22	72.7
Total	22	80.2

It was observed at the beginning of this study that waste in Minna is managed by government agencies, private agencies, individuals and informal waste collectors. Table 6.8 presents the preference of respondents for whom should manage their waste, 41.6% prefer Government agencies and 38.2% (n=89) prefer joining the Government agency and private agencies.

In terms of preference for means of communication on waste management, 58.4% (n=136) of the respondents chose the Radio, while 24.5% (n=57) respondents selected street campaign posters as the most appropriate means of communicating waste management issues or changes in policy/regulations to the public (table 6.8).

The choice of these two means of communication may be influenced by the instability of energy supply in Minna, which may have discouraged the option of a TV program as

it would require a power supply and people to have a TV. However, since waste management awareness is essential, 51.7% (n=121) of the respondents are willing to be involved in raising awareness about waste management, while 36.3% (n=85) are unsure if they will be involved (Table 6.7).



Table 6.8: Public views and opinions on waste management in Minna

Views	Number of respondents	Percentage (%)
<b>Preferred service provider</b>		
Government agencies	97	41.6
Private agencies	24	10.3
Joint Government private	89	38.2
Individual	14	6
Informal waste collectors	9	3.9
<b>N=233</b>		
<b>Amount willing to pay</b>		
N500	154	84.2
N1,000	23	12.6
N1,500	2	1.1
N2,000	2	1.1
N2,500	1	0.5
N3,000 and above	1	0.5
<b>N=183</b>		
<b>Preferred methods of communication</b>		
TV programme	36	15.5
Radio programme	136	58.4
Leaflets	4	1.7
Street campaign posters	57	24.5
<b>N=233</b>		
<b>Willingness to be involved in raising awareness on WM</b>		
Yes, definitely	121	51.7
Yes, probably	85	36.3
Not interested	18	7.7
Not sure	10	4.3
<b>N=234</b>		

## **6.5 PUBLIC EXPECTATION AND SUGGESTIONS FOR EFFECTIVE WASTE MANAGEMENT IN MINNA**

This section presents some of the respondent's statements provided in the survey (extra information) related to public expectations of the Government for effective waste management practices in Minna. The respondent's comments show that they have no part in the waste management system, considering that the government works alone without involving them or communicating with them on the state of waste management in Minna. Therefore, since the public sees waste management as a government responsibility, a conscious effort may be required to change public perception through awareness/education and public involvement in waste management affairs.

Respondent expectations for effective waste management reported in this study were summarized and grouped into themes.

### **THEME 1: General Waste Management**

The residents of Minna have some expectations from the government to improve waste management services in their community. These expectations include: (i) extending waste management services to every part of Minna; (ii) the creation of more strategic CWCPs; (iii) the inclusion of private waste collectors as part of waste management authorities service; and (iv) government commitment to waste management as some areas are becoming worst with dirt's e.g. Kpakungu.

### **THEME 2: Waste Collection and Disposal services**

In terms of waste collections and disposal services in Minna, residents expected the following; (i) the government to provide house -to- house collection services; (ii) to provide free bins to households or make bins available for people to purchase; and (iii) household waste management should be handed over to private sectors for effective waste collection, disposal and supervision.

### **THEME 3: Policy and Regulations**

The residents expect waste management policy in Minna to be improved with effective implementation. This will enhance public responsibilities and should reduce the creation of UWDSs within residential areas. They also expect improved law enforcement related to waste that would ban the disposal of waste on streets, drains and streams implemented. The lack of enforcement has made Minna City dirty and not pleasant for residents. The residents however, acknowledge that the waste management agency needs support but also emphasize that they needed to be serious about what was expected from them.

### **THEME 4: Awareness/Education**

Waste management education and awareness was considered important by the residents. It was shown that people need to be informed on the dangers their waste activities. For example, respondents suggest that “the so-called housewife needs to be educated on how to handle waste at home; charts that contain proper waste management practice should be provided; house-to-house awareness conducted; and show on TV, Radio, etc should be made available”.

## **6.6 SUMMARY**

The public survey was intended to explore further and validate the geo-spatial findings reported in chapter five. The findings reveal that various factors influence residents' attitudes and perceptions of waste collection and disposal in Minna. This includes demographic characteristics of residents, waste management services operating in Minna, the location of CWCPs (distance from resident due to being only on Primary and secondary roads), lack of public awareness and education. Also, the findings suggest that there are some lapses in waste management services linked to insufficient waste collection and infrequent collection services which have been shown to have a significant influence on the attitudes of the residents regarding the use and development of UWDSs. It was observed that another issue that may hinder effective waste management is corruption (e.g. disparities in the sales of waste bins) and special

considerations given to certain areas. This will be discussed in more detail in chapter seven.

These findings have contributed to answering the questions of what is seen as the residents' attitude and perceptions on waste collection and disposal practice in Minna. However, the role of waste management stakeholders in the creation and management of UWDSs is to be investigated (chapter seven) as this chapter could not answer the questions of why these factors exist and how are they tackled. Therefore, these questions are addressed using semi-structured interviews in the next chapter (chapter seven) by providing analysis of the roles of stakeholders in managing waste disposal sites (both UWDSs, CWCP and the government landfill site) in Minna.

## **CHAPTER SEVEN: ROLES OF STAKEHOLDERS IN MANAGING WASTE DISPOSAL SITES IN MINNA**

### **7.1 INTRODUCTION**

This chapter examines the roles of stakeholders in managing waste disposal sites in Minna. Chapter six provided information on public perceptions of waste management in Minna. However, there were unanswered questions regarding responsibility for managing waste generated in Minna. It is not fully known who the key stakeholders are and the scope of their roles in managing waste disposal sites to the management of dumpsites. For example, what is the nature of the interaction between stakeholders, challenges and barriers to the effective management of waste, common practices and existing policies that influence the management of waste disposal sites?

This study (stakeholders' interviews) placed specific interest on stakeholders involved in waste management policies/regulations formulation and implementation, who were State Government Ministries (SGMs), State Government Agencies (SGAs), Community Heads (Community Leaders), Private Contractors and the Residents. The chapter provides stakeholders' responsibilities for managing dumpsites, and data analysis of waste management operations of the agencies and the contractors. The chapter further presents data analysis of the challenges of waste management operation and services, followed by the summary of the chapter. However, the methodology for this study is presented in Chapter Four.

Table 7.1: Themes and sub-themes identified from analysis

Research objective	Theme	Sub-themes
To identify those political factors influencing the development and management of UWDSs in Minna.	7.2 Stakeholders who manage dumpsites in Minna: who are responsible?	
	7.3 Waste management in Minna: the operation of contractors and agencies	7.3.1 Federated nature of operation of NISEPA 7.3.2 Waste management incentive to contractors
	7.4 Challenges of waste management operation and services in Minna	<p><b>7.4.1 Attitudinal challenges</b></p> 7.4.1.1 Unwillingness of the residents of Minna to pay for waste management services: 7.4.1.2 Use of waste by farmers as plant manure/fertilizer and grazing field: <p><b>7.4.2 Institutional challenges</b></p> 7.4.2.1 Funding for waste services and operations: 7.4.2.2 Lack of political will from government: 7.4.2.3 Law enforcement for waste management policies and regulations: 7.4.2.4 Corruption by the top managers in government: 7.4.2.5 Poor provision of waste collection equipment and services: <p><b>7.4.3 Environmental challenges</b></p>

## 7.2 STAKEHOLDERS' RESPONSIBILITIES FOR MANAGING DUMPSITES IN MINNA

Interviews conducted with the State Ministry of Environment who are the policy formulators reveal that there are several stakeholders who work toward achieving effective waste management in Minna. The stakeholders involved in waste management operations in Minna are the Niger State Ministry of Environment, Niger State Environmental Protection Agency (NISEPA), National Environmental Standards and Regulations Enforcement Agency (NESREA), Community Leaders within districts, private contractors and residents. These stakeholders, depending on the scope of their organisation, have varying roles in managing waste. For instance, within the government ministry of environment, there are departments with responsibilities for environmental health and environmental protection. Private contractors are responsible for waste collection while the state government ministries (SGMs) (e.g. Ministry of Environment) and state government agencies (SGAs) (e.g. NISEPA and NESREA) are formulators, implementers and enforcers of government waste management policies and regulations. However, the key stakeholder overseeing waste management operations in Minna is the Niger State Environmental Protection Agency (NISEPA). NISEPA has responsibility for awarding contracts and ensuring that government resources are managed to ensure a clean environment in Minna and its surroundings.

*The agency (NISEPA) is not directly involved in the process of collection, transportation and disposal of waste, they contract some individuals and private operators and segment the whole of Minna into districts which are allocated to each of the contractors. So, the contractors do door-to-door collection and collect at the central collection points designated by the agency (NISEPA). SGM3.*

In some cases, the private contractors' form partnerships with SGAs and SGMs in implementing government waste management regulation. In response to the question of how SGAs work with other non-government agencies, a participant (SGA1) stated that:

*“apart from the agency, we have a private organization, private contractors that partner with the government agencies to manage waste”.*

In a similar response, another participant (SGA2) stated that *“we have the private sectors or vendors that form part of the stakeholders that oversee all the collection of waste”.*

In a different view, a private contractor (PC1) stated that:

*“everybody is a stakeholder and everybody that has anything to do with the environment is a stakeholder”.* The private contractor went further to state the importance of individuals (e.g. residents/public) and their role as stakeholders in managing waste in Minna.

*For example, in the case of women in Minna, most of the waste generated is from our kitchen, and if that waste is not properly handled, properly collected and disposed of, it will lead to a disaster. So, we are to see women as part of stakeholders in waste generation, even in terms of sorting, sorting beginning or start from the point of generation and the women affairs are often saddled with that responsibility” PC3*

Responsibility to collect and dispose of waste in Minna was perceived by other participants to be a:

*‘call for everyone, and waste management should be a part of everyone lifestyle’* irrespective of job position or organisation.

Again, in answering the question of whom the participants think should be responsible for managing waste in Minna, a waste contractor also shared his view:

*“Keeping Minna environment clean is a call for everyone to answer and waste management should be part of our lifestyle. For, example, the Ministry of Information is also part of it because they are often given the responsibility of dissemination of information to the public” PC2*

These responses show that waste management operation in Minna is considered not only the responsibility of Government or Government agencies and ministries; it is a collective responsibility of every resident, irrespective of gender and professional



backgrounds. Therefore, every individual involved in managing waste in one way or other is considered as a stakeholder.

As waste management stakeholders, there is a hierarchy in reporting and discharging duties. For example, NISEPA only reports to the Ministry of Environment but gives instructions and responsibilities to the waste contractor, while every other stakeholder report to NISEPA (including the Ministry of Environment and NESREA) on any issue regarding waste, as shown in figure 7.1.

*“NISEPA is an independent agency, but we operate under the Ministry of Environment, and we report to the Permanent Secretary and the Commissioner of the Ministry from time-to-time (quarterly and as the need arise) on the activities in the agency. The ministry also has a Director for Environmental Services who liaises to the agency for the ministry”. SGA1*

Therefore, the bulk of waste management decisions are made by NISEPA, which is the key stakeholder.

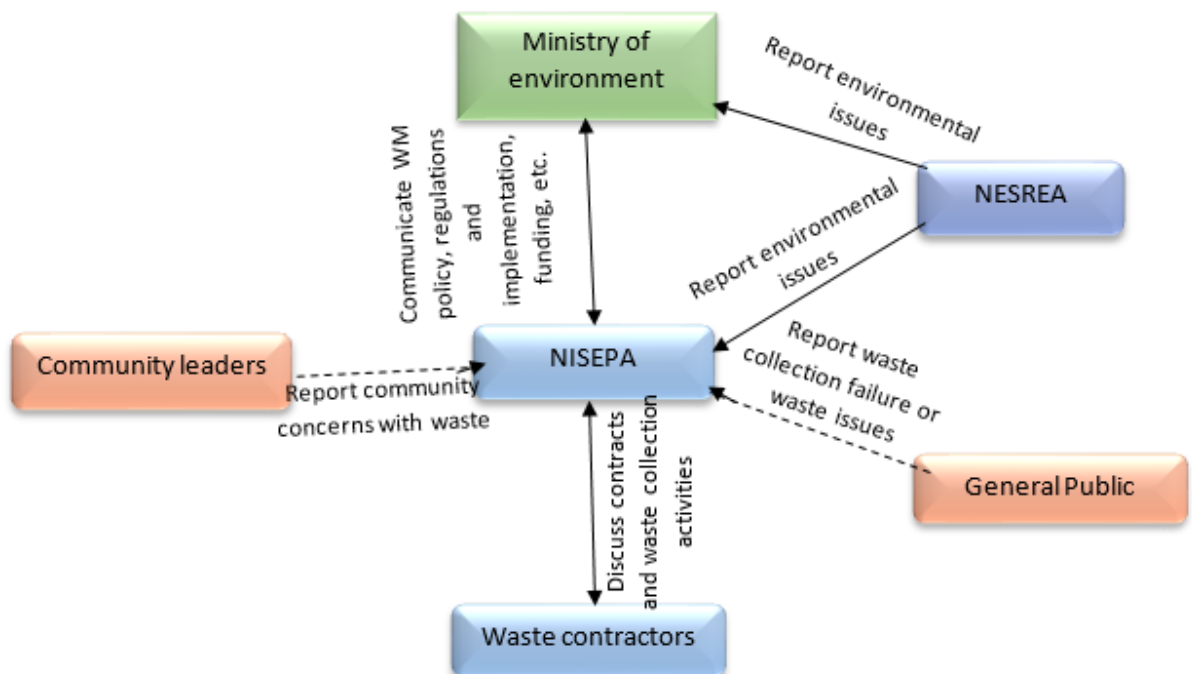


Figure 7.1: Stakeholders’ hierarchy of communication and interactions.

Overall, the stakeholder roles are primarily described through the role they play in managing waste, except the role of the community leaders and the general public. Figure 7.1 show that some of the stakeholders only report cases or issues to NISEPA (e.g. NESREA, community leaders and the general public) when necessary while others interact accordingly. For example, the community leaders and the general public only on rare occasions (presented by dotted lines) report cases such as a UWDS turning into a crime centre in the community, waste collectors not showing up and waste overflow, signs of flood in some communities due to block drainage systems, etc. to NISEPA for necessary action. Analysis of the interview data revealed that the community leaders and the public (e.g. young people) are underutilised in managing waste in Minna. All community leaders interviewed saw waste management as part of their responsibility through the influence they have on the community, but they lack government support.

*“They (Waste management authority) did not give me any role to play in terms of waste management as a community leader, and I have a lot of influence on the youth” CL1*

*“The youth has different groups, and they do come out to clean the drainage system voluntarily, but Government never support us as community leaders nor encourage the youth by incorporating them into their waste management activities at least for a token” CL2*

*“As a community leader, the Government did not tell me what to do in terms of waste management, and we always come out as a community to clean the environment and burn the waste. When I see that the environment is dirty, I do call the youth (because they listen to me) to come out for general cleaning (especially the drainage system) and then inform NISEPA afterwards to come and evacuate the waste which sometimes they do show up and sometimes not” CL3.*

These views were repeatedly reported by community leaders because their roles are not recognized but limited to handling local issues. Therefore, all community leaders interviewed felt underutilised. They perceived that a role extension would promote the utilisation of their skills and influence on the community and help to bring about effective waste management in Minna.

In contrast, many participants report that community leaders alongside with the youth (youth representatives) are involved in waste management affairs in Minna.

*"We also liaise with the community leaders, traditional heads, we meet with them; we seek their cooperation before we start things in the community. So, whoever does not try to cooperate within a community is punished by the same community" SGA1*

*"We have been trying our best through community leaders because they are the ones who live with the people so that they could control them" SGA2*

*"I know that we work with traditional rulers and all this' mai unguas' (Community leaders) and even religious leaders who help us to sensitize (educate) their ward so that when we come around to collect the waste, we could find it easy to manage" SGA2*

*"We employ the youths, and we pay them just upkeep which is better than nothing, and it is a motivation for them to do more" SGA1*

*"We have conservation officers in every district, and we have what we called environmental vanguard. They are young people employed by the government as a way of employing them" SGA1*

*"We tried all we could to prevent dumping of waste in open spaces and drainage system but to no avail, because they took another dimension by going to dump their waste at night. So, the last option was to go through community leaders to let them know because we use them to sensitize their populace" SGA2*

The last report from SGA2 indicates that community leaders are only considered when all options to communicate to the residents have failed. Therefore, community leaders are considered as options, not the key to achieving effective waste management in Minna.

*"About a year or two years ago we had a meeting with them (NISEPA) ones, which they gave us letters that we are among the stakeholders. Since then we did not hear from them and another meeting did not hold again. So, I don't have any part given to me in*

*the waste management except the general cleaning I do with my youth always. If we are involved, honestly things will be better" CL1*

*"As a community leader, some government delegate came to me to discuss about the health benefit of clean environment, but all this meeting, they only tell us that our health is important, and we should help ourselves by doing the right thing because it is for our good not for the government, that was all. So, I am not involved in waste management affairs in Minna, but I will be delighted to be part of it" CL2.*

*"... look at the young people without jobs, so if the government involves them, they will do it, and they will be happy. The government did not even involve them, but they do it willingly, so imagine if the government now involve them" CL3*

### **7.3 WASTE MANAGEMENT IN MINNA: THE OPERATION OF CONTRACTORS AND AGENCIES**

By understanding how the stakeholders operate in managing waste, and what leads to ineffective waste management services as reported in chapter 6 of the respondents' view of waste management Minna, there are two key areas drawn out that need consideration. These areas include:

- Federated nature of operation of NISEPA – a monopoly of waste management operation in Minna, and
- Service payment incentives to contractors by NISEPA

#### **7.3.1 Federated nature of operation of NISEPA**

The management structure (where NISEPA is predominantly in charge) creates a perception of overuse of power by NISEPA as a government agency. The semi-structured interviews findings show that operations of waste management in Minna are heavily dependent on NISEPA, and most services are subcontracted to private waste consultancy companies and operators.

*“We (NISEPA) could hire, and we could fire without contacting the ministry, but on policy issues, it is mandatory that the ministry must be fully briefed” SGA1*

*“According to the constitution of the Federal Republic of Nigeria, waste management is handled by local government, but because of the way the system runs, the local government does not have the capacity which NISEPA has taken over the responsibility”. SGM1*

It was revealed by SGA1 that there are about nine waste collection contractors covering the entire Minna metropolis. One of the participants (SGA2) noted that the Niger State Government appoints waste contractors who are paid for their services at month-end through NISEPA. The waste collection contractors are allocated to the ten waste collection districts in Minna. However, waste generated from Talba estate and M.I Wushishi estate in Minna is managed by private contractors instead of the state government agency (NISEPA). Estate residents pay for their waste to be collected on a scheduled date while collection in the rest of Minna is free of charge.

*“We have private companies that are registered with us, they are given designated areas, and their job is to make sure that the waste within those areas is evacuated and disposed of accordantly”. SGA2*

*“The agency must license you before you touch waste in this state, and once you are licensed you will use the official regulated site, but those that are not licensed do not have our training, so they dispose of waste anywhere”. SGA1*

*“What we do is to open an account and give it to NISEPA, NISEPA will be a signatory to that account, and we are a signatory to the account too. We charge the estates (both M.I Wushishi and Talba Estate) residents’ flat rate of N1,000 per month, and we remit 25% of the total amount paid to NISEPA at the month-end. We have payment platforms for the estate resident, you either pay to our person within the estate, use the POS, or you pay into the bank using the account information. Upon payment, the residents will have a bill (receipt) that is divided into four sections; Customer copy, bank copy, NISEPA*

*copy and our copy (private contractor) which will be submitted before the waste can be collected". PC2*

Therefore, as waste management operations are run as a business subcontracted to private business owners by NISEPA, there is an expression of monopoly where NISEPA makes and influences every decision on how the waste collection and disposal services should be carried out. By allocating private contractors to serve the Estates, residents create the perception that effectiveness of waste management depends on the class of persons (e.g high-income earners, politicians etc.) living in an area (e.g estates, government reserved areas, etc.). This set of people are given special consideration by diverting the services of the private contractors to their area leaving other areas unserved and dirty which leads to the creation of UWDS within residential areas.

Despite the federated nature of operation of NISEPA, the private waste companies and other individual business persons engage themselves in additional 'pay and collect services.

*"We collect waste from shops (e.g. shopping complex) which we charge every shop N500 per month. The N500 naira paid by the shops is not paid into NISEPA account (estate payment account) but to the property manager of the complex and then remitted to us afterwards" PC1.*

*"There are companies and some rich people that do not allow NISEPA trucks into their area to evacuate their waste, so they do bring it themselves" DSG1*

Therefore, for effective waste management, the present structure of waste management operation in Minna demands restructuring to enable equal treatment in terms of services. Moreover, the residents in chapter 6 indicate interest and willingness to pay for effective waste management services and to be involved in creating awareness.

### 7.3.2 Waste management incentive to contractors

It was indicated by all the contractors interviewed (both NISEPA contractors and Private contractors) that they lack motivation/encouragement in rendering their services which affect their productivity. Waste management incentives were considered as a significant concern as the absence of it was viewed as a setback in discharging duties. For example, evidence from the interviews shows that there is no increase in salary and no allowance to contractors, even though most of the waste contractors have been working for NISEPA for many years. With increasing inflation in Nigeria, which affects the cost of maintaining and fuelling their waste collection trucks, NISEPA has neglected the impact this may have on the contractors. Instead, government agencies incentivised the contractors by assigning them with more communities to provide services based on the amount of waste generated. Therefore, contractors considered the lackadaisical attitudes of NISEPA and the Government as a hindrance to achieving effective waste management services as the workers are not motivated.

One of the contractors stated how the increasingly high cost of vehicle maintenance has a significant impact on the level of waste services provided by their company.

*“Somewhere at the end of last year we were buying the diesel for N45 naira per litre, but as at today, we bought diesel for N185 naira per litre. There was a time we were buying diesel for N205 naira per litre, and yet NISEPA did not increase the payment, so at the end of the day we are more at the receiving end in the sense that they increase the cost of everything for us” PC2*

In a similar response to contractor payments, one of the private contractors stated that ‘payment of contractors is not NISEPA’s priority’.

*“in the government expenditure, there is what we call ‘first line charge’. What we mean by first line charge is that, when money comes from the federation account, whether it is raining cat and dogs (i.e. what come may), first-line charges will have to be deducted before they can dispose the remaining money to their respective ministries. For example, if they bring allocation from the federation account, they must remove money for*

*Doctors, for teachers and so on before they attend to any other thing. That is what we call 'first line charge'. So, in the previous administration, payment of NISEPA contractors was put in first line charge, but this present administration did not put it on the first-line charge but the availability of fund" PC1*

From the waste contractor report, it shows that change in government affects the effectiveness of waste management services in Minna either positively or negatively.

*"...the present administration, particularly the Governor, has not attached the desired importance to the issue of waste collection and disposal in Minna" PC1*

A contractor stated how the government/agency does not support or provide necessary incentives to encourage the contractors to tackle the issue of creation of unofficial dumpsites in Minna. All the contractors interviewed confirmed that

*"we are not receiving anything from the government, and the government is not assisting in doing our business (waste collection services) work" PC2.*

#### **7.4 CHALLENGES OF WASTE MANAGEMENT OPERATION AND SERVICES IN MINN**

The findings from the interviews revealed a myriad of waste management challenges that participants related to providing services that may tackle the creation of UWDSs in Minna. The challenges include attitudinal, institutional and environmental issues.

##### **7.4.1 Attitudinal challenges**

A statement drawn from one of the private contractors indicated that

*"One of the challenges which is the major one is the attitude of the people. The waste management practice here is very, very poor; people don't take it very seriously". PC3*

This statement confirms that residents and government agencies do not make waste management their priority. At the time of this study, NISEPA provides residents with free waste management services and that makes the public reluctant to pay for waste management services - even though only few pays through taxation. Furthermore, the public is not educated on how waste management services operate (communication).



There is no clarity of who should pay, who does not need to pay, and who to make payment to for effective waste management services. Although a percentage of money is deducted from the civil servant's monthly salary as tax, this is used to manage both federal and the state affairs which is not always enough (e.g. see table 6.1 – only 18% are civil servants who pay tax). Therefore, some of the residents believe that the government should pay for waste management services.

In a statement to express the challenges contractors face because of the attitudinal perception of individual residents, a contractor noted that:

*“the people in the estates (both M.I Wushishi and Talba Estates) are confused and are complaining that why are they the only people paying for waste collection and disposal services while others are enjoying free services from the government” PC1*

However, the estate residents are classified as upper-class income earners who can afford waste management services. Based on their class, the estate residents are given special and practical consideration by assigning private contractors who can offer effective waste management services to the residents.

*“The public attitude towards waste management is a challenge. For example, you will see houses built by educated people, he built a house of N20 million but for him to bring out N3,000 to buy a bin is a problem” SGA1*

*“The worst challenge we have is the attitude of the public. Some people don't care about the environment, and they don't seem to know much about the effect of the waste on their health and the environment” PC3*

The majority of stakeholders (9 participants) interviewed indicated that residents rarely consider the option of recycling waste or receive education on sorting waste components.

*“We have not started any re-use or recycling. There is also a challenge of people dumping all kind of waste in the waste bins, and they expect you to come and evacuate it. That means our people are still not used to sorting waste at all, whether it is leather, leftover*

*food, papers, broken bottles, just name it! Everything goes to one bin; no sorting, no categorization". SGA1*

Findings in chapter six show that many residents know their waste collection schedule but are not informed on waste segregations/sorting. More so, there is a culture among residents that they decide within their communities on what to do and how to manage the waste they generate. In most cases, this culture is not regulated, and this can develop to the level where communities cannot handle the generated waste or dumpsites.

*"There are some places within communities where waste disposal sites are created, controlled and managed, but there are places that when waste accumulates, it will overpower the community that they cannot control again". In some cases, the residents "put fire on waste especially during the dry season where some fumes, hazardous fumes are products that can affect human life" SGM2*

One of the waste contractors working for the NISEPA stated how frustrated their staff were when working within communities who do not allow the waste operators to come to their area because of the value in converting organic waste into fertiliser for their farmlands.

*"The residents have an executive forum within their communities. The people in the executive gave us serious frustration when we start; they do not allow trucks to pass through or go to their communities for waste collection" PC2*

Contractors working for NISEPA also noted that residents rarely use the waste metal drums and skips (at the CWCPs) provided to them by government. Some of the residents left the waste components besides the containers while some scatter the waste at a distance from the collection point.

*"Some residents do not put their waste in the proper container they supposed to put it, so they just pour it on the floor expecting their labourers (contractors) to come and gather it together before evacuating" PC3*

This attitude makes the collection more tedious than when the waste is left in the waste bins (contractors). Some contractors noted that this attitude could be linked to illiteracy and ignorance on behalf of the household.

*“For people who have not gone to school it is difficult for them to understand, they don't even care about their wives who take care of the waste, and they don't care to know where they dump the waste. For me I think ignorance and lack of awareness/education is the major problem”. SGM2*

Although residents are not ignorant on the importance of keeping their environment clean, ineffective waste collection services often lead to behaviours such as residents throwing waste through their fenced houses into the walkways and roads, littering surroundings and premises.

#### ***7.4.1.1 Unwillingness of the residents of Minna to pay for waste management services***

In Chapter six, some of the residents express the view that they want waste management services to be free of charge. Moreover, it is the government's responsibility to provide the public with an effective waste management system. Again, a response from one of the participants that *“we want free services, everybody wants free something”*, indicates the perception of residents that firstly they want a service, and if they get the service, it should be free. This response suggests that in situations where the government is unable to provide adequate waste services, and the residents cannot afford to pay private waste collectors, they may be left with no option other than the creation of UWDSs. And this is evident from a comment made by one of the community leaders that:

*The problem of unofficial waste disposal site is mostly in areas where there are no collection services” CL2.*

*“There is that difficulty in getting people to pay for the waste collection and disposal services because the government is offering free services for all residents who are a problem” SGA2*

*"For people to start paying for their services the government must come in by providing more equipment like the truck that will go into every corner if it is an area that is not accessible. They should purchase small trucks like pick-up that can go into the interior and collect the waste. When the government does all of these things, then the agency will utilize all the means that they have at hand to render the services to the people, and that is when the people will see the quality of service, they are rendering to them, and they will pay their revenue to the government" SGA3.*

However, the interview findings show that there are areas in Minna that are yet to start receiving waste collection services due to either a poor road network or insufficient trucks.

*"Every part of Minna receives waste collection services except places like Barkin sale, Kpakungu, Gurara, Mkangbe, etc. and the major reason is lack of access roads into the residential areas". SGA2*

The above statement provides further explanation for the high number of UWDSs in Kpakungu (41) and Sauka ka Huta (24) waste collection district in Chapter five, although there are plans to move receptacles (CWCPs) from some of the districts to areas where there are no collection services such as Kpakungu.

*"In reas where our waste collection service has not reached, the issue of enforcement to buy the waste bin will not go to those areas for now. Our receptacle that is kept along Chanchaga road (primary road) will be moved from that area to Kpakungu side, for the residents to put their waste instead of dropping it on the ground for the contractors to collect" SGA2*

Apart from the government free collection and disposal services that exist in Minna, there are individual business services used by residents to collect and dispose of their waste.

*"There are those individuals who use their little pick-up trucks to work house-to-house to negotiate with the household to evacuate their waste for pay, especially in areas where the big agency trucks cannot gain access. Some householders engage some of the*

*wheelbarrow pushers to collect their waste and take it to the collection point (CWCP), and they are paid". SGA3.*

*"Sometimes some people who cannot be reached by the agency waste contractors get their waste removed one way or the other, and they hire other trucks to collect their waste which it somewhere to dump since they did not register the vehicle with NISEPA. However, our enforcement unit moves about, trying to catch those kinds of people, and once they are arrested, the truck is impounded and then we fine the criminal in court"*  
SGA1

In a similar response to the question of how much the residents in Minna are charged to pay for their waste disposal services, a community leader state that;

*"The government was saying that householders will be paying either N1 or N2 through their phone to assist the government so that they will manage waste. They only said it, but they did not do it, it did not work"* CL1

Considering that the initiative of asking the residents to pay for their waste management services (through phone) by the government has failed; waste collection and disposal services have not improved, and so, the unregulated dumping of waste has become more prevalent leading to an increasing number of UWDSs across Minna. This could be the reason for the free waste management system, considering that there is no proper payment method in place for the public. Again, the respondents in Chapter six indicate interest and willingness to pay for waste management services. However, without appropriate mechanism put in place to collect the money from the public will yield no positive result as happened with the mobile payment strategy.

*I M wushishi estate and Talba estate are plan areas, and the residents are enlightened and very educated people occupying the estate. The house belongs to them, each person is occupying his own house because the government sold it to them, but can you imagine that the residents were negotiating N200 naira per month for their services?"* SGA2

The government agency and contractors dispose of collected waste on government-regulated sites (KM 12 maikunkele) while Informal collectors (pay and collect services

dump in UWDS) and some of the private waste collectors dispose of their waste in other places (e.g. Individual farmlands and UWDS). However, many participants (SGA, SGM, contractors and community leaders) report that residents/farmers request waste to be dumped on their farmlands which the public perceive to be a means of (waste contractors and SGA) making extra money who sell waste to farmers and expect them to pay for waste collection and disposal services. Therefore, this act can lead to an unwillingness to pay for waste collection services, considering the flow of communication among stakeholders in figure 7.1.

#### ***7.4.1.2 Use of waste by farmers as a fertiliser***

This study revealed that farmers encourage the creation of dumpsites by patronizing the UWDS in search of organic matter for their crops (see figure 7.2). It was reported by a waste contractor (PC2) that residents/farmers request waste from the waste disposal operators to be disposed of in their farmlands which is now a common practice in Minna.



Figure 7.2: Residents farmers scavenging for organic matter as manure/fertilizer for their farmlands (Author, April 2017)

Figure 7.2 shows how residents/farmers scavenge for organic matter from a waste disposal site. The residents/farmers confirm that the waste grows crops faster and better than the usual fertilizer, which is more expensive to them. This can be linked to poverty as many cannot afford the fertilizer in the market but the potential negative

effects of this waste on crops and human health are not considered:

*"The contractors in charge of one of the districts in Minna (district name withheld) and other nearby districts dump the collected waste in a UWDS because of farming activities around the areas as the residents are always happy when they are bringing such waste to their farmland" PC2*

*Most times when they (residents) see the truck passing they will call them and request that they should come and drop waste in their farmland. As this is a local area, every house has a place to dump their waste and when it is raining, you will see this waste moving with the water into residential houses". PC2*

*"The demand of waste services has overpowered them (NISEPA). That is why they cannot clear all, and there are so many areas with this kind of waste (UWDSs) in town in this Minna" CL2.*

Almost all participants noted that transient waste in the neighbourhoods smells and the breeze blows the smells and flies which affect the residents and communities (e.g. SGAs, Community leaders, Contractors, SGM, etc.). About poverty, one of the participants stated:

*"Considering the economic hardship and poverty situation in Minna and Nigeria, you will go and ask somebody to go and buy a waste bin or a waste container that costs N3,000 (approximately £6) or N5,000 (£10). He will tell you that he is even looking for money to go to buy food". PC1*

The demand for waste (organic matter) by residents-farmers may lead to the creation of more UWDSs within residential areas as this may be perceived as a business opportunity by residents. When sales of waste to farmers become the order of the day, then more UWDSs should be expected. Considering the health implication of mixed waste in crops/human, the use of organic matter for growing crops should be discouraged.

### 7.4.2 Institutional challenges

It was found that the key issues in institutions (e.g. state government) that oversee the roles of the stakeholders include:

- Funding for waste services and operation,
- Lack of political will from the government,
- Public awareness/education on the importance of waste management,
- Law enforcement for waste management policies and regulations,
- Corruption by the top managers in the government agencies,
- inadequate provision of waste collection equipment and services

Participants' statements on institutional challenges show that several issues are hindering effective waste management in Minna:

*"One of the challenges of effective waste management, in general, is funding. Funding is one of the biggest challenges" SGM1*

*"Lack of political will from the part of the government. If the government does not have the political will to tackle the problem, then that is a huge challenge" PC3*

*'I think the level of awareness among the populace is one of the critical challenges affecting effective waste management.'* SGM2 and PC2

In contrast, some participants believe that the two most challenging issues in providing effective waste management services in Minna are the *'residents who produce the waste and NISEPA who manage the waste'*. One of the participants further explained that the problem is more NISEPA than waste producers (the residents).

*"The challenge is from two sides, from the waste producers and NISEPA. The challenge is not coming from the community but the government side, because if there is no law enforcement, you can't blame people for doing what they are doing" PC3*

Also, some participants see corruption from the top government managers as the significant hindrance to effective waste management in Minna.



#### **7.4.2.1 Funding for waste services and operations**

It is the responsibility of the state government to ensure that waste is collected and adequately disposed of in Minna. The state government releases funds every month (as a standing order) to pay contractors, fuel NISEPA trucks, pay cleaners (women sweeping the major roads), etc (see chapter two for waste management financed and flow of fund). So, the money is paid into a NISEPA account every month (SGM1).

*“The fund release for waste management is never enough. If it were enough, we wouldn't have been thinking of diversifying and start thinking of xxx again” SGM1*

*“We have obsolete trucks and insufficient trucks which is equal to lack of fund” SGM2*

This study reveals that waste management practice in Minna is not sustainable because the population is increasing, and there is more demand for waste services, and the government cannot fund it. For example, some of the contractors' report that they are owed several months of wages by NISEPA for waste management services they have executed.

*“I have an outstanding payment getting to three months, I have not been paid for September, October 2017 and this is November, and by culture (contractual agreement) we are supposed to receive payment by 25th at most 27th of every month” PC3*

In a similar response, contractors share their thoughts:

*“Some of us were threatening that let's ask our workers not to work for a week so that people will understand what we are doing, not that they are doing us a favour, but we are actually providing a sanitary service which is very key to the people” PC2*

*“Honestly, we are experiencing poor payment, because of the labourers. You have to pay them when they come back from work; you have to pay for the vehicle you use; you have to pay for diesel you use and, at the end of the day even you the contractor has not been paid up to three months. So, this makes the work quite difficult for us. We don't wait for NISEPA; we have to pay the labourers because even though ordinarily we need to wait*

*until NISEPA pays us, but if you look at the nature of work and not demoralize the labourers, we have to source for money to pay them” PC1.*

*“Many of us, or let me say all of us, if we are not of means we will not be able to do this job (waste collection). This is because we need money to pay our workers, to buy diesel, to maintain our vehicle till any day NISEPA will pay us. And some of us that don't have the money have to borrow it. So, many of us have been running this waste collection on credit”. PC2*

Generally, it was noted among all waste contractors that the wages of the labourers who collect and dispose of the waste from the residential areas are too small. It was noted that some of the workers are paid as little as N11, 000 (approximately £22) per month which in most cases is reduced to N10, 000 per month because the employer (NISEPA) deducts N1,000 for site maintenance fee.

Some of the contractors’ state that in some cases, they have had to take out a loan because the payment from NISEPA is not regular enough to allow the contractors to save money to buy a truck. So, the waste collectors experienced delays in salary payments for two to three months. The contractors’ statement on the salary delay was

*“...so how can you save money to invest in training your labourers and buying more trucks for effective waste services when your salary is delayed for months”.*

Other contractors note that at times they end up taking out a loan from the banks to fund their waste operation services which one of the participants describing how hard it was for contractors to work with NISEPA.

*“one of the challenging points for example is when we are working, and suddenly our truck breaks down. NISEPA does not consider it whether you have worked 50% of the day or 30% of the day no, they will cancel the whole day for us, so we lose that day, and we still have to pay the labourers and repair the truck” PC1.*

This experience was shared by all contractors who participated in the interviews. The contractors report that the cost of maintaining the trucks has continued to increase,

which impose a greater financial burden on contractors, and there is no associated pay increment from the Government (e.g. NISEPA):

*“The cost of even maintaining our trucks has increased. Before now we would spend just about N50,000 Naira (approximately £100) every month to service our trucks, but presently the spending has almost doubled. We spend about N80,000 Naira (approximately £160). This is to maintain the trucks, and you cannot blame the mechanics. The cost of engine oil has increased because of the increase in the dollar (\$). So, the government is not paying us more to provide the service, and that makes it quite challenging” PC2.*

#### **7.4.2.2 Lack of political will from government**

Private contractors and those working for NISEPA express their concerns that there is little or no effective collaboration and cooperation between the contractors and NISEPA which:

‘Sees itself as a mini-god for waste management services. NISEPA does not delegate powers to both NISEPA waste contractors and contractors who work with them.’

In a statement from one of the private contractors, it was noted that:

*“NISEPA sees itself as a mini-god, and we don't have the power to enforce any waste management services without the undue implement of NISEPA, because NISEPA has all the power to enforce by-laws. So, if NISEPA had given us the necessary support to enforce rules or laws in the places like the estates, we could do better than what we are doing presently” PC1.*

Even when they (NISEPA) agree to work with contractors and strike an agreement, they rarely keep to the contract according to the waste contractors:

*“Our experience as contractors with NISEPA is not encouraging effective waste management. For example, we are supposed to have three hundred and seventy-five thousand (N375, 000) naira when we work, but we are getting fifteen to twenty thousand (N15000 to N20000) naira. We must pay for the hired truck because it is an instalment payment for the truck we do; we must buy fuel for the truck. Also, there is a*

*situation that if the truck is not full of waste, you will not be paid by NISEPA. Meanwhile, the same fuel used to transport the half-filled truck that will not be paid is the same fuel that will be used to transport the full truck.’ PC2*

The waste contractors perceive that they are only being used by NISEPA to remove waste in Minna without involving them in waste management affairs.

*"We (contractors) don't even have a forum or a union for the waste collection. We don't have a collection point that we can put pressure on the government to negotiate on what we want or what we feel is good that will improve waste management in Minna" PC1*

*"... for example, there is no room for negotiation of price when contracted by NISEPA. They only tell you the price you will be paid. If you agree you then sign, if not then forget it" PC3.*

#### **7.4.2.3 Law enforcement for waste management policies and regulations**

A lack of willingness by NISEPA to establish a collaborative working relationship with the contractors is a huge challenge. This relates to a lack of political will on the part of contractors for not giving them support to implement some laws in the Estate without being manipulated. This study reveals that there are policies and regulations established to guide waste management practices in Minna, but the challenge is enforcement. There are existing structures that the Ministry of Environment is to formulate policies which NISEPA, waste contractors, and NESREA are to implement/enforce. However, waste contractors are perceived not to be allowed to enforce any law that will improve their services:

*"The challenge is not coming from the community but also from the government side, because if there is no law enforcement, you can't blame people for doing what they are doing" PC3*

*"The Ministry makes policies that could help us (NISEPA), but we also form our regulations within the laws of the state; we have gazetted laws with regards to our operations; we have public health laws which also help us, and we make regulations on how waste should be handled and stored" SGA1*

The SGA1 report shows that NISEPA subjected those working with them (Contractors) to work within the regulations formed by NISEPA, which may not be in favour of the contractors or their workers.

For example, NISEPA has a law that 'no one touches waste in Minna except those registered with NISEPA'. However, they contracted private companies to collect waste from Estate residents and to be paid by the residents (not free like government services). The private companies have their company laws which allow them to negotiate prices of waste collection services, but NISEPA did the negotiation with the Estate residents on behalf of the private companies and only informed them of the amount agreed.

*"We (NISEPA) went to the estate and held dialogue with them. The management wrote to the estates, we sat down and negotiated with them. They wanted to pay N200 per month; we told them that even N500 naira could not work. So, we brought the price down to N1,000 per month, and there are 500 houses which is N500,000 naira, but they later refused to pay and then asked the contractor to withdraw. Presently they are not receiving services, but they came back to request for continuation of the service" SGA2*

*"We opened an account for the estate residents which NISEPA is a signatory to that account, and we are a signatory to the account too. Anyone who pays will have a bill (receipt) that is divided into four section, customer copy, bank copy, NISEPA copy and our company copy. Since we have the database of people that have paid, we go straight to their houses even when they are not at home. We go straight to collect their waste. However, we pay NISEPA 25% of the money paid by the residents every month, and the 25% is for the agency fee, which is supposed to be for the government, but we remit 25% to NISEPA for site maintenance" PC1*

The report from the SGA participant shows that private contractors and NISEPA contractors are subjected to NISEPA rules and regulations of the agency without any option. Therefore, this confirms the federated nature of NISEPA operation that makes them 'Superiors'. (See Section 2.2, Chapter two, for more information on Waste Management Law Enforcement and Policies in Minna.)

#### **7.4.2.4 Corruption by senior managers in the government**

Findings suggest that there is nepotism among managers in government Ministries/agencies who grant most waste management services contracts to private companies. This involve bribes for contracts or favours for family members. The private contractors pointed out that there is indigenous discrimination among contractors. It is suggested that only those from Minna or Niger State (known as 'Nigerlites') are awarded most waste operation contracts and are given special consideration over those that are not 'Nigerlites'. The managers of government agencies implement a policy which is favourable to indigenous workers that stipulates that 90% of staff in the companies must be 'Nigerlites'. In one of the respondents' statements:

*"We have a policy in our company that 90% of the staff in the company must be Nigerlites. So, we don't employ outsiders in the company except where the situation is critical." PC2*

The system of corruption extends to how residents are provided with services during waste collection. It was observed from interviews that wealthy residents and high-rank government employees are offered special services at the expense of poor residents. One of the respondents noted that:

*"The majority of the rich residents and high ranked government employees don't pay for waste services, especially those who are highly connected and know 'big' men (prominent men in the society)" PC1.*

Although waste collection and disposal services in Minna are predominantly free of charge, some individuals (e.g. the rich, prominent men/women, and politicians) who require special services in their areas pay for services. Therefore, this class of people has special trucks dedicated to their households for effective waste collection and disposal services.

*"Government officials hire and invite their trucks to pick up waste and people will pay, so NISEPA will just be on a backup now on the intervention". PC2*

These affluent/wealthy individuals don't allow the NISEPA trucks into their communities or areas as they see contractors are meant for poor residential areas.

*"There are some rich people who do not allow NISEPA trucks into their area to evacuate their waste, so they take their waste to the site themselves, and we don't know if they do negotiate with the environmentalist (NISEPA or Ministry of the Environment)" DSG*

In some cases, communities must lobby the local government chairman and top managers in NISEPA to plead with them to send trucks to remove heaps of waste that have become a threat to their communities. A comment from a participant noted that: *"As a community leader, I practically have to meet with the local government chairman and plead with him to use his influence to help us remove the heap of waste in my community that was turning to a crime centre". CL3*

Also, as stated earlier, private companies were assigned to collect waste from Estates residents (high-class income earners residential). However, the residents would pay for services which were agreed and had been the usual practice. The private contractors interviewed in this study noted that there was an ongoing protest from the estate residents that they cannot pay N1,000 per month for waste management services anymore because it is meant to be free for all residents:

*"One of the challenges we are facing now as contractors is that the people in the estate are complaining that why is it that some people pay for their waste collection services in Minna while some residents enjoy free services from the government? For this reason, the estate residents decided not to pay for their waste collection and disposal services forgetting that we are private collectors assigned to them, and we are not the government" PC2*

However, there is an existing culture of giving special consideration to certain individuals in Minna.

*"There are some private waste collectors that are allocated to some areas like 123 quarters, Bosso low cost, Tunga low cost, Tamoris, airport quarters, GRA,*

*commissioners' quarters, F-layout; all these areas are planned, and every house has its own bin" SGA2*

Based on SGA2 comment, it shows that the prominent men/ women in society live in well-planned areas and deserve special services and consideration. This can be linked to a sort of politics on the side of the NISEPA which can be assumed as one of the reasons for positioning almost all CWCPs (43) along the primary and secondary road to impress the government of effective services in the state.

#### ***7.4.2.5 Poor provision of waste collection equipment and services***

There are indications from the interviews that waste collection service providers and labourers are not appropriately equipped to carry out their operations. The waste operation clothing provided such as boots, gloves and hoses are not sufficient for all labourers. In a situation where a labourer does not have a spare outfit, the labourer may have to work without clothing. Similar cases were observed during the interview at the government-regulated dumpsites. There were no single structure/offices for the waste workers to rest after their morning or afternoon shifts to document the activities taking place at the site. In a statement by a participant who worked at the government-regulated sites:

*"...We do not have a seat on-site as staff, and we do not have shade. We stand in the hot sun without seating. There is no office for us on-site, and the salary is peanuts" DSG1*

Moreover, the vehicles and trucks used for waste transportation are not sufficient to cater for the demands of waste collection in Minna. More so, part of the policy for contracting waste collectors is that contractors must have not less than six tyre truck/tipper for waste transportation before he/she will be contacted. The waste transportation proves more difficult with high costs of 6 or 10 tyre tippers which only a few big private companies can afford. As a recommendation, a contractor suggests that:

*"The government needs to have more vehicles that will offload this waste outside the Minna towns" PC3*



*“There is no equipment; for now, only service trucks which are very old but able to move with the help of maintenance” SGA1*

Some participants report that there is no waste management in Minna, as there are so many factors that surround waste management.

*‘I would not call what we are doing ‘waste management’ because we are not managing, and why we don't manage is not because we lack the knowledge, but we require equipment. Waste management is costly, and because of the lack of funding the government has so much in its hands like pet care, primary and secondary health care, schools, educational development, opening of the rural areas to the city to stop rural-urban grievd which require the provision of the road network. The problems of water supply which have become a problem to the country, the problem of agricultural input, fertilizer to be provided, the population is growing very fast, and youth employment; we have a lot of issues. So, it is becoming challenging and increasingly difficult for the government to give us so much and provide us with equipment. So that is why we are now moving to privatise the issue of waste management to overcome the challenges of funding and equipment” SGA1.*

There may be no effective system to manage waste in Minna, but the residents adopt local ways of managing their waste such as burning, disposal in streams, drainage systems, etc.

#### **7.4.3 Environmental challenges – Quality of the Road Network**

It was indicated by the participants (all waste contractors and SGAs) that lack of accessible roads is one of the major challenges faced by waste management operators. One of the participants interviewed (a contractor) described the distance of the government regulated sites as a problem, coupled with inadequate access roads to the site:

*“From Wushishi estate to NISEPA dump site (official government designated/regulated site) is 27km. Now, if the truck must go there 4 times, that means we are talking about*

*100 and something km every day (108km every day), but if we were to go to our site (a proposed private site), that is less than 9km from Wushishi estate". PC2*

During the raining season, the contractors note that waste collection and disposal services are always at their worst state, especially in remote communities:

*"During raining season, the trucks cannot go into the remote site (e.g. government official site) because the government site has a bad road and is swampy and muddy. This leaves the contractors with no other option than to dump waste at the nearest unofficial dumpsites". SGM1*

Improper planning without access roads into the residential area is considered a challenge and a factor to the development of UWDSs as mentioned earlier.

*"... Then the problem is accessibility to the waste, because we have areas that are not planned. There are traditional settlements that are 50 years old (e.g. Kpakungu) and never care about waste management, never care about creating living space for large vehicles that could come in to evacuate waste so, in such places waste are generated but cannot be accessed." SGA2*

*"Urban development in most places where people live in Minna does not have an urban development plan, and the access to them becomes difficult." Waste Contractor*

*"There are places like Sabon Gari, and part of Bosso is an ancient community area. In all those places, before a contractor will get out of those places, they can spend up to four hours." PC3*

## **7.5 SUMMARY**

A summary of the key points identified from stakeholder's interviews reveals the following themes:

- (i) factors that hinder effective waste management,
- (ii) problems leading to the formation of unofficial waste disposal sites in Minna:

### **7.5.1 Factors that hinder effective waste management**

- Lack of funding:

- Lack of political will:
- Corruption:
- Scarcity of official waste bin for the public:
- Lack of proper planning:
- Weak policy on waste management:
- Lack of education.

### **7.5.2 Contributory factors to the development of unofficial waste disposal sites in the city**

- Poverty and lack of awareness:
- Lack of access roads to residents for waste collection:
- The distance of central waste collection points to residents (chapter 5) (wrong siting):
- Poor attitude of the public toward waste management:
- Scarcity of official waste bins for the public:
- Weak policy on waste management.

## CHAPTER EIGHT: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

### 8.1 INTRODUCTION

This chapter presents an integrated discussion of the key findings of the three studies presented in this thesis.

ISWMM, as described in section 3.5, is used to contextualize the findings. The three key research areas which this study has addressed are mapped onto the fundamental concepts of ISWMM:

- 1) attitudes of residents in managing wastes:
- 2) roles of stakeholders in creation and management of UWDS:
- 3) elements or operations in the creation of waste disposal site'

The key contributory factors that lead to the creation of unofficial waste disposal sites in Minna have been identified earlier in the study as follows:

- Lack of waste collection services in areas of the city:
  - due to insufficient number or inadequate waste collection equipment (e.g. old waste collection trucks with limited capacity):
  - lack of waste collection coverage by collection companies meaning that some areas do not receive a waste collection service:
  - CWCP location is determined mainly by access and ease of collection, not for residential use, due to lack of specified criteria for siting.
- Lack of public engagement in waste management affairs:
  - No mechanisms have been identified which facilitate feedback to waste collection companies/NESEPA from residents or community leaders:
  - Lack of awareness and education on waste management for residents or community leaders.
- Lack of stakeholder collaboration (e.g. teamwork between SGMs, SGAs, Waste Contractors, and the Public) and poor organisational strategies:
  - Poor flow of communication among stakeholders (Both SGMs, SGAs, Waste Collectors and the public):

- Key stakeholders removed from the decision making and consultation on waste management:
- Weak policies and regulations governing waste management practices:
  - Central government policies not integrated into regional state policies:
  - The organisations responsible for implementing waste policy and regulation are not aligned with local councils:
  - Lack of funding to implement policies and regulations for adequate waste collection services:
  - Limited political will, at both a national and local level, to invest in waste management:
  - Lack of accountability on services to evaluate value for money or the use of dishonest practices.

A brief summary of the three studies carried out as waste management operations in Minna is presented. The findings are grouped in Chapter Seven into themes of waste management and operational challenges in Minna. In this Chapter the themes are further grouped into;

- 1) economic dimensions,
- 2) urban planning and environmental dimensions and
- 3) policy and regulations dimensions in relation to ISWMM.

This chapter also presents conclusions and then makes recommendations for intervention for the effective management of UWDSs within formal waste management strategies.

## **8.2 WASTE MANAGEMENT OPERATIONS IN MINNA**

It was established in section 6.3 that male survey respondents (n=157; 68.6%) came forward to supply data or information on household perceptions regarding their waste collection and disposal. However, culturally, women predominantly undertake the management of household waste within communities in Nigeria. Kassim and Ali (2006) conducted a study on the households' perception on solid waste collection in Dar es Salaam of Tanzania and they found that:

“Waste management at the household level is generally considered to be housekeeping, so normally falls to women and house servants as practised in many African countries”.

Therefore, it is a cultural aspect in most Africa countries, such as Nigeria, that waste transportation/disposal at household level is usually carried out by women, older children or domestic staff/house servant under the supervision of women. These types of waste (in the absence of door-to-door collection or informal collectors) are transported to either a UWDS, CWCP or burned.

UWDSs were mainly located close to tertiary roads within residential areas while the CWCPs were located along the main (primary and secondary) roads as established in Chapter Five. This allowed easy access to CWCPs by collection companies. Observation from Chapter Five of this study shows that crowded districts (low-income areas) with tertiary roads have more UWDS than the planned areas with good roads. This is similar to the findings of Boadi and Kuitunen, (2005) and Drechsel and Kunze, (2001) as reported in chapter three. However, it was suggested that the location of CWCPs may be inconvenient due to distance and would have discouraged their use. For example, as reported in Chapter Six, 65.9% of respondents took 0-10 minutes to walk to an unofficial waste disposal site. Also, the geo-spatial mapping showed that most of the waste collection districts with minor road networks (tertiary roads) have more UWDSs with fewer CWCPs (e.g. Akpakungu and Sauka ka Huta), highlighting that lack of accessibility leads to the creation of UWDSs within residential areas.

Different waste management services exist in different areas of Minna. Observation and investigations show that the planned areas which can be referred to as high-income areas (e.g. private estates, government reserved areas, etc.) receive excellent door-to-door collection services.

Providing a reliable service is easier than in other areas (low-income areas) as reported by the waste collectors interviewed. This is because of easy access for collection trucks, proper waste storage, and payment for waste services as established in chapter five and seven. In contrast, in low-income areas a door to door collection service may be

provided by informal collectors (paid by residents with waste collected on pushcarts) who collect and transfer waste to either a CWCP or UWDS.

However, due to the costs associated with informal collection services the majority of residents still manage their own waste through disposal at a CWCP or UWDS and/or by burning waste which reduces volume and health risks associated with vermin.

The survey respondents link the lack of waste collection to the waste management authorities having issues of poor services in Minna. For example, the responses to the question *'In your opinion, why is your waste not collected'*? voice the opinion that:

*"The authority always complains of the operating vehicles breaking down and a lack of fuel to run the vehicles that are functioning. Our waste is not collected because the authority does what pleases them, which creates poor government and poor services."*

*Householder*

The stakeholder's interviews also affirm that:

*"in most cases, the service depends on the availability of trucks, staff for collection and the condition of the vehicle".*

The SGAs interviewed report that the poor state of the trucks in their possession makes the waste collection schedule ineffective. This can be linked to a lack of government prioritisation of waste management, with waste management provision based on 'availability of funds' instead of a 'first line charge' (interview with waste contractors). The interviews conducted in Chapter Seven with the stakeholders revealed that there are funds allocated for waste management from the federation account, which is paid into the state government account to be disbursed to various sectors.

However, there has been no proper strategic follow-up by the federal government to ensure that the funds allocated are used for the purpose since there is a "first-line charge" procedure in Minna. 'First line Charge' is a process whereby funds released from the federation account into state government account is disbursed on priority. For example, the medical sector and educational sector receive their allocation of funds first because they are placed on 'first line charge' for they are a priority to the society, while

every other sector outside the 'first line charge' is placed on 'availability of funds' (e.g. waste management in Minna). Therefore, it is evident in the geospatial mapping, survey and interviews conducted in Chapter Five, Six, and Seven that government support is lacking considering that waste management is placed on 'availability of funds' not as 'first line charged'.

The poor state of waste collection trucks is a situation that has caused conflict and misunderstanding between the waste collectors and households. This is because when the trucks have broken down, waste is not collected, and the residents predominantly blame the collectors. This is linked to the communication gap among stakeholders who 'work in isolation' or 'work alone'. Therefore, failure to follow the waste collection schedule has increased the use and development of UWDS and waste burning as the households needed to dispose of their waste to reduce vermin and odour issues (see section 6.4.1, 6.4.2 – survey result and section 7.3.1 – interview results).

There is a consensus as established in section 8.2 that the current waste management practice in Minna is not effective and this is confirmed in all the three elements of the study (mapping, survey, and interview). For example, the main aim/target for siting CWCPs should be resident accessibility for easy disposal of their waste and for easy collection by the waste collectors. However, the findings of this study show that there is an insufficient number of CWCP sites, and the existing sites were located mainly on primary and secondary roads.

The study identifies that there are issues between waste collection operators and the general public in rendering services. For example, in section 7.4.1, a private contractor interviewed (PC2) reports:

*“The residents have an executive forum within their communities and the people in the executive gave us serious frustration when we started. They do not allow trucks to pass through or go to their communities for waste collection” PC2.*



This is because residents do not want the contractors to remove organic waste which they use as fertiliser for growing crops (as report by a contractor) as shown in figure 8.1. Meanwhile, a respondent in the survey reports that:

*“The management do not provide a refuse collection centre for us. The official waste collection point is far from my house, and they don't always come until the waste overflows and is scattered around, and they work at will because there is no legal law”*  
Householder.

Therefore, PC2 report could be the factor influencing the insufficient or lack of waste collection coverage in some community areas because the waste is a resource to residents’ farmers (e.g. figure 8.1).



Figure 8.1: Residents scavenging organic waste as fertiliser for their farmlands (Author, April 2017)

In terms of collection services, 83.7% of respondents in the survey reported that their waste is rarely or never collected. In contrast, NISEPA provided information that suggests that waste collection services are provided three times per week in the majority of districts. Again, the poor state and low number of NISEPA waste collection trucks may have hindered the effectiveness and frequency of scheduled waste collections. Although, as at the time of this study, waste management in Minna is free

to all residents (except for the Estate residents who pay to be served by private companies). However, NISEPA reports during the interview that there is an ongoing plan to extend payment for waste collection and disposal services to all district's residents, even though they lack both facilities (insufficient trucks) and government support to do so. The implementation of waste management payment to all residents in Minna may not be the solution to insufficient collection due to ageing equipment and accessibility as highlighted as factors. This is because, the lack of knowledge/records on the number of household (both served and unserved) currently in Minna and cost of waste management per household per month shows lack of accountability which needs to be tackled first. However, it was asked in the public survey:

*'Are you willing to pay for waste collection and disposal services to improve the standard of waste management in the city'? If yes/not sure 'how much'? If no, please give reasons.'*

Interestingly, responses in the public survey show that 75.5% are willing to start paying for waste collection and disposal services with 84.2% (with those not sure) willing to pay N500 per month (about a £1) for waste collection and disposal services. However, since waste management is based on availability of funds (instead of first line charge), records of how much NISEPA pays for residents' waste to be collected per household per month in Minna is not available. This information, in the form of records, could help in assessing the level of payment required by residents to improve the waste management system. The following related respondent responses provide further insight into charging for waste collection services:

*"They (NISEPA) don't collect my waste, and they cannot access my premises that is why I cannot pay."* Resident.

*'Government pay NISEPA salary to do the work, I am a citizen, so it is my right to enjoy free services to the government. Besides, the Government should be able to arrange this without people having to pay for waste collection.'* Resident.

*"My waste is rarely collected so I cannot pay for services not received."* Resident.

*'Pay for service I am not receiving? Until they change, I don't have money to waste because I know that they will not change.'* Resident.

*They went further to report that 'The waste collection may not be active even after payment'.* Resident.

*"My reason is that the government should first enforce the cleanliness of the community then the individual will follow up because the environment is for all."* Resident.

Again, the current practice of waste management in Minna has made the residents see waste management as a government responsibility. Some of the respondents' report that:

*"It is the responsibility of the government to help the masses reduce sickness in the state."* Resident.

*"Because they are not encouraging me, even though we pay we are not going to have good service, so there is no need to pay."* Resident.

One of the reasons for 19.7% of the respondents who say 'no' for the payment of their waste services may be associated with practical experiences of waste management failure or accountability issue in the past or current in practice.

The collection of waste at CWCP sites by waste collectors was considered difficult and time-consuming. This is because residents often put their waste on bare ground instead of the provided skips or metal drums, and waste collectors report that their crews must collect the waste manually (using their hands and sometimes hand tools). They spend a large proportion of their allocated collection time gathering dispersed waste (litter/transient) to the detriment of their collection routes.

Householders use a range of containers to store their domestic waste prior to disposal (Chapter 6 section 6.4.1). Many of the containers used are plastic buckets /baskets. However, the plastic buckets used are typically old and are themselves discarded washing /water buckets which are broken. These are inadequate for long-term waste storage, and usually, only provide enough capacity for one day's volume of waste. More

so, even in door-to-door waste collection, the waste collectors only target bins that are positioned on the street with a larger capacity (e.g. the metal drums, 250 litres wheeled bin). This has contributed to the utilization and creation of UWDSs as other bins such as plastic bags, water bucket etc. may be ignored or not put outside by households for waste collectors due to their small size. Therefore, many residents were excluding themselves from the limited waste services that exist and would, therefore, need to use CWCPs. The limited number of these and their location meant that many householders with inappropriate containers disposed of waste in UWDS. In addition, buying a NISEPA bin does not guarantee waste collection services (if not living on a NISEPA waste collection routes), and the disparities in purchase price of NISEPA bins may discourage residents from using the formal bins and further enhances the disposal of waste to UWDSs.

All stakeholders interviewed, (including SGMs, SGAs and private waste contractors), consider that lack of policy enactment and enabling environments such as legal backing, enforcement mechanisms, good governance, political stability, and incentives are issues contributing to the formation of UWDSs. From stakeholder responses, the study identifies that lack of government investigation of these UWDSs, in terms of land ownership, prevents implementation of effective measures to deal with them which encourages the public to create sites more convenient for themselves. In addition, the underutilisation of community leaders is a further setback in achieving effective waste management. This is because the community leaders interact and have direct influence with the public who own the land, generate waste, and create the UWDSs. Nevertheless, strategies are required to manage the identified issues without waiting until the pressure to handle the problem is greater than the convenience of collection and disposal (Seadon, 2010).

The synthesis of findings from geo-spatial mapping, questionnaire, and semi-structured interviews analysis has shown that the management of UWDSs in Minna involves multi-faceted challenges (e.g. attitudinal, environmental and institutional as established in Chapter Seven), some of which pose more significant concern than others depending on the perception of different stakeholders. Although, the research indicates that there

are diverse stakeholders involved in waste management in Minna, the complexity of these challenges requires a structure or model that can guide the current waste management system into effective management of UWDSs. Therefore, the scope of ISWMM clearly explains steps to achieving a sustainable management system, which can be used to manage various factors influencing the creation of UWDSs in Minna such as the federated nature of operation of NISEPA, the location of CWCPs, lack of waste collection services, funding, etc.

ISWMM, as adopted in this research, has been applied in various contexts of waste management in developing countries. It is an appropriate model that provides scope in interpreting the priority needs of stakeholders while encouraging the roles of stakeholders in waste management decision-making. This is done, in this context, by examining the research findings to determine what aspect of ISWMM would be most effective at enhancing better decision-making in managing UWDSs in Minna. The ISWMM is used to ensure that all aspects of waste management challenges, including attitudinal, operational, and socio-economic aspects, such as policy and enforcement measures and regulations are addressed. Existing stakeholders and waste management practices in Minna, particularly the roles and practices of Niger State Environmental Protection Agency (NISEPA), are reviewed and examined to determine what aspects need improvement.

Waste operations that lead to the creation of UWDSs were examined to determine their impact and dysfunctionalities. Addressing their dysfunctionalities is a key focus for ISWMM application. Also, operational challenges with current waste management roles and practices in Minna are explored and considered (drawn from findings discussed in Chapters Five, Six and Seven) to understand which elements of ISWMM will be appropriate to address the challenges.

ISWMM helps to elaborate on the importance of understanding the attitudinal elements and operations of the stakeholders that manage wastes problems (ISSOWAMA Consortium, 2009). The three principal dimensions of ISWMM focus on the attitudinal elements or 'lenses' through which the existing waste management system is analyzed;

the stakeholders who have interests in waste management and their roles; and the elements or operations of waste creation (ISSOWAMA Consortium, 2009; Scheinberg et al., 2010). As shown in figure 3.7 section 3.5 in Chapter Three, the uppermost part of the circle covers the stakeholders' involvement that facilitates the management of the waste system, and lower part of the circle is an enabling environment that powers socio-economic aspects, thus covering the overall impact of effective waste management.

### **8.3.1 Stakeholders involvement/participation for effective waste management**

The identification of stakeholders and their interests is important in coordinating their participation and involvement in various waste management activities. More so, these stakeholders are people and organisations with an interest in delivering effective waste management and participating in activities that make this possible. Stakeholders who have an interest in the management of waste have been identified in table 8.1. These include community leaders and public and it clearly indicates that their participation is a fundamental component for effective sustainable waste management.

Table 8.1: Stakeholders identified and roles in the management of waste

Stakeholders	Roles in managing waste	Drivers stakeholders	The possible implication for effective waste management (including UWDSs) and stakeholder's cooperation
<b>State Government Ministries</b>	Policy development and regulations	Economic interest and development	Can change policy and regulations to improve current waste management practice
	Overseer of the State Government Agencies and local government activities	Corruption	Can restructure the existing stakeholders' structure to bottom-top focus
	Intermediary between government agencies and communities –public	Resources	

<b>State Government Agencies</b>	Protection and development of the Environment to Standard; implementation of policies; oversee and control waste management affairs (waste collection and disposal)	Environmental interest and development	Can enforce laws, regulations, rules and implement policies
	Coordination and liaison with relevant stakeholders on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.		
<b>Community leaders</b>	Representing the public; handling local issues including environmental issues associated with waste	Source of clean water is contaminated; good ventilation is deprived; urban development	Strong support to prevent the creation of UWDSs; Strong influential on the public decisions



	Aware of the risk associated with UWDSs and managing to the best of ability	Lack of inclusion into waste management affairs; poverty; illiteracy	
<b>Waste contractors and informal collectors</b>	Representing the waste management authority in waste collection and disposal	Lack of incentive/motivation	Support to clean environment and effective waste collection and disposal
	Focus on waste evacuation and disposal only		
<b>General public</b>	Generate waste and Landowners for waste disposal	Lack of motivation; education; awareness	Strong support to clean environment; Prevent creation of UWDSs; support to evacuate existing UWDSs
	Aware of the impact of UWDSs	Poverty	

The environmental problems of cities can be addressed, in a large part, by the interaction of stakeholders as presented in figure 3.7. Stakeholders may generate waste, function as service providers or participate as state or local government departments, non-governmental organisations (NGOs) and other organisations concerned with certain aspects of waste management. The waste management authorities, community leaders, and the public are generally aware of the health risks and environmental problems caused by ineffective waste management. One of the key facilitators to effective waste management identified in this study is the willingness of the community leaders and the residents to be involved in the waste management affairs in Minna. However, the public looks for new ways to share their traditional/local responsibilities in these areas with waste management authorities but their lack of involvement and enabling environment (e.g. Socio-cultural, policy, political, etc.) stands as a hindrance. Therefore, it can be concluded that the underutilisation of community leaders as key stakeholders is considered a barrier to effective waste management, which contributes to the development of UWDSs within residential areas.

Figure 8.2 presents the key stakeholders' report (e.g. NISEPA) on the stakeholders' workforce and communication flow in managing waste in Minna. Figure 8.2 shows that there are interactions and circulation of information among stakeholders except for the private contractors, public, and the informal waste collectors who are outside the circle and receive instruction and directives from NISEPA only. The black arrows in figure 8.2 do not necessarily mean reporting or passing of information but show working relationships as a team among stakeholders as reported by the SGAs interviewed. The grey arrow is pointing at the key stakeholder (green colour box) involved in managing waste in Minna as reported by the SGM and SGAs. Also, the yellow box indicates stakeholders who are considered to be part of but not key to the waste management system in Minna. For example, the Ministry of Women's Affairs was reported to be responsible for educating and creating awareness to women on the importance of a clean environment; whereas the Ministry of Health educates the public on health implication of their activities – creation of UWDSs and indiscriminate dumping; while the Ministry of Land and Housing/ Urban and Regional Planning help create accessible

road networks when planning an area. Finally, the orange colour represents stakeholders connected directly to NISEPA who only receive directives and instructions.

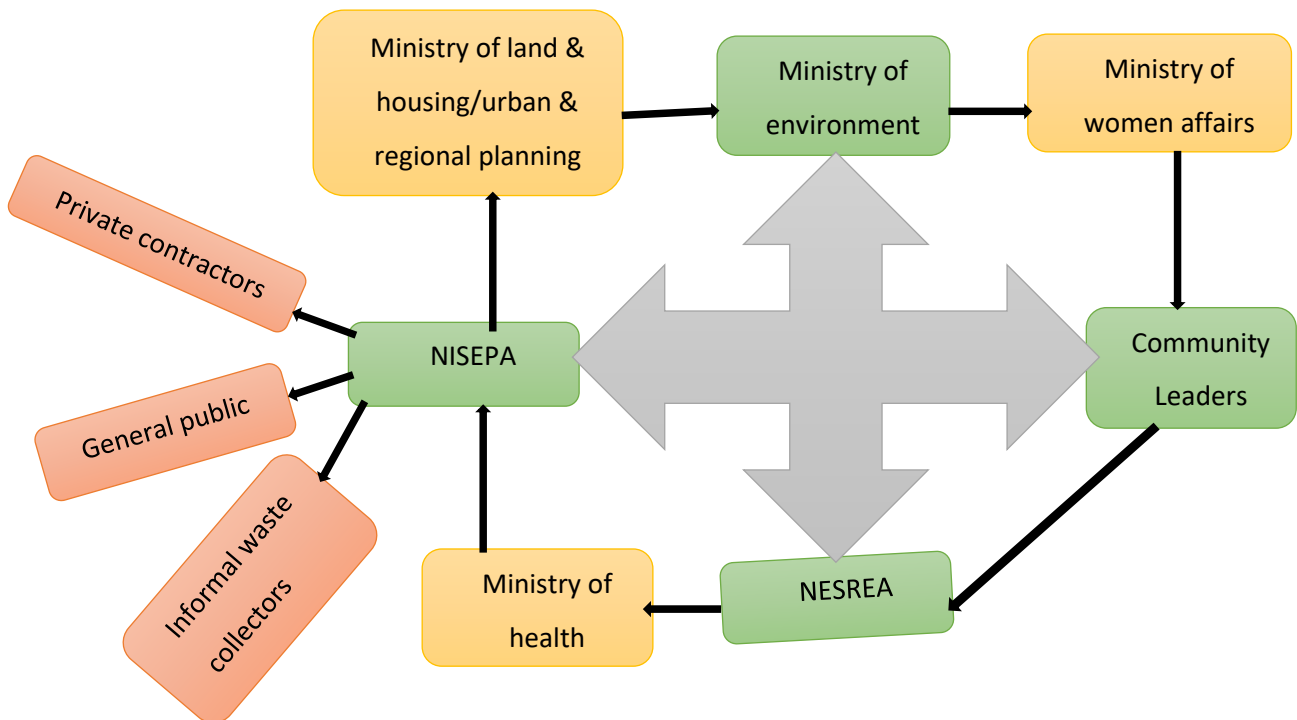


Figure 8.2: Stakeholder involved in managing waste in Minna (SGAs and SGM report)

In rural areas, community management of waste is increasingly common but in urban settings formal relationships with communities are rare. The establishment of such initiatives was found to be limited from the research carried out. The most powerful local message was seen when the leaders (e.g. community leaders) were committed to setting a local waste management procedure/example such as depositing waste in the appropriate containers/bin; cleaning public places; participating in community clean-ups of drainage system; keeping the streets in front of their dwellings clean and litter-free. Joseph (2006) suggests that to support households in playing their expected roles in waste management, it is important to recognise that within a neighbourhood community, households may belong to a variety of social or religious groups, and so may vary in their cultural/religious beliefs and practices, major occupations, income and expenditure patterns, access to community and infrastructure services, gender and age. Political or social leaders can play an important role in stimulating the desired behaviour in the public.

### **8.3.2 Enabling environment for effective waste management**

Zurbrugg et al. (2012) describe enabling environments in terms of sustainability as a set of interrelated conditions that bring about sustained and effective change. It is suggested by these writers that critical elements of the enabling environment should be identified at the early stage of a project to create a favourable environment for solid waste improvement. Therefore, the purpose of an enabling environment is to provide a set of solid foundations (laid out rules) establishing the priorities and best ways which can help governance structure reach their goals, while balancing out the socio-cultural, economic, political, environmental factors etc. for effective waste management. A proper enabling environment establishes the right and assets of all stakeholders (SGMs, SGAs, private sector, general public, etc.), while ensuring a healthy environment. For example, the general public as stakeholders plays an important role in sustainable SWM for which awareness of waste reduction, segregation and recycling or appropriate final disposal needs to be enhanced. Also, political or social leaders can play an important role in stimulating the desired behaviour in the public. Previous studies (e.g. Lougheed et al., 2016; Wilson, et al., 2013; Desa et al., 2011; Kapoor, 2009; Joseph, 2006) show that effective management of the environment in urban areas is dependent on the willingness of residents to change their attitude and inculcate behaviour related to maintaining a cleaner environment. Lougheed et al. (2016) agree with Wilson et al. (2013) and conclude that a change in people's attitude is much more important than implementation and enforcement of waste management policies and regulations in developing countries. Considering the rapid increase in population and waste generation in Minna, regulatory organizations or government need continuous dialogue with stakeholders to introduce appropriate regulations which will bring the required improvements in solid waste management system. To achieve sustainability in waste management, it is important to consider the role, interests and power structures of stakeholders that are prevalent in waste management.

Within the Minna City waste management system there is a lack of financial accountability. Without this component, one of the underpinning resources is missing. The research shows that the waste management authority (NISEPA) has no record of

the number of households in Minna and neither does it have a figure for the real cost of providing a waste management service to them. NISEPA is unable to provide any details on the cost of its service per household that does have a collection. This lack of information means that there is no financial accountability in the waste management system in Minna. The funding for waste management provision in Minna is by funds being available once the primary services (e.g. medical personnel etc.) has had their full allocation. This means that funding is not consistent over each month. As NISEPA lacks information on the real cost of providing a waste management service to the residents and the number of households is not known, it becomes difficult for NISEPA to determine whether it has been provided with adequate funding or not. In section 7.4.2 and 7.4.2.5 of this study, a report provides evidence of SGMs and SGAs pointing at lack of funding being the biggest challenge for waste management services in Minna, meanwhile, the basic information/data for accurate allocation of funds (e.g. number of household, cost of waste management services per household per month) as an element of enabling environment for effective services is lacking. This is evidence that the private contractors in Minna are provided with a fee without any key performance indicators such as number of households serviced per day. Therefore, it can be concluded that waste management in Minna and some urban developing countries is operated on a fund guess and estimation which may have resulted in the ineffective waste management system. Also, this means that the lack of funding and accountability as an aspect of enabling environment is a huge contributor to the use of ageing equipment (e.g. waste collection trucks) without maintenance or replacement. Transparency of the cost of waste collection and disposal services to the householders as to how NISEPA gauge what the cost should be per month is important for accountability. Therefore, funding and accountability as a critical element of enabling environment needs to be addressed first before other element such as policies, etc.

An enabling environment essentially consists of laid out rules to achieve sustainable balance between the socio-cultural and environmental factors etc. which can be defined using policies and laws. These policies and laws are to be suitably modified to ensure stakeholder participation in SWM services. Deterrent punishments may be required for

violating the laws. A national action plan needs to be formulated based on community participation, institutional and human resource development, technology transfer, financial support, cost recovery, and efforts towards privatisation and legislative support to discipline the people. Stakeholders can improve the efficiency of solid waste management by continuous interaction to bring improvements to the system and by active participation when each stakeholder has a clear role to play. Close cooperation would be required between waste generators and waste collectors to increase the coverage and effectiveness of the waste collection system. Similar cooperation is vital for waste disposal, recycling and recovering (depending on the cooperation of waste generation and collection).

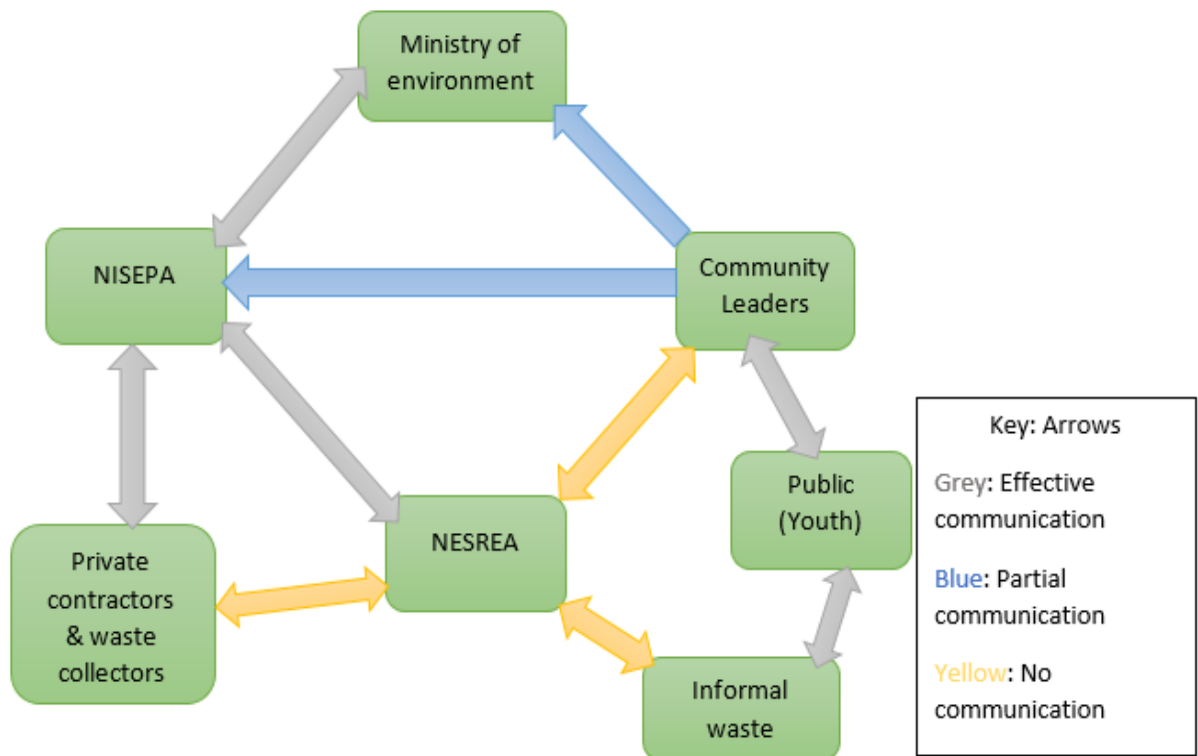


Figure 8.3: Communication channel for effective waste management in Minna

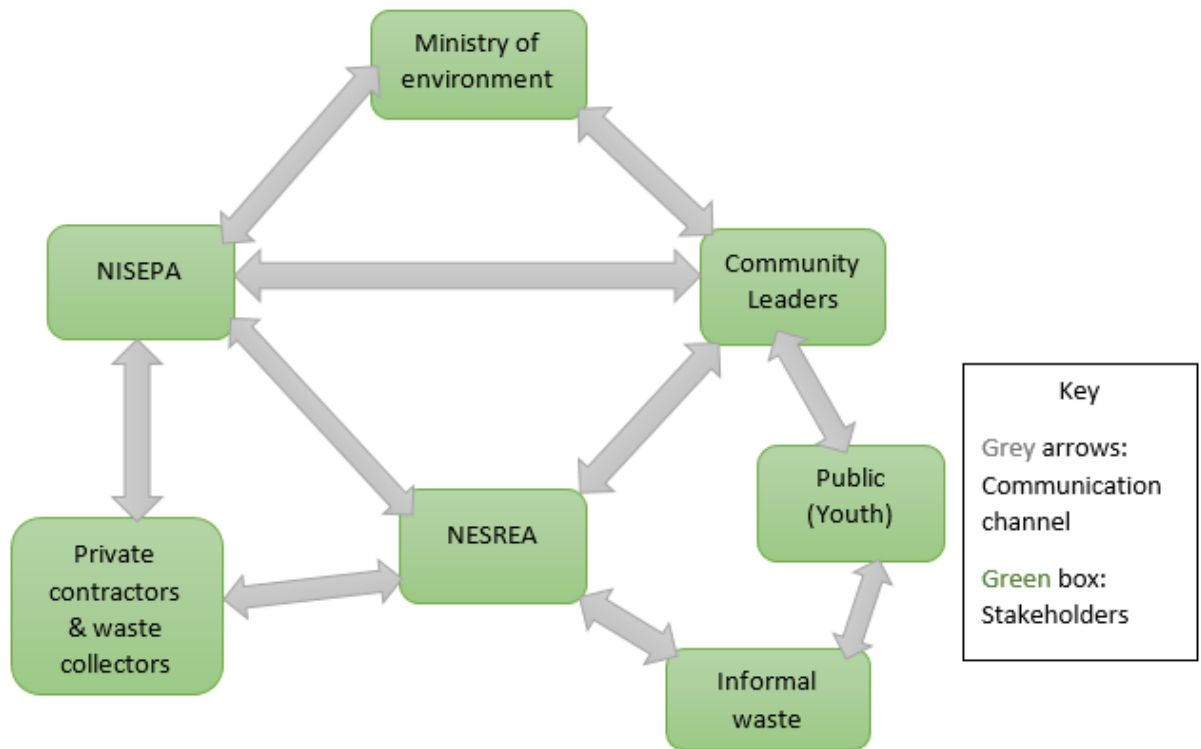


Figure 8.4: Communication channel required for effective waste management in Minna

A good communication flow among stakeholders to enable a favourable environment for waste management improvement is required. Figure 8.3 shows how communication flows among ‘current’ waste management stakeholders, the majority of whom is either not communicating or is undertaking a form of one-way communication. The communication flows show the level of stakeholders’ interaction and collaboration for effective waste management system in Minna. Therefore, the lack of an enabling environment contributes to ineffectiveness in services and development of UWDSs within residential area in urban cities. In line with ISWMM, the findings of this study are further grouped into three dimensions relating to the key themes in Chapter Seven.

### 8.3.2.1 Economic dimension

At the time of this study, there are no definite plans to achieve financial sustainability in waste management practice in Minna. Apart from the infrequent federal government allocation funding received for waste management, there is no other source of income to manage waste in Minna (except the estate residents paying for their services). Waste contractors and SGAs report that the inadequate and untimely funding for waste

management and program implementation is a challenge in performing their duties. Although, waste management services are free for the residents of Minna as at the time of this study, residents may have been paying for their waste collection services through taxes to the government. The tax payers may be few because only a few are civil servants (see section 6.3 -18%) whereby the government has access to their salary to deduct taxes. This may be the reason for the delay in funding waste management, coupled with the lack of accountability. The insufficient number of tax payers, lack of accountability, free waste management services to the public, etc. is a setback to achieving effective waste management. For example, Zurbrugg et al. (2012) carried out a study on waste recovery project in Indonesia to determine the sustainability in solid waste management using the ISWM approach, reporting that to boost the economic aspect of the enabling environment, the project team may increase its effort and energy on boosting the sale of compost by penetrating existing markets. Therefore, the lack of strategy and means of boosting the economy to generate more funds may create the lack of waste collection services due to ageing equipment, which will, in turn, influence the creation of UWDSs within residential areas and increase waste burning.

### ***8.3.2.2 Urban planning and environmental dimension***

Inadequate planning may lead to serious environmental problems and unsustainable waste management as many undeveloped countries are undergoing a rapid rural – urban migration. As reported by Parrot et al. (2009) the migration of people from rural to urban areas not only places a financial strain on waste management authorities, already short of funds, but impacts on limited urban planning. However, urban congestion, shantytowns, and limited urban planning, creating crowded settlements, may hinder effective waste management services due to lack of access roads which can result in the creation of UWDSs within residential areas. Table 2.1 and 2.2 present the infrastructural characteristics of selected areas within the two LGA in Minna. The environmental attributes of this area (Table 2.1 and 2.2) show that the quality of most of the building infrastructure and road networks in the metropolis falls below recommended quality standards of urban planning in Nigeria.



Waste collection from generation source (door – to door) is an aspect of waste management that has been considered ineffective in most urban areas (including Minna) due to poor urban planning. The absence of accessible roads into the residential areas for ease of waste collection services is identified in the study as an issue. Improper urban planning may exist, or there is an existing culture for people to build on their plot of land without putting basic amenities such as access roads into consideration. The findings of this study show that in areas where access to residential areas is limited, due to improper road planning, households are expected to take their waste to a CWCP located along primary and secondary roads. Therefore, improper planning without access roads into the residential area and improper strategies to collect waste from the residents are factors influencing the development of UWDSs. Urban planners are expected to play an important role in the waste management system as key stakeholders alongside the general public who are the landowners.

The current government regulated site (open Landfill) which is located at Tayi village and very close to a secondary road causes traffic congestion during the rainy season. The road leading to the site (diversion from the secondary road) is untarred and becomes muddy or swampy (due to heavy trucks with waste) which shows a lack of organizational planning in site selection and maintenance. Also, the environmental impact of the landfill to the host community is immeasurable. The impact of the sites ranges from contamination of water, flies, offensive odour emanating from the site, smoke from waste burning on sites (figure 8.5), etc. Therefore, the waste management policies on selection and siting of official waste disposal sites (government regulated site) need to be reviewed by the appropriate authorities (e.g. policy formulators - SGM and SGAs).



Figure 8.5: Waste burning at the government-regulated open landfill site in Minna (Author, April 2017)

Figure 8.5 shows evidence that waste burning is not only practised at local levels by residents but also at state or national levels by Government authorities, aiming at the same goals of reducing the heaps of waste, control odour, etc. Both the open landfill sites and the UWDSs threaten environmental and human health due to their location within residential areas, created by landfill within host communities while UWDSs within residential areas (figure 8.5 and 8.6) and such activities as burning waste. These sites (UWDSs) encourage the breeding of disease vectors like flies, mosquitoes, cockroaches and rats amongst other creatures (Ogunrionola and Adepegba 2012).



Figure 8.6: A UWDS within a residential area with animals feeding on site (Author, April 2017)

These sites (UWDSs) are managed at times by setting the mixed waste on fire which generates toxic smoke into the atmosphere, as seen in Chapter Five. This is a common practice in most developing countries to burn the waste intermittently at a registered official site like open landfills or unregistered sites such as UWDS., This, in turn, causes environmental pollution by releasing thick-dark smoke from the mixed waste (Karani and Jewasikewitz 2007). However, the public has little or no option but to embrace the current practice despite the environmental and health impact of these sites (UWDSs), thus encouraging their continued use. Therefore, an in-depth study on the spatial distribution (geospatial mapping) of these sites to determine the environmental and health impact of the sites is important.

Nilsson-Djerf and McDougall (2000), and Morrissey and Browne (2004) posit that for a waste management system to be effective, it must be accepted by the public. Petts (2000) supports this viewpoint by saying that:

"Effective management must relate to local environmental, economic and social priorities" and must go beyond the traditional consultative approaches that require experts to draft the solution in advance of public involvement to a much more effective approach by involving the public before key choices have been made (Morrissey and

Browne 2004). There is no doubt that the waste generated in most urban cities of developing countries is at the point of overpowering the waste management authorities. Ebenezer (2012) reports that even though the residents generate the waste and create the UWDSs within residential areas, the environmental conditions are becoming so unbearable that they have to call for help through a peaceful protest for government to come to their rescue. This is because they live amidst the stench of waste created and piled-up by them without evacuation for lack of many alternatives.

### ***8.3.2.3 Policy and regulations dimension***

There are policies and regulations in place to guide waste management in Minna (see section 2.4 and section 3.2.1.4). However, these policies and regulation only exist on paper without implementation (from interviews with NESREA and Ministry of Environment). The evidence from the survey of residents indicates that many of the residents of Minna believe that waste management is a government service to which they were entitled. This is due to lack of information from NISEPA on waste management services and changes to service policies. Policies and regulations are not communicated to the general public and this makes them see waste management as a government responsibility to manage waste in their communities. Also, weak policies and regulations result in ineffective waste management systems and an unfavourable environment. For example, developed countries have made their waste management a priority by adopting strict regulations and innovative measures concerning its use, as well as putting and monitoring mechanisms in place to ensure that waste management is included in development plans (policies) of cities (Ezeah 2009).

The lack of enactment of the waste policies has resulted in many of the key stakeholders devolving their responsibilities to NISEPA, who have been shown to have little control directing waste policies at a local level. This leads to inefficiencies, which result in wastage of both human and capital resources. This is because the current regulatory system relies on a top-down approach to decision making wherein the waste management authority can exercise control over local authorities (e.g. community leaders and general public) which have limited autonomy. Manga et al. (2008) argue

that such an approach results in decisions that reflect political rather than scientific inclinations.

Several of the stakeholders, who provided the direct waste management service, repeatedly cite financial restraints as the cause of lack of workers, poorly maintained equipment, and the lack of incentives which results in an 'unfit for purpose' waste collection system. The lack of accountability and any form of regulation enforcement means that a minimal service is provided to the residents of Minna. This leads to the conclusion that insufficient administrative planning is one of the root causes of an ineffective service. Therefore, implementing appropriate and sustainable management legislation and practice may be difficult when these critical issues are not adequately addressed.

From the interviews carried out, communication has been identified as another important gap that disconnects the key waste management stakeholders, especially community leaders and the public as shown in figure 8.4. The research reveals that community leaders have a significant direct influence on the public, with respect to the local management of waste. Therefore, organisational strategy to incorporate key stakeholders and their defined role in the policy for effective waste management is important. For example, the role of SGMs (e.g. Ministry of Environment, Health, Women Affairs, and Urban and Regional Planning/Land and Housing), SGAs (e.g. NISEPA and NESREA), Private sector, Informal collectors, community leaders, and the general public needs to be clearly defined to enable effectiveness in services.

Overall, the factors that lead to the development of UWDSs in Minna have been identified and discussed. However, a model for effective management of these UWDSs within formal waste management strategies is required. The findings of the study agree with the elements of ISWMM which consider the stakeholders' interest and stakeholders' involvement/participation in an enabling environment as the key to sustainable waste management. Utilising the ISWMM to conceptualise the findings of this study proves that effective management of UWDSs is achievable through a

workforce model which has been produced putting the current waste management strategies and findings into consideration (figure 8.7).

Figure 8.7 presents a workforce model adopted from ISWMM, with the stakeholders (green and blue box) expected to be involved in waste management in Minna and the enabling tools presented as the enabling environment (Orange box) for effective management of dumpsites (both UWDSs, CWCPs and Landfill) in Minna.

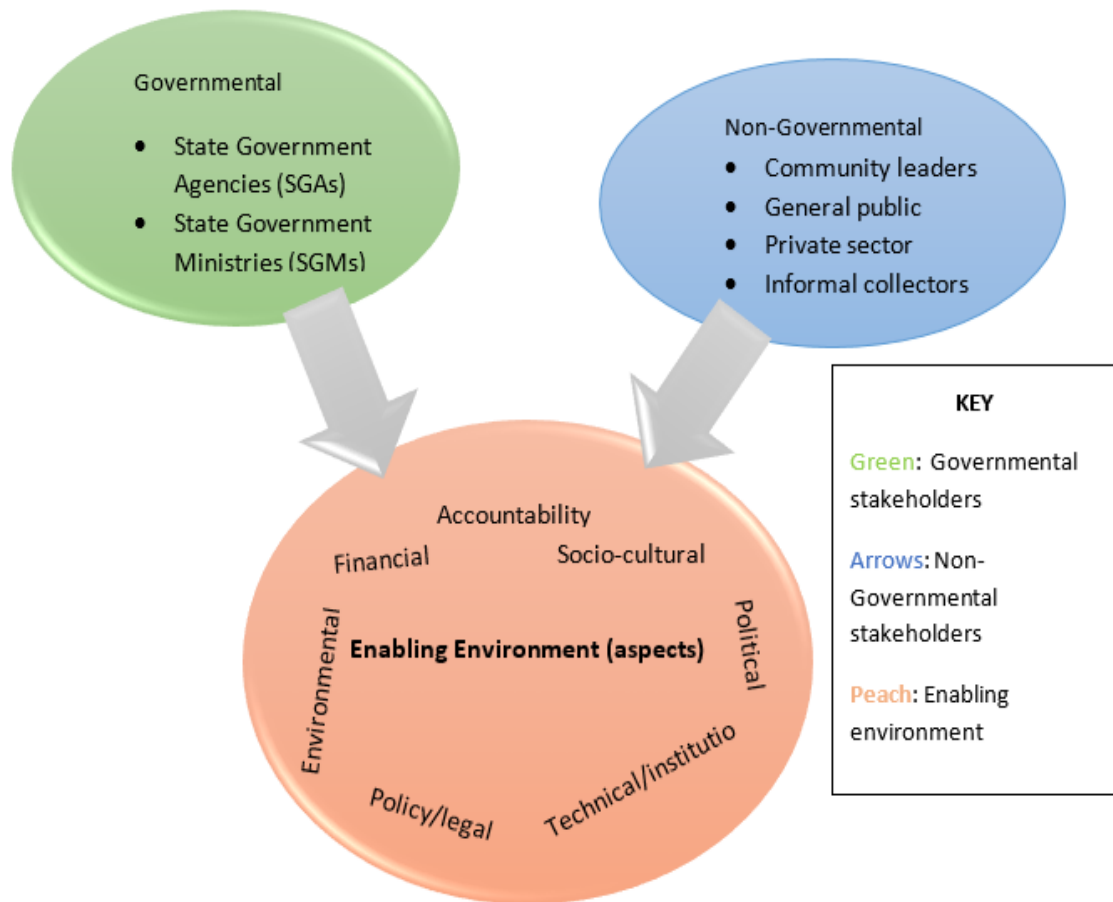


Figure 8.7: A proposed model for effective waste management of UWDSs in Minna

Stakeholder collaboration in an enabling environment is vital to achieving a sustainable waste management system. Strategies on effective adoption of ISWM concept, focusing on the key stakeholders' interest in working in an enabling environment, are required for effective waste management. For example, Kassim and Ali (2006) conducted a study on solid waste collection by private sectors in Tanzania, where a working group on solid waste adopted a five-point strategy, then developed and implemented it. The writers report that the five-point strategy was achieved because various stakeholders

participated during the implementation of the strategy including the federal government, local government, agencies, private sectors, institutions, and individuals. It is recorded that the city council gained experience on how the waste collection could be improved through stakeholders' participation (collaboration) using available equipment and personnel. Therefore, it is recommended that waste management authority in Minna should work with the available equipment utilising the staff and the public for effective waste management.

#### **8.4 CONCLUSION**

This research investigates the factors influencing the development of unofficial waste disposal sites (UWDSs) in developing countries by drawing evidence from the case of Minna, Nigeria.

This study reveals that one of the challenges of waste management in Minna is the lack of awareness and inactive involvement/underutilisation of some stakeholders (e.g. the public through community leaders) in service provision and planning. This is a common practice in most developing countries because most of the time the public is not given the opportunity to participate in designing and planning the waste management activities which render them inactive (Kassim and Ali 2006).

The quantitative study reveals that a majority (83.7%) of the respondents rarely or never receive collection services, which shows a lack of satisfaction and unhappiness of the residents with the provision for waste management. However, observation and the geospatial distribution of dumpsite in Chapter Five shows that the planned areas which are referred to as high-income areas are cleaner than the low-income areas which are identified by tertiary roads.

Based on the mapping result presented in Chapter Five in this study and observation made on site reveals that crowded districts with tertiary roads have more UWDS (e.g. Kpakungu) than the planned areas with good roads (e.g. Keteren Gwari). This finding is a confirmation of Boadi and Kuitunen (2005); Drechsel and Kunze (2001) who argue that there are more UWDS deposited in low and middle-income areas of developing countries. This is because more than half of the urban residents live in crowded slums

and shanty areas where basic sanitation facilities are lacking. Therefore, the role of urban planners (Ministry of Urban and Regional Planning) as stakeholders needs to be defined within the waste management policy and regulations (under SGMs).

The study finding shows that the waste management authorities in Minna are under resourced and this may be attributed to lack of an enabling environment such as funding, manpower, and appropriate technological equipment. This results in poor waste collection services in Minna.

The lack of effective stakeholders' collaboration and enabling environment creates communication gaps between stakeholders. This is because the structural design of waste management operations in Minna is carried out in a '*top-bottom approach*' (see figure 8.8) which affects effective waste management. The communication flow in figure 8.8 shows a disconnection between top management (SGMs and SGAs) and bottom management (community leaders and general public) at the grassroots level. However, the SGMs and SGAs (top) may not achieve an effective result without the cooperation of community leaders and the general public (bottom). Therefore, a '*bottom to top*' approach would be good in tackling UWDSs issues in Minna. This is because low or no level of involvement and poor flow of information between stakeholders has contributed to the creation of UWDS by residents (see figure 8.8). Therefore, it is important to consult residents on the most appropriate methods of waste management (e.g. how to prevent UWDSs) in their areas, affordability of possible charges in line with the cost of waste management per household per month, and a possible role in monitoring the services. Both general public, informal collectors, private sector and community leaders (figure 8.7) are required to be involved in decision-making, regardless of their income level or class because they may not be as wealthy with money as the government, but they have opulent ideas to effective waste management.



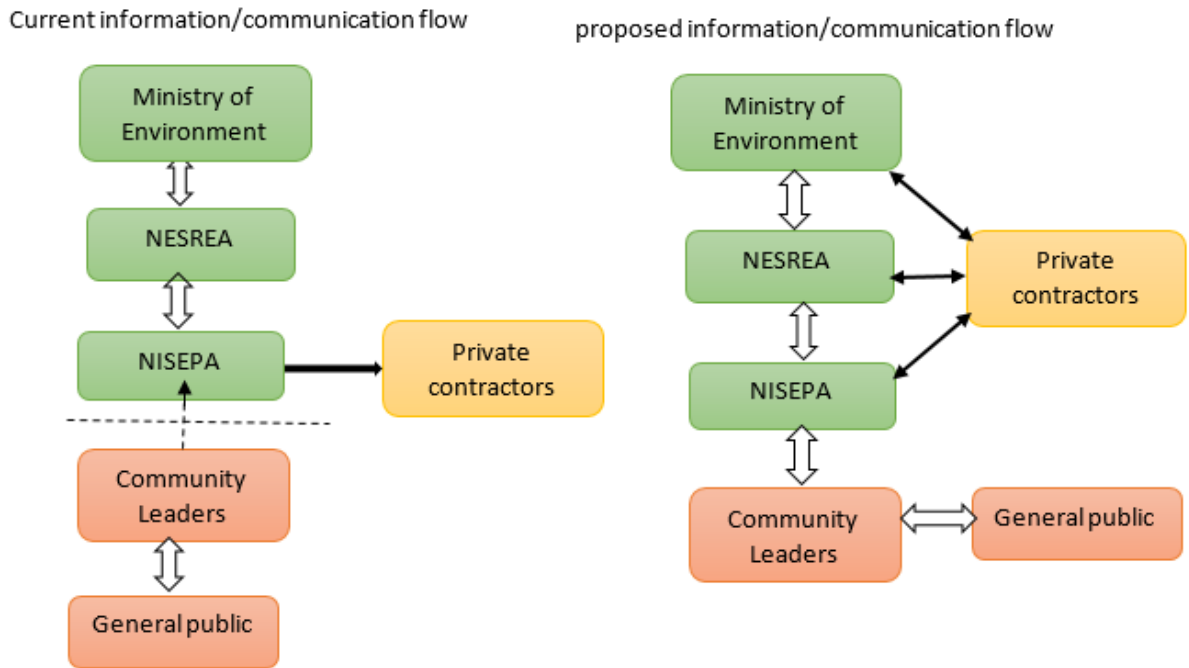


Figure 8.8: The current communication flow among stakeholders(left) and the required communication flow (right)

All 141 UWDSs visited within the 10 districts of Minna are located within residential areas as discussed in Chapter Five. Public participation as a tool in waste management can enhance clean-up of some UWDS as community development services while adaptation of some sites to CWCPs reduces the number of existing sites. However, the waste management policies on selection and siting of official waste disposal sites (both CWCPs and Landfill) need to be reviewed by the policy formulators - SGM and SGAs for basic consideration such as the distance to residents, health impact, environmental and economic impact.

The ISWM concept used in this study is to facilitate the changing role of the public and stakeholders to engage or collaborate with a more environmentally and socially acceptable waste solution. This study seeks to mitigate existing sites and prevent the creation of new sites in Minna, Nigeria and other developing countries with a similar context. Therefore, the three principal dimensions of ISWMM focus on the attitudinal elements or 'lenses' through which the existing waste management system is analyzed; the stakeholders that have interests in waste management and their roles and the

elements or operations of waste creations are carefully considered for effective waste management.

For effective management of UWDSs to be achieved in Minna, the three principal and structural dimensions of ISWMM is required (section 3.5 in Chapter Three):

First, engaging the public on the front line of decision-making regarding waste management wherein education and awareness to change their perception on waste management is important.

Second, the role of all stakeholders involved in waste management must be defined and monitored.

Third, waste management operations – waste creation, storage, collection, transportation and disposal are to be monitored within the enabling environment.

#### **8.4.1 Research Strength and Summary**

The main challenge for Minna to have an effective waste management practices was the lack of data on waste management logistics, operation and the site and frequency of UWDSs. This was not helped by the unavailability of public and stakeholder data on waste management. This research has produced the first of its kind database on waste management practices in Minna. All the data was primary sourced using a range of approaches and methods. For example, there was no map of the waste collection district and the location of UWDSs were unknown. Using geospatial, qualitative and quantitative approach enabled an in-depth exploration and understanding of the factors leading to the creation of UWDSs within residential areas. This is the first study that explored the factors that lead to the development of UWDSs in developing countries. Therefore, it is anticipated that the findings from this study can be used not only in Minna, Nigeria but also in other developing countries with similar waste context to manage waste disposal management challenges.

During this case study, the following key findings were identified as the factors that leads to the development of UWDSs within urban residential areas in developing countries:

- Lack of stakeholders' collaboration
- Lack of public awareness and underutilization of community leaders in tackling waste problems within communities (grassroot strategy)
- Lack of accountability which result to poor services and misconducts
- Ineffective waste management policy and implementation
- Insufficient waste collection coverage due to poor waste management structure and poor/insufficient waste collection vehicles
- Inappropriate siting of CWCPs.
- Poor urban planning and waste management strategies.

## **8.5 RECOMMENDATIONS FOR ADOPTION OF ISWMM TO IMPROVE WASTE MANAGEMENT**

### **8.5.1 Recommendation for removing UWDS and improve system**

- **Short term with high impact:** Community participation is required to launch a quick clean-up to remove some heaps of waste (e.g. size 8m<sup>2</sup> to 500m<sup>2</sup> in Chapter Five) located within residential areas, marketplaces, streets, open spaces and drainage system. For this to be achieved, both the SGMs, SGAs, Community leaders, Private sector, and the general public are expected to be involved in the exercise to ensure clean living environment
- **Long term with medium impact:** The cost of waste management per household per month should be known and recorded by NISEPA to ensure accountability.
- **Long term with high impact:** Adoption of UWDS as CWCP

### **8.5.2 Recommendations for policy changes**

- **Long term with high impact:** Policymakers – government should make policies that would support public participation, especially the community leaders. This is because community leaders have valuable roles to play in waste management, so they should be integrated within the waste management stakeholders

- **Short term with high impact:** These policies should be made known to the public through engagement events, not only existing on paper.
- **Long term with high impact:** An improved organisational structure should be recreated to accommodate all stakeholders and their defined roles. This will allow individual organisations to be more active in executing their task locally within the general policy.
  - A bottom-top approach should be developed to utilise both the community leaders and young people, as well as the public. Although it is recognized that the government plays vital roles in managing UWDSs but, over dependency on the government actions may not be enough to achieve effective waste management in developing countries with low-income. However, public involvement through public stakeholder engagement can help to achieve sustainable waste management.
  - The policy should relieve NISEPA from handling the entire waste management systems, which has made them be ‘mini-gods’
- **Short term with high impact:** Working committees should be set up to build relationship (collaboration) among stakeholders who should be encouraged to close the communication gap for effective waste management
- **Short term with high impact:** Redefined roles and responsibilities for stakeholders (Figure 8.5/8.7) should be made clear to all stakeholders. An opportunity to promote young people by extending the responsibility of guiding districts against unofficial waste disposal activities should be developed. The youth should serve as change agents and guard against indiscriminate dumping of waste within communities.
  - Informal collectors should form an association and provide leaders who will be considered as part of waste management stakeholders and their role defined.
  - All residents should be treated equally without given a special treatment to some set of individuals because of their social status or economic class.

### 8.5.3 Recommendation for practices

- **Long term with medium impact:** Urban Planners role: The criteria for siting the CWCPs should be reviewed to increased accessibility to residents to reduce the number of UWDS and prevent the creation of new ones. Therefore, there should be widespread use of CWCPs – evenly distributed across districts.
- **Long term with high impact:** Waste management operators should be trained to perform roles that are equivalent to their level of training. Therefore, contracts should be awarded to qualified staff and be supported.
  - Waste management operators should be encouraged with incentives and be given the political will to implement some innovative changes within their service areas.
- **Long term with high impact:** Collaborative practices between the SGMs, SGAs, Private collectors, Residents, and informal collectors are considered important in achieving effective waste management.
  - Some local roles of waste management, including going into the interior areas where there are no access roads for trucks to collect their waste, should be handled by the informal waste collectors alongside young people. They will be trained and supported to avoid dumping the collected waste in UWDSs or creating new sites.
- **Short term with medium impact:** A more environmental and affordable waste bin should be made available and recommended to people to buy rather than the metal drum which is too big, sub-standard, and becomes rusted because it has no covers and is kept outside.
- **Long term with high impact:** With the lack of proper waste collection equipment in Minna, it is recommended that the waste management in Minna should be privatised because the stakeholders (e.g. government agency) acknowledge in the interview how difficult it is providing adequate waste management services by itself. Therefore, it is

vital to involve private companies as partners in waste collection and disposal services, not as contractors from a distance.

- Given the shortage of staff, the government should consider contracting more private companies. This is because the government waste collection trucks are old and cannot work for long hours without breaking down, which put the collection exercise on hold and causes more piles of waste.
- Strategies should be made on present UWDSs to be evacuated and possible conversion of the centralized sites (UWDSs) with less environmental and human impact to CWCPs.
- Waste management should be given to competent staff, not based on relationship or indigenous basis. Employment and contracts are given to only Nigerlites (Niger State indigenes), which could hinder effective waste management.

#### **8.5.4 Recommendations for education and awareness**

- **Short term with medium impact:** Waste management components should be included and taught at the secondary school/high school level and form part of the undergraduate curriculum. More practical exercise should be involved.
- **Medium term with high impact:** Changes in waste management practices or policy and regulations should be made known to the public accordingly, raising awareness using the right channels for people to have access.
- **Medium term with high impact:** Stakeholders' commitment to training should be encouraged and supported.

#### **8.5.5 Recommendation for Funding**

- **Medium term with high impact:** Waste management in Minna should be put on 'first line charge' not on the availability of funds. Since funds are released from the federation account for proper allocation, waste management should be placed on priority because cleanliness is good health.

- **Short term with Medium impact:** Personal Protection Equipment (PPE) should be provided to staff and be trained on how to use it.
- **Long term with high impact:** The ageing equipment should consider changed and arrangement for proper maintenance should be made available.
- **Medium term with high impact:** A new landfill with low impact on both environment and health should be acquired.

## **8.6 RECOMMENDATIONS FOR FUTURE RESEARCH**

- Only Minna case study is used in this research to determine the factors influencing the creation of UWDSs in developing countries. Using Nigeria as a case study could assist generalizing the findings within Chapter Five, Six, Seven and Eight. The case study was geographically limited and broader approach would help generalization.
- Stakeholders' collaborations for effective waste management (including UWDSs) are identified as vital but are currently lacking in Minna, which presents an important area of further research.
- During the geospatial mapping of the waste disposal sites, apart from the location of the sites, waste compositions were observed but not considered in the research. A composition study of this waste disposed at the UWDSs within residential areas presents an important area of further research;
- In determining the proximity of CWCPs to residential buildings, tertiary roads and the UWDSs (being within residential areas) were used to measure the distance from CWCPs to the nearest UWDS. Further research to explore the proximity of UWDSs to the residential houses is required to determine the health and environmental impact of these sites to the residents.

- Similarly, use of waste as organic matter for farmlands presents an important area for further research to measure the level of effect of the waste to human life when consuming the farm produce.



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## APPENDIX

### Appendix 1: Questionnaire for Minna residents on waste collection and disposal services

**(Q1)** In what district of Minna do you live?

Chanchaga	
Bosso East	
Maintumbi	
Saka kahuta	
Tunga A (East)	
Tunga B (West)	
Bosso West	
Sabon gari/ Anguwa Daji	
Ketarent Gwari	
Kpakungu/Dutsen kura	
Other	

**(Q2a)** How many minutes/hours does it take you to reach the nearest official waste disposal site/central waste collection point from your house, and how far is the official waste disposal site from your house?

Hours/minutes	Kilometres

**(Q2b)** How many hours/minutes does it take you to reach the nearest unofficial waste disposal site from your house, and how far is the unofficial waste disposal site from your house?

Hours/minutes	Kilometres

**(Q3)** What type of waste bin do you have? Please state how many of each bin type you own?

	Number of bins
Metal drum	
Plastic bag	
Plastic basket	
240 litres plastic wheeled bin	
Other(please specify)	

**(Q4)** How many times your household bin get full/emptied per week (only estimates are required)?

1	
1-3	
4-6	
5-8	
9 and above (please specify)	

**(Q5)** Did you purchase your waste bin from NISEPA?

Yes  How much? .....

No  Why not (please select the most important factor that influenced your decision?)

Too expensive	
Too big	
Low quality	
Too small	
Other(please specify)	

**(Q6)** Is waste collected from your house?

Yes  Go to Q7

No  where is it collected? ..... Go to Q14

**(Q7)** How often is your waste scheduled to be collected?

Weekly	
Two times a week	
Three times a week	
Four times a week	
I have no idea	

**(Q8)** How often is your waste actually collected on the scheduled day?

Never collected	
Rarely collected	
Often collected	
Very often collected	

**(9)** How often would you like your waste to be collected?

Weekly	
Two times a week	
Three times a week	
Four times a week	
Other(please specify)	

**(Q10)** In your opinion why is your waste not collected?

--

**(Q11)** Do you know the organization that is responsible for your waste collection?

Yes [ ]

No [ ]

**(Q12)** If yes, what is the name of the organization that is responsible for your waste collection?

--

**(Q13a)** If your waste has not been collected as scheduled have you ever complained to the authority?

Yes [ ]

No [ ] always collected

No [ ] don't know how to complain

No [ ] not interested

**(Q13b)** If yes, what was the response?

--

**(Q14a)** How do you dispose of your waste if it is not collected by the authority responsible? (Please select all that apply)

Take to official disposal site	
Dispose of in open spaces (unofficial)	
Dispose of in river/street or drains	
Give to informal collectors	
Burn the waste	
Other	

**(Q14b)** If you selected "burn the waste" please indicate why you do this? (Please select all that apply)

No collection services	
Infrequent collection services	
Distance to central waste collection point	
It is easier	
Control Odours	

Prevent vermin being attracted to the waste	
Other	

**(Q15)** How would you describe the effectiveness of waste management in your area?

Excellent	
Good	
Fair	
Poor	
Very poor	
Not sure	

**(Q16)** In your opinion, rank the reasons why people chose to dispose their waste in unofficial places following the reasons why they prefer that system using the scale (Please rank 1-7)

1=Major reason while 7=least important reason

	1	2	3	4	5	6	7
Lack of collection services							
Lack of proper disposal site							
Distance to central waste collection point							
Infrequent collection service							
Insufficient information							
Waste laws are not enforced							
Easier, faster and no cost							

**(Q17)** With the present state of waste management in Minna, who do you think is best equipped to effectively manage the waste problems in the city?

Government agencies	
Private agencies	
Joint government and private	
Individual	
Informal waste collectors	
other	



**(Q18a)** Are you willing/able to pay for waste collection and disposal to improve the standard of waste management in the city?

Yes [ ]

No [ ]

Not sure [ ]

**(Q18b)** If yes/not sure, how much would you be able/willing to pay for your waste collection services a month?

N500	
N1,000	
N1,500	
N2,000	
N2,500	
N3,000 and above	

**(Q19)** If No, Please give reason

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**(Q20)** Which of the following methods of communication options do you consider to be the most effective in informing the public of waste awareness campaigns (please select all that apply)

TV programme	
Radio programme	
Leaflets	
Street campaign posters	
Other	

**(Q21)** Would you consider getting directly involved in raising awareness of waste issues in your community?

Yes, definitely [ ]

Yes, probably [ ]

No, not interested [ ]

Not sure [ ]

**(Q22)** If Not interested or not sure, please give reasons

--

**(Q23)** What is your Gender?

Male	
Female	

**(Q24)** How long have you lived in Minna?

<1 year	
1-5 years	
6-10 years	
11-20 years	
21-30 years	
>30 years	

**(Q25)** What is your age?

18-25	
26-30	
31-35	
36-40	
41-45	
46-50	
51-55	
56-60	
60+	

**(Q26)** What is your occupation?

Civil Servant (e.g. Government worker)	
Unemployed	
Self-employed (e.g. Carpenter, hair dresser, Mechanic, Trader, Farmer, etc.)	
Work for a private company	
Retired	
Student	

**(Q27)** What is your highest level of education?

Primary (First living certificate)	
Secondary (WAEC and NECO)	
NCE	
ND	
HND	

B.Sc.	
MSc.	
PhD	

Thank you for completing this survey. Please use the space below if you would like to provide any additional information or views on waste management practices in the city.

## **Appendix 2: Semi – Structure interview**

### **MINISTRY OF ENVIRONMENT AND NESREA QUESTIONS**

1. Please what is your name, your role and your years in service?
2. When was your organization established in Minna?
3. What is the mandate of your office/organization with respect to waste management/ environment?
4. Who are the key stakeholders that are involved in waste management in Minna?
5. What are the success factors in working together with NISEPA, contractors etc.?
6. Do you receive complains in your office from individual (public), agency or waste collectors and contractors?
7. Are there policies and regulations that has been adopted for the past five years?
8. How do you ensure that this policy and regulations are implemented?
9. How is the waste management in Minna funded?
10. In your opinion, is the fund released for the waste management enough?
11. What are the successes achieved or challenges faced while working together with other stakeholders? For example, Ministry of women affairs handling the communication of environmental matters to the public.
12. How do you carry out public education on waste disposal activities and also communicate to the public on waste management policies and regulations?
13. Is your organization involve in siting official waste disposal site?
14. As an organization, what role do you play in siting the official waste disposal site?
15. Which sites have you approved for siting waste disposal facilities in Minna?
16. What are the issues surrounding the regulated/approved site?
17. How do you monitor the official waste disposal site?
18. In your opinion, what are the reasons for the formation of the unofficial waste disposal sites within residential areas?
19. Are there strategies to put a stop to the formation of unofficial waste disposal site within residential areas?
20. How would you describe the public attitude towards waste disposal activities in Minna?

21. What are the challenges that hinder effective waste management in Minna?
22. Based on the sanitation document on offences and the penalties, have you ever caught anyone and charged them according to the regulation?
23. The regulation shows that occupants are to keep at least 15 metres from their premises clean, how are the residents monitored to ensure compliance?

#### **NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA) QUESTIONS**

Q1: Please what is your name, your role and your years in service?

Q2: When was your organization establish in Minna?

Q3: What is the mandate of your office/organization with respect to waste management/environment?

Q4: Who do you report /answerable to as an agency in terms of waste management in Minna?

Q5: Who are the stakeholders you work with as an agency to manage the waste in Minna?

Q6: What are the success factors in working together with this people (stakeholders)?

Q7: Who fund the waste management as an agency?

Q8: What type of equipment do you have for waste management operations?

Q9: How do you acquire the equipment for waste management and who provides the equipment?

Q10: Are you involve in policy making as a waste management agency?

Q11: Are there policy and regulations that have been adopted in your organization for the past five (5yrs) years?

Q12: How do you ensure that the policy and regulations are implemented by your organization?

Q13: Are you involve in selection and siting of official waste facilities in Minna?

Q14: What are the factors you consider when siting an official waste disposal facility?

Q15: What considerations qualify a site suitable for waste disposal facility (official site)?

Q16: Is the fund allocated by government enough to manage the waste in the city?

Q17: What category of staff do you employ in the waste management, and how easy it is to attract them into the waste management sector?

Q18: What are the criteria for the employment of your staff?

Q19: How do you determine the amount you pay waste collectors (Is it a fixed salary or it is per truck, per tonne, per district per household etc.?)

Q20: Do you monitor the waste collectors before payment?

Q21: Is waste generation in Minna increasing or decreasing, and what is the cause?

Q22: What are the challenges you are facing in terms of waste collection and disposal in Minna?

Q23: What are the factors that influence the quality of waste collection services?

Q24: How would you describe public attitude towards waste disposal in Minna?

Q25: What part of Minna receive effective waste collection services and which part is not?

Q26: Is accessibility to certain areas an issue affecting waste collection service and do you work with ministry of land and housing?

Q27: In your own opinion, what are factors or reasons for the development of unofficial waste disposal sites within residential areas?

Q28: What are the strategies you put in place to stop the formation of unofficial waste disposal sites within residential area?

Q29: Do NISEPA have their specified route? if yes, what is the rationale behind the selection of this routes for waste collection in Minna?

Q30: How do you conduct your grouping of Minna into the ten district?

Q31: Is it possible for some of the residents do not know the appropriate authority to report issues to?

Q32: What is your opinion about Informal waste collectors' activities?

Q33: Do you work with community leaders?

Q34: Do you pay the community leaders while working with them?

Q35: What are the biggest challenges you face in terms of waste management in Minna?

### **COMMUNITY LEADERS QUESTION**

Q1: Please what is your name, position and district?

- Q2: What can you say about the waste management in Minna?
- Q3: What is your role in managing the waste in Minna as a community leader?
- Q4: What influence do you have on residents especially the youth as a community leader related to waste disposal?
- Q5: Based on your office as community leader, has there been any time that the residents complained to you about waste management in Bosso community?
- Q6: As a community leader, has NISEPA or the government called you for a meeting to discuss things concerning waste management in your area or Minna?
- Q7: What would be your major focus if you were fully involved in waste management as a waste management authority?
- Q8: In your opinion what are the factors or reasons for the formation of unofficial waste disposal sites within residential areas?
- Q9: Do you have any strategy to control or manage this unofficial site or to stop people from using them?
- Q10: In your opinion, is it with the permission of the landowner for people to dump waste in their piece of land?
- Q11: What are the things you can suggest to improve the waste management practice in Minna?
- Q12: Is access road a problem that NISEPA cannot come to the area to collect the waste?
- Q13: Is there any defined role for you to play as a community leader in terms of waste management?
- Q14: Do NISEPA encourage you to burn your waste?
- Q15: Do you report to NISEPA about the residents complain and the unofficial sites within residential areas how it is a problem?
- Q16: Are you willing to take some responsible if handed over to you concerning the waste management in Minna?

**STAFF AT THE OFFICIAL SITE (Open landfill)**

- Q1: How long has the official site been in operation?
- Q2: How long have you been working at the official waste disposal site?

Q3: Which agency/organization is responsible for the maintenance of the official waste disposal site?

Q4: Do you work with ministry of environment or NISEPA?

Q5: Do you receive complain from the surrounding communities about flies, odour, contamination of water, or anything disturbing them from site?

Q6: Who bring waste to the site apart from NISEPA and their contractors?

Q7: How many tonnes of waste does the site receive in a day?

Q8: Do you keep record of the activities on site?

Q9: Do you submit to NISEPA weekly or monthly?

Q10: Since segregation of waste is not done at source, do you in any way segregate waste on site?

Q11: Do you charge the scavengers for picking those recyclables since they will make money out of it?

Q12: Do you treat the waste after segregating on site?

Q13: How do the people (residents) get the portion of land they farm on site considering that this is government land?

Q14: What are the equipment you use on site?

Q15: Do you do health check up at the hospital considering your level of exposure on site or receive some allowances for that?

Q16: The equipment provided to be use on site are they sufficient?

Q17: Do the waste collector pay any money to you as a gate fee?

Q18: Have you ever had any issue with NISEPA?

Q19: What are the challenges you face on site?

### **SCAVENGERS AT OFFICIAL SITE (Open landfill)**

Q1: How long has the official site been in operation?

Q2: How long have you been scavenging at the official site?

Q3: Who buy the recyclable materials you scavenge?

Q4: How do you sell the recyclable to them (buyers)? Is it per kilogram?

Q5: Do you know what they do with the materials they buy from you?

Q6: Do you reside at the official dumpsite?



Q7: Do you pay any money to NISEPA or Government to allow you scavenge at official waste disposal site?

Q8: Do you plant crops on the official site?

## Appendix 3: Ethical approval

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18<sup>th</sup> August 2016

Karl Williams/Salamatu Kassah  
School of Forensic and Applied Sciences  
University of Central Lancashire

Dear Karl/Salamatu,

**Re: STEMH Ethics Committee Application**  
**Unique Reference Number: STEMH 521**

The STEMH ethics committee has granted approval of your proposal application 'A Conceptual Model Approach for the Management of unofficial/informal waste disposal sites in developing countries'. Approval is granted up to the end of project date\* or for 5 years from the date of this letter, whichever is the longer.

It is your responsibility to ensure that:

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify [roffice@uclan.ac.uk](mailto:roffice@uclan.ac.uk) if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Committee
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purposes e.g. funder's end of grant report; abstract for student award or NRES final report. If none of these are available use [e-Ethics Closure Report Proforma](#)).

Yours sincerely,

A handwritten signature in black ink, appearing to read "Emma", with a long horizontal flourish extending to the right.

Emma Hesketh  
Head of Research Development and Support  
STEMH Ethics Committee

**Appendix 4: Weekly waste collection schedule list for Minna residents**

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

**District:** Chanchaga, Minna  
**Vehicle Type:** Tipper (6 Tyres)  
**Vehicle Number:** XH 827 DKA  
**Parastatal/Company:** AMJAL RESOURCES LTD (Manager Saidu Safiyanu)

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	IBRAHIM ABDULMALIK	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Usman Ubandoma Rd. (Kolawole) - Mustapha Babangida Road.</li> <li>• Soggi Guest Inn Road Tunga.</li> <li>• Doctor Musa Ahmed Ibeto Avenue Tunga Low Cost.</li> <li>• Adamu Aliyu Close Tunga Low Cost</li> <li>• Garba Kuta road, Dan Dar'man Minna Close Intermediate Qrts</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00am – 11:00pm 11:00am – 1:00pm 1:00pm – 2:00pm 2.00pm – 4.00pm	

Tuesday	IBRAHIM ABDULMALIK	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Kabala road, Alh. Baba Doko Rd (Custom Barracks) Tunga &amp; Back of Shiroro Hotel Avenue</li> <li>• Assembly of God Way &amp; Central Bank Qrts Tunga .</li> <li>• Fadama road Tunga .</li> <li>• Hydro Hotel Way, Brighter Suit Rd Tunga (Farm Centre) &amp; Neco Computer Rd</li> <li>• Custom Office road Tunga and Back of Custom Office Tunga</li> </ul>	8:00am – 9:00am 9:00am – 11:00am 11:00am – 12:00pm 12:00pm – 1:00pm 1.00pm – 3.00pm  3.00pm – 4.00pm	
Wednesday	IBRAHIM ABDULMALIK	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Usman Ubandoma Rd. (Kolawole) - Mustapha Babangida Road.</li> <li>• Soggi Guest Inn Road Tunga.</li> <li>• Doctor Musa Ahmed Ibeto Avenue Tunga Low Cost.</li> <li>• Adamu Aliyu Close Tunga Low Cost</li> <li>• Garba Kuta road, Dan Dar’man Minna Close Intermediate Qrts</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00am – 11:00pm 11:00am – 1:00pm 1:00pm – 2:00pm 2.00pm – 4.00pm	
Thursday	IBRAHIM ABDULMALIK	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Kabala road, Alh. Baba Doko Rd (Custom Barracks) Tunga &amp; Back of Shiroro Hotel Avenue</li> <li>• Assembly of God Way &amp; Central Bank Qrts Tunga.</li> <li>• Fadama road Tunga.</li> <li>• Hydro Hotel Way, Brighter Suit Rd Tunga (Farm Centre) &amp; Neco Computer Rd</li> <li>• Custom Office road Tunga and Back of Custom Office Tunga</li> </ul>	8:00am – 9:00am 9:00am – 11:00am  11:00am – 12:00pm 12:00pm – 1:00pm 1.00pm – 3.00pm 3.00pm – 4.00pm	

<b>Friday</b>	IBRAHIM ABDULMALIK	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Usman Ubandoma Rd. (Kolawole) - Mustapha Babangida Road.</li> <li>• Soggi Guest Inn Road Tunga.</li> <li>• Doctor Musa Ahmed Ibeto Avenue Tunga Low Cost.</li> <li>• Adamu Aliyu Close Tunga Low Cost</li> <li>• Garba Kuta road, Dan Dar'man Minna Close Intermediate Qrts</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00am – 11:00pm 11:00am – 1:00pm 1:00pm – 2:00pm 2.00pm – 4.00pm	
<b>Saturday</b>	IBRAHIM ABDULMALIK	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Kabala road, Alh. Baba Doko Rd (Custom Barracks) Tunga &amp; Back of Shiroro Hotel Avenue</li> <li>• Assembly of God Way &amp; Central Bank Qrts Tunga .</li> <li>• Fadama road Tunga.</li> <li>• Hydro Hotel Way, Brighter Suit Rd Tunga (Farm Centre) &amp; Neco Computer Rd</li> <li>• Custom Office road Tunga and Back of Custom Office Tunga</li> </ul>	8:00am – 9:00am 9:00am – 11:00am 11:00am – 12:00pm 12:00pm – 1:00pm 1.00pm –3.00pm  3.00pm – 4.00pm	
Sunday				

**Name & Designation of Supervising Officer:** Abudullahi Baba Sallah

**Signature & Date**.....

**Engr. Barau Lucky (DGM WM& SS)**

**Sign**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

**District:** **Sabon Gari / Anguwan Daji, Minna**

**Vehicle Type:** **Tipper (10 Tyres)**

**Vehicle Number:** **XC 364 BSA**

**Parastatal/Company:** **SAUMA INTERGRATED SERVICES LTD. (Manager- Mohammed)**

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	Mal. Umar	<ul style="list-style-type: none"> <li>• Abdul street, Old market, Sabon gari "A" &amp; Sabon gari "B"- New market junction</li> <li>• Paida Hill, Abayi Close, stadium road &amp; Emir's palace road</li> <li>• Kuta Road, Ogbomosho road &amp; Central Mosque road</li> <li>• Justice Muazu road –Jonapal bridge, Alh. Nasidi road, Central police station road and Massallacin Iddi Open Dump.</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Tuesday	Mal. Umar	<ul style="list-style-type: none"> <li>• Abdul street, Old market, Sabon gari "A" &amp; Sabon gari "B"- New market junction</li> <li>• Paida Hill, Abayi Close, stadium road &amp; Emir's palace road</li> <li>• Anguwan daji community &amp; Northern Bypass to Massallacin Iddi open dump</li> <li>• Massallacin Iddi to Mustapha clinic road, F-layout and Tayi Community</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm  2:00pm – 4:00pm	
Wednesday	Mal. Umar	<ul style="list-style-type: none"> <li>• Abdul street, Old market, Sabon gari "A" &amp; Sabon gari "B"- New market junction</li> </ul>	8:00am – 10:00am	

		<ul style="list-style-type: none"> <li>• Paida Hill, Abayi Close, stadium road &amp; Emir’s palace road</li> <li>• Kuta Road,Ogbomosho road &amp; Central Mosque road</li> <li>• Justice Muazu road –Jonapal bridge,Alh.Nasidi road, Central police station road and Massallacin Iddi Open Dump.</li> </ul>	10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Thursday</b>	Mal. Umar	<ul style="list-style-type: none"> <li>• Abdul street,Old market,Sabon gari “A” &amp; Sabon gari “B”- New market junction</li> <li>• Paida Hill, Abayi Close, stadium road &amp; Emir’s palace road</li> <li>• Anguwan daji community&amp; Northern Bypass to Massallacin Iddi open dump</li> <li>• Massallacin Iddi to Mustapha clinic road,F-layout and Tayi Community</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm  2:00pm – 4:00pm	
<b>Friday</b>	Mal. Umar	<ul style="list-style-type: none"> <li>• Abdul street,Old market,Sabon gari “A” &amp; Sabon gari “B”- New market junction</li> <li>• Paida Hill, Abayi Close, stadium road &amp; Emir’s palace road</li> <li>• Kuta Road,Ogbomosho road &amp; Central Mosque road</li> <li>• Justice Muazu road –Jonapal bridge,Alh.Nasidi road, Central police station road and Massallacin Iddi Open Dump.</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Saturday</b>	Mal. Umar	<ul style="list-style-type: none"> <li>• Abdul street,Old market,Sabon gari “A” &amp; Sabon gari “B”- New market junction</li> <li>• Paida Hill, Abayi Close, stadium road &amp; Emir’s palace road</li> <li>• Anguwan daji community&amp; Northern Bypass to Massallacin Iddi open dump</li> <li>• Massallacin Iddi to Mustapha clinic road,F-layout and Tayi Community</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm  2:00pm – 4:00pm	
<b>Sunday</b>				

**Name & Designation of Supervising Officer:** MR. John Nda Sunday & Adamu Bosso

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)  
WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

District: **Tunga East (Tunga A), Minna**

Vehicle Type: **Compactor**

Vehicle Number: **F2 531 WF 44**

parastatal/ Company: **HIKMA MULTI-CONCEPT LTD. (Manager – Musa Adams)**

<b>Day &amp; Date</b>	<b>Name &amp; GSM No. of Driver</b>	<b>Service Locations</b>	<b>Duration</b>	<b>Comments</b>
Monday	Nurudeen Mohammed	<ul style="list-style-type: none"> <li>• New Secretariat roundabout – Bahago Plaza Tunga</li> <li>• Bahago Plaza - Mobil Round-about</li> <li>• Mobil Round-about - Pot roundabout</li> <li>• Pot roundabout – New Secretariat Roundabout Tunga</li> <li>• New Rd Tunga Market to Mobile Police Barrack Tunga</li> <li>• David Mark Rd, El-Amin Inter. Sch. - Flamingo junction</li> <li>• Re-collection at Tunga Main Road</li> </ul>	8:00am – 8:30am 8:30am – 10:30am 10:30am 11:00am 11:00am 1:00pm 1:00pm – 2:00pm 2.00pm – 3.00pm 3.00pm – 4.00pm	
Tuesday	Nurudeen Mohammed 07037417894	<ul style="list-style-type: none"> <li>• New Secretariat roundabout – Bahago Plaza Tunga</li> <li>• Bahago Plaza - Mobil Round-about</li> <li>• Mobil Round-about - Pot roundabout</li> <li>• Pot roundabout – New Secretariat Roundabout Tunga</li> <li>• Top Medical Rd Tunga - Eastern Bypass Junction Tunga</li> <li>• House of Assembly Quarters &amp; Eastern Bye pass Tunga</li> </ul>	8:00am – 8:30am 8:30am – 10:30am 10:30am 11:00am 11:00am 1:00pm 1:00pm – 2:00pm 2.00pm – 3.00pm	



		<ul style="list-style-type: none"> <li>• Re-collection at Tunga Main Road</li> </ul>	3.00pm – 4.00pm	
Wednesday	Nurudeen Mohammed	<ul style="list-style-type: none"> <li>• New Secretariat roundabout – Bahago Plaza Tunga</li> <li>• Bahago Plaza - Mobil Round-about</li> <li>• Mobil Round-about - Pot roundabout</li> <li>• Pot roundabout – New Secretariat Roundabout Tunga</li> <li>• New Rd Tunga Market to Mobile Police Barrack Tunga</li> <li>• David Mark Rd, El-Amin Inter. Sch. - Flamingo junction</li> <li>• Re-collection at Tunga Main Road</li> </ul>	8:00am – 8:30am 8:30am – 10:30am 10:30am 11:00am 11:00am 1:00pm 1:00pm – 2:00pm 2.00pm – 3.00pm 3.00pm – 4.00pm	
Thursday	Nurudeen Mohammed	<ul style="list-style-type: none"> <li>• New Secretariat roundabout – Bahago Plaza Tunga</li> <li>• Bahago Plaza - Mobil Round-about</li> <li>• Mobil Round-about - Pot roundabout</li> <li>• Pot roundabout – New Secreteriat Roundabout Tunga</li> <li>• Top Medical Rd Tunga - Eastern Bypass Junction Tunga</li> <li>• House of Assembly Quarters &amp; Eastern Bye pass Tunga</li> <li>• Re-collection at Tunga Main Road</li> </ul>	8:00am – 8:30am 8:30am – 10:30am 10:30am 11:00am 11:00am 1:00pm 1:00pm – 2:00pm 2.00pm – 3.00pm 3.00pm – 4.00pm	

<b>Friday</b>	Nurudeen Mohammed	<ul style="list-style-type: none"> <li>• New Secretariat roundabout – Bahago Plaza Tunga</li> <li>• Bahago Plaza - Mobil Round-about</li> <li>• Mobil Round-about - Pot roundabout</li> <li>• Pot roundabout – New Secretariat Roundabout Tunga</li> <li>• New Rd Tunga Market to Mobile Police Barrack Tunga</li> <li>• David Mark Rd, El-Amin Inter. Sch. - Flamingo junction</li> <li>• Re-collection at Tunga Main Road</li> </ul>	8:00am – 8:30am 8:30am – 10:30am 10:30am 11:00am 11:00am 1:00pm 1:00pm – 2:00pm 2.00pm – 3.00pm 3.00pm – 4.00pm	
<b>Saturday</b>	Nurudeen Mohammed	<ul style="list-style-type: none"> <li>• New Secretariat roundabout – Bahago Plaza Tunga</li> <li>• Bahago Plaza - Mobil Round-about</li> <li>• Mobil Round-about - Pot roundabout</li> <li>• Pot roundabout – New Secretariat Roundabout Tunga</li> <li>• Top Medical Rd Tunga - Eastern Bypass Junction Tunga</li> <li>• House of Assembly Quarters &amp; Eastern Bye pass Tunga</li> <li>• Re-collection at Tunga Main Road</li> </ul>	8:00am – 8:30am 8:30am – 10:30am 10:30am 11:00am 11:00am 1:00pm 1:00pm – 2:00pm 2.00pm – 3.00pm 3.00pm – 4.00pm	
<b>Sunday</b>				

**Name & Designation of Supervising Officer:** Musa Shaba

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

**District:** Ketaren Gwari, Minna  
**Vehicle Type:** Side Loader  
**Vehicle Number:** XE 732 YAB  
**Parastatal /Company:** MAI-GASKIYA CONCEPT LTD. (Manager – Mr. Jerry)

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	BAWA	<ul style="list-style-type: none"> <li>• Mobil Roundabout – AP Roundabout (Ketaren Gwari Rd)</li> <li>• AP Roundabout – Mobil Roundabout (Ketaren Gwari Rd)</li> <li>• Democracy Roundabout – Government House Roundabout</li> <li>• Limawa ‘A’ &amp; Limawa ‘B’</li> <li>• Makera, Kwangila</li> </ul>	8:00am – 9:00am 9 :00am – 10:00am 10:00am –12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Tuesday	BAWA	<ul style="list-style-type: none"> <li>• Mobile Roundabout – AP Roundabout (Ketaren Gwari Rd)</li> <li>• AP Roundabout – Mobile Roundabout (Ketaren Gwari Rd)</li> <li>• Democracy Roundabout – Government House Roundabout</li> <li>• Old Secreteriat,Hospital Road, Yoruba Road and Ibo Road</li> <li>• Ketaren-Gwari “ A” and Ketaren Gwari “ B”</li> </ul>	8:00am – 9:00am 9 :00am – 10:00am 10:00am –12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Wednesday	BAWA	<ul style="list-style-type: none"> <li>• Mobile Roundabout – AP Roundabout (Ketaren Gwari Rd)</li> <li>• AP Roundabout – Mobile Roundabout (Ketaren Gwari Rd)</li> <li>• Democracy Roundabout – Government House Roundabout</li> </ul>	8:00am – 9:00am 9 :00am – 10:00am 10:00am –12:00pm	

		<ul style="list-style-type: none"> <li>• Limawa 'A' &amp; Limawa 'B'</li> <li>• Makera, Kwangila</li> </ul>	12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Thursday</b>	BAWA	<ul style="list-style-type: none"> <li>• Mobile Roundabout – AP Roundabout (Ketaren Gwari Rd)</li> <li>• AP Roundabout – Mobile Roundabout (Ketaren Gwari Rd)</li> <li>• Democracy Roundabout – Government House Roundabout</li> <li>• Old Secreteriat, Hospital Road, Yoruba Road and Ibo Road</li> <li>• Ketaren-Gwari “ A” and Ketaren Gwari “ B”</li> </ul>	8:00am – 9:00am 9 :00am – 10:00am 10:00am –12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Friday</b>	BAWA	<ul style="list-style-type: none"> <li>• Mobile Roundabout – AP Roundabout (Ketaren Gwari Rd)</li> <li>• AP Roundabout – Mobile Roundabout (Ketaren Gwari Rd)</li> <li>• Democracy roundabout – Government House Roundabout</li> <li>• Limawa 'A' &amp; Limawa 'B'</li> <li>• Makera, Kwangila</li> </ul>	8:00am – 9:00am 9 :00am – 10:00am 10:00am –12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Saturday</b>	BAWA	<ul style="list-style-type: none"> <li>• Mobile Roundabout – AP Roundabout (Ketaren Gwari Rd)</li> <li>• AP Roundabout – Mobile Roundabout (Ketaren Gwari Rd)</li> <li>• Democracy roundabout – Government House Roundabout</li> <li>• Old Secreteriat, Hospital Road, Yoruba Road and Ibo Road</li> <li>• Ketaren-Gwari “ A” and Ketaren Gwari “ B”</li> </ul>	8:00am – 9:00am 9 :00am – 10:00am 10:00am –12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	

**Name & Designation of Supervising Officer:** Mathew John, Baba Shayago, & Abu N. Abu

**Signature & Date**.....

**Engr. Barau Lucky**

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

**District:** Bosso West, Minna

**Vehicle Type:** Compactor

**Vehicle Number:** XN 621 ABC

**Parastatal/Company:** MBEL CONCEPT NIG. LTD. (Manager- Mr. Paul)

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	SABIU MOHAMMED	<ul style="list-style-type: none"> <li>Bosso low-cost junction to Mobil round about</li> <li>Mobil round about to Bosso low-cost junction</li> <li>Govrt House rd, Okada rd, &amp; Mataza Drive</li> <li>Zarumai rd. and Onigbinde rd.</li> <li>Re-collection at makera junction. &amp; Sky bank.</li> </ul>	8:00am – 10:00am 10:0am – 12:00pm 12:00pm – 2.00pm 2:00pm – 3:00pm 3:00pm – 4:00pm	
Tuesday	SABIU MOHAMMED	<ul style="list-style-type: none"> <li>Bosso low-cost junction to Mobil round about</li> <li>Mobil round about to Bosso low-cost junction</li> <li>Govt House rd, Okada rd, Adamawa str&amp; Dutsen Kura Hausa &amp; Off London rd. by Jikpam Pry. Sch. Bajogo Street</li> <li>London Rd., Kaduna street and VEEZ Garden Avenue.</li> <li>Re-collection at makera junction. &amp; Sky bank.</li> </ul>	8:00am – 10:00am 10:00am –12:00pm 12:00pm – 2.00pm 2:00pm – 3:00pm 3:00pm – 4:00pm	
Wednesday	SABIU MOHAMMED	<ul style="list-style-type: none"> <li>Bosso low-cost junction to Mobil round about</li> <li>Mobil round about to Bosso low-cost junction</li> </ul>	8:00am – 10:00am 10:0am – 12:00pm	

		<ul style="list-style-type: none"> <li>Govrt House rd, Okada rd, &amp; Mataza Drive</li> <li>Zarumai rd. and Onigbinde rd.</li> <li>Re-collection at makera junction. &amp; Sky bank.</li> </ul>	12:00pm – 2.00pm 2:00pm – 3:00pm 3:00pm – 4:00pm	
<b>Thursday</b>	SABIU MOHAMMED	<ul style="list-style-type: none"> <li>Bosso low-cost junction to Mobil round about</li> <li>Mobil round about to Bosso low-cost junction</li> <li>Govt House rd, Okada rd, Adamawa str&amp; Dutsen Kura Hausa &amp; Off London rd. by Jikpam Pry. Sch. Bajogo Street</li> <li>London Rd., Kaduna street and VEEZ Garden Avenue</li> <li>Re-collection at makera junction. &amp; Sky bank.</li> </ul>	8:00am – 10:00am 10:00am –12:00pm 12:00pm – 2.00pm  2:00pm – 3:00pm 3:00pm – 4:00pm	
<b>Friday</b>	SABIU MOHAMMED	<ul style="list-style-type: none"> <li>Bosso low-cost junction to Mobil round about</li> <li>Mobil round about to Bosso low-cost junction</li> <li>Govrt House rd, Okada rd, &amp; Mataza Drive</li> <li>Zarumai rd. and Onigbinde rd.</li> <li>Re-collection at makera junction. &amp; Sky bank.</li> </ul>	8:00am – 10:00am 10:0am – 12:00pm 12:00pm – 2.00pm 2:00pm – 3:00pm 3:00pm – 4:00pm	
<b>Saturday</b>	SABIU MOHAMMED	<ul style="list-style-type: none"> <li>Bosso low-cost junction to Mobil round about</li> <li>Mobil round about to Bosso low-cost junction</li> <li>Govt House rd, Okada rd, Adamawa str&amp; Dutsen Kura Hausa &amp; Off London rd. by Jikpam Pry. Sch. Bajogo Street</li> <li>London Rd., Kaduna street and VEEZ Garden Avenue.</li> <li>Re-collection at makera junction. &amp; Sky bank.</li> </ul>	8:00am – 10:00am 10:00am –12:00pm 12:00pm – 2.00pm  2:00pm – 3:00pm 3:00pm – 4:00pm	

**Name & Designation of Supervising Officer:** Aminu A. Giwa , Adamu Bosso & Abu N. Abu

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

**District:** Sauka Ka Huta, Minna

**Vehicle Type:** Tipper (6 Tyres)

**Vehicle Number:** XB – 210 - RSH

**Parastatal/Company:** ABDULRAHMAN MUREGI FARMS LTD (Manager – Mr. Austin)

<b>Day &amp; Date</b>	<b>Name &amp; GSM No. of Driver</b>	<b>Service Locations</b>	<b>Duration</b>	<b>Comments</b>
Monday	Abdulrahman Mohammed	<ul style="list-style-type: none"> <li>• Broadcasting road junction to City Gate R/about western bypass</li> <li>• City Gate R/about, Garima Group, Shiroro Hotel to broadcasting road junction western bypass &amp; Barkin Sale Under the Bridge</li> <li>• Brighter sch. Road, Goodluck Jonathan Place (Mandela road)</li> <li>• Sauka ka Huta Masallaci road &amp; Sauka ka Huta ECWA church road.</li> <li>• Sadiya Guest-inn road Sauka ka Huta</li> </ul>	8:00am – 9:00am 9:00am – 11:00am  11:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Tuesday	Abdulrahman Mohammed	<ul style="list-style-type: none"> <li>• Broadcasting road junction to City Gate R/about western bypass</li> <li>• City Gate R/about, Garima Group, Shiroro Hotel to broadcasting road junction western bypass.</li> <li>• Barikin Sale primary school/ under bridge</li> <li>• Barikin Sale “A” wakili road.</li> </ul>	8:00am – 9:00am 9:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	

		<ul style="list-style-type: none"> <li>• Sabon Gari Barikin Sale &amp; Police post road Barikin Sale</li> </ul>		
Wednesday	Abdulrahman Mohammed	<ul style="list-style-type: none"> <li>• Broadcasting road junction to City Gate R/about western bypass</li> <li>• City Gate R/about, Garima Group, Shiroro Hotel to broadcasting road junction western bypass &amp; Barkin Sale Under the Bridge</li> <li>• Brighter sch. Road, Goodluck Jonathan Place (Mandela road)</li> <li>• Sauka ka Huta Masallaci road &amp; Sauka ka Huta ECWA church road.</li> <li>• Sadiya Guest-inn road Sauka ka Huta</li> </ul>	8:00am – 9:00am 9:00am – 11:00am  11:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Thursday	Abdulrahman Mohammed	<ul style="list-style-type: none"> <li>• Broadcasting road junction to City Gate R/about western bypass</li> <li>• City Gate R/about, Garima Group, Shiroro Hotel to broadcasting road junction western bypass.</li> <li>• Barikin Sale primary school/ under bridge</li> <li>• Barikin Sale “A” wakili road.</li> <li>• Sabon Gari Barikin Sale &amp; Police post road Barikin Sale</li> </ul>	8:00am – 9:00am 9:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Friday	Abdulrahman Mohammed	<ul style="list-style-type: none"> <li>• Broadcasting road junction to City Gate R/about western bypass</li> <li>• City Gate R/about, Garima Group, Shiroro Hotel to broadcasting road junction western bypass &amp; Barkin Sale Under the Bridge</li> <li>• Brighter sch. Road, Goodluck Jonathan Place (Mandela road)</li> <li>• Sauka ka Huta Masallaci road &amp; Sauka ka Huta ECWA church road.</li> <li>• Sadiya Guest-inn road Sauka ka Huta</li> </ul>	8:00am – 9:00am 9:00am – 11:00am  11:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
Saturday	Abdulrahman Mohammed	<ul style="list-style-type: none"> <li>• Broadcasting road junction to City Gate R/about western bypass</li> </ul>	8:00am – 9:00am 9:00am – 10:00am	



		<ul style="list-style-type: none"> <li>• City Gate R/about, Garima Group, Shiroro Hotel to broadcasting road junction western bypass.</li> <li>• Barikin Sale primary school/ under bridge</li> <li>• Barikin Sale "A" wakili road.</li> <li>• Sabon Gari Barikin Sale &amp; Police post road Barikin Sale</li> </ul>	10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Sunday</b>				

**Name & Designation of Supervising Officer:** Ramatu Mohammed

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

District: **Maitumbi, Minna**

Vehicle Type: **Tipper (10 Tyres)**

Vehicle Number: **XK – 719 – ABJ**

Parastatal /Company: **AL-MUSTY NIG. LTD. (Manager-Mr. Austin)**

<b>Day &amp; Date</b>	<b>Name &amp; GSM No. of Driver</b>	<b>Service Locations</b>	<b>Duration</b>	<b>Comments</b>
Monday	Mal. SA'ADU	<ul style="list-style-type: none"><li>• New market junction to Flamingo U-turn to David Mark road</li><li>• Flamingo U-turn to ADP round about</li><li>• ADP round about to Flamingo U-turn</li><li>• Anguwan kaje community and primary school road Maitumbi</li><li>• Anguwan Kadara, Muazu quarters, Anguwan Muazu Maitumbi and DANA Pharmaceutical LTD Maitumbi.</li></ul>	8:00am – 10:00am 10:00am-11:00am 11:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	

Tuesday	Mal. SA'ADU	<ul style="list-style-type: none"> <li>• New market junction to Flamingo U-turn to David Mark road</li> <li>• Flamingo U-turn to ADP round about</li> <li>• ADP round about to Flamingo U-turn</li> <li>• Flamingo Estate, Anguwan Roka, Primary school road, Sabon Gari Rd Maitumbi and DANA Pharmaceutical LTD. Maitumbi.</li> <li>• Maitumbi Community by Muazu Estate and Gbadayi Community Maitumbi</li> </ul>	8:00am – 10:00am 10:00am-11:00am 11:00am – 12:00pm 12:00pm – 2:00pm  2:00pm – 4:00pm	
Wednesday	Mal. SA'ADU	<ul style="list-style-type: none"> <li>• New market junction to Flamingo U-turn to David Mark road</li> <li>• Flamingo U-turn to ADP round about</li> <li>• ADP round about to Flamingo U-turn</li> <li>• Anguwan kaje community and primary school road Maitumbi</li> <li>• Anguwan Kadara, Muazu quarters, Anguwan Muazu Maitumbi and DANA Pharmaceutical LTD Maitumbi.</li> </ul>	8:00am – 10:00am 10:00am-11:00am 11:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Thursday</b>	Mal. SA'ADU	<ul style="list-style-type: none"> <li>• New market junction to Flamingo U-turn to David Mark road</li> <li>• Flamingo U-turn to ADP round about</li> <li>• ADP round about to Flamingo U-turn</li> <li>• Flamingo Estate, Anguwan Roka, Primary school road, Sabon Gari Rd Maitumbi and DANA Pharmaceutical LTD. Maitumbi.</li> <li>• Maitumbi Community by Muazu Estate and Gbadayi Community Maitumbi</li> </ul>	8:00am – 10:00am 10:00am-11:00am 11:00am – 12:00pm 12:00pm – 2:00pm  2:00pm – 4:00pm	

<b>Friday</b>	Mal.SA'ADU	<ul style="list-style-type: none"> <li>• New market junction to Flamingo U-turn to David Mark road</li> <li>• Flamingo U-turn to ADP round about</li> <li>• ADP round about to Flamingo U-turn</li> <li>• Anguwan kaje community and primary school road Maitumbi</li> <li>• Anguwan Kadara, Muazu quarters, Anguwan Muazu Maitumbi and DANA Pharmaceutical LTD Maitumbi.</li> </ul>	8:00am – 10:00am 10:00am-11:00am 11:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Saturday</b>	Mal.SA'ADU	<ul style="list-style-type: none"> <li>• New market junction to Flamingo U-turn to David Mark road</li> <li>• Flamingo U-turn to ADP round about</li> <li>• ADP round about to Flamingo U-turn</li> <li>• Flamingo Estate, Anguwan Roka, Primary school road, Sabon Gari Rd Maitumbi and DANA Pharmaceutical LTD. Maitumbi.</li> <li>• Maitumbi Community by Muazu Estate and Gbadayi Community Maitumbi</li> </ul>	8:00am – 10:00am 10:00am-11:00am 11:00am – 12:00pm 12:00pm – 2:00pm  2:00pm – 4:00pm	
<b>Sunday</b>				

5.

**Name & Designation of Supervising Officer:** Mr. John Nda Sunda

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

District: **Bosso East, Minna**

Vehicle Type: **Tipper (6 Tyres)**

Vehicle Number: **XC 712 RSH**

Parastatal /Company: **NAICCO NIG. LTD. (Manager-Alpha Bologi Bida)**

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	Danjumma Mohammed	<ul style="list-style-type: none"> <li>• Former Advance Teachers College (ATC) Avenue</li> <li>• Unguwan Biri, Gidan Sarkin Bosso road &amp; 7up Tudun fulani</li> <li>• Back of FUT Bosso,Jinkpa(Any a Gwari) &amp; Mypa road Bosso</li> <li>• FERMA Sch Rd,Former Julius Berger Camp, CAIS Rd, Tudun Fulani open dumps "A" &amp; "B"</li> <li>• Rafin Yashi, River Basin Quarters, Administrative Blocks And Open dumps at Maikunkele Market</li> </ul>	<p>8:00am – 9:00am</p> <p>9:00am – 11:00pm</p> <p>11:00am – 12:00pm</p> <p>12:00pm - 2:00pm</p> <p>2:00pm – 4:00pm</p>	
Tuesday	Danjumma Mohammed	<ul style="list-style-type: none"> <li>• Bosso Estate,Abdulsalam Quarters, Bosso Estate Extension &amp; Western Bypass -Imurat</li> <li>• Airport Quarters &amp; Airforce Quarters Maikunkele</li> <li>• Senior staff quarters &amp; Shagari Low-cost Maikunkele</li> <li>• Maikunkele Hakimi road – Secreteriat Head Quarters and open dumps at Maikunkele market.</li> </ul>	<p>8:00am – 10:00am</p> <p>10:00am – 12:00pm</p> <p>12:00pm – 2:00pm</p> <p>2:00pm – 4:00pm</p>	

<b>Wednesday</b>	Danjumma Mohammed	<ul style="list-style-type: none"> <li>• Former Advance Teachers College (ATC) Avenue</li> <li>• Unguwan Biri, Gidan Sarkin Bosso road &amp; 7up Tudun fulani</li> <li>• Back of FUT Bosso,Jinkpa(Anyu Gwari) &amp; Mypa road Bosso</li> <li>• FERMA Sch Rd,Former Julius Berger Camp, CAIS Rd, Tudun Fulani open dumps “A” &amp; “B”</li> <li>• Rafin Yashi, River Basin Quarters , Administrative Blocks And Open dumps at Maikunkele Market</li> </ul>	8:00am – 9:00am 9:00am – 11:00pm  11:00am – 12:00pm  12:00pm - 2:00pm  2:00pm – 4:00pm	
<b>Thursday</b>	Danjumma Mohammed	<ul style="list-style-type: none"> <li>• Bosso Estate,Abdulsalam Quarters, Bosso Estate Extension &amp; Western Bypass -Imurat</li> <li>• Airport Quarters &amp; Airforce Quarters Maikunkele</li> <li>• Senior staff quarters &amp; Shagari Low-cost Maikunkele</li> <li>• Maikunkele Hakimi road – Secreteriat Head Quarters and open dumps at Maikunkele market.</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Friday</b>	Danjumma Mohammed	<ul style="list-style-type: none"> <li>• Former Advance Teachers College (ATC) Avenue</li> <li>• Unguwan Biri, Gidan Sarkin Bosso road &amp; 7up Tudun fulani</li> <li>• Back of FUT Bosso,Jinkpa(Anyu Gwari) &amp; Mypa road Bosso</li> <li>• FERMA Sch Rd,Former Julius Berger Camp, CAIS Rd, Tudun Fulani open dumps “A” &amp; “B”</li> <li>• Rafin Yashi, River Basin Quarters, Administrative Blocks and Open dumps at Maikunkele Market</li> </ul>	8:00am – 9:00am 9:00am – 11:00pm  11:00am – 12:00pm  12:00pm - 2:00pm  2:00pm – 4:00pm	
<b>Saturday</b>	Danjumma Mohammed	<ul style="list-style-type: none"> <li>• Bosso Estate,Abdulsalam Quarters , Bosso Estate Extension &amp; Western Bye pass -Imurat</li> <li>• Airport Quarters &amp; Airforce Quarters Maikunkele</li> <li>• Senior staff quarters &amp; Shagari Low-cost Maikunkele</li> </ul>	8:00am – 10:00am  10:00am – 12:00pm 12:00pm – 2:00pm	

		<ul style="list-style-type: none"> <li>Maikunkele Hakimi road – Secreteriat Head Quarters and open dumps at Maikunkele market.</li> </ul>	2:00pm – 4:00pm	
<b>Sunday</b>				

**Name & Designation of Supervising Officer:** Aminu A. Giwa

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR WASTE EVACUATION TRUCKS**

District: **Kpakungu, Minna**

Vehicle Type: **Tipper (6 tyres)**

Vehicle Number: **XC 688 MNA**

Parastatal /Company: **RYDER TRANSPORT & TRAVELS LTD. (Manager Miss Victoria)**

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	Suleiman Yunusa	<ul style="list-style-type: none"> <li>• Shiroro Junction to Dutsen Kura</li> <li>• Dutsen Kura to Shiroro Junction</li> <li>• Bida road Kpakungu</li> <li>• Back of Haske Block Industry Western bye Pass</li> <li>• Fadipke Village</li> <li>• Dutsen Kura Gwari Community and Re-collection at Bida Rd Kpakungu</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00pm – 12:00pm 12:00pm – 1:00pm 1:00pm – 2:00pm 2:00pm – 4:00pm	
Tuesday	Suleiman Yunusa	<ul style="list-style-type: none"> <li>• Shiroro Junction to Dutsen Kura</li> <li>• Dutsen Kura to Shiroro Junction</li> <li>• Bida road Kpakungu, Back of White Heart Furniture and Gbendenu Road</li> <li>• Back of Ladan Blocks Industry, Gurara Community Bida Rd. and Soje 'A' Kpakungu</li> <li>• Kpakungu Community (Village) 'A'</li> </ul>	8:00am – 9:00am 9:00am – 10:00pm 10:00pm – 12:00pm 12:00pm – 2:00pm 2:00pm – 3:00pm 3:00pm – 4:00pm	



		<ul style="list-style-type: none"> <li>• Soje 'B' Kpakungu and Re-collection at Bida Road Kpakungu</li> </ul>		
<b>Wednesday</b>	Suleiman Yunusa	<ul style="list-style-type: none"> <li>• Shiroro Junction to Dutsen Kura</li> <li>• Dutsen Kura to Shiroro Junction</li> <li>• Bida road Kpakungu</li> <li>• Back of Haske Block Industry Western bye Pass</li> <li>• Fadipke Village</li> <li>• Dutsen Kura Gwari Community and Re-collection at Bida Rd Kpakungu</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00pm – 12:00pm 12:00pm – 1:00pm 1:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Thursday</b>	Suleiman Yunusa	<ul style="list-style-type: none"> <li>• Shiroro Junction to Dutsen Kura</li> <li>• Dutsen Kura to Shiroro Junction</li> <li>• Bida road Kpakungu, Back of White Heart Furniture and Gbendenu Road</li> <li>• Back of Ladan Blocks Industry, Gurara Community Bida Rd. and Soje 'A' Kpakungu</li> <li>• Kpakungu Community (Village) 'A'</li> <li>• Soje 'B' Kpakungu and Re-collection at Bida Road Kpakungu</li> </ul>	8:00am – 9:00am 9:00am – 10:00pm 10:00pm –12:00pm  12:00pm – 2:00pm  2:00pm – 3:00pm  3:00pm – 4:00pm	
<b>Friday</b>	Suleiman Yunusa	<ul style="list-style-type: none"> <li>• Shiroro Junction to Dutsen Kura</li> <li>• Dutsen Kura to Shiroro Junction</li> <li>• Bida road Kpakungu</li> <li>• Back of Haske Block Industry Western bye Pass</li> <li>• Fadipke Village</li> <li>• Dutsen Kura Gwari Community and Re-collection at Bida Rd Kpakungu</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00pm – 12:00pm 12:00pm – 1:00pm 1:00pm – 2:00pm 2:00pm – 4:00pm	
<b>Saturday</b>	Suleiman Yunusa	<ul style="list-style-type: none"> <li>• Shiroro Junction to Dutsen Kura</li> <li>• Dutsen Kura to Shiroro Junction</li> </ul>	8:00am – 9:00am 9:00am – 10:00pm 10:00pm –12:00pm	

		<ul style="list-style-type: none"> <li>• Bida road Kpakungu, Back of White Heart Furniture and Gbendenu Road</li> <li>• Back of Ladan Blocks Industry, Gurara Community Bida Rd. and Soje 'A' Kpakungu</li> <li>• Kpakungu Community (Village) 'A'</li> <li>• Soje 'B' Kpakungu and Re-collection at Bida Road Kpakungu</li> </ul>	<p>12:00pm – 2:00pm</p> <p>2:00pm – 3:00pm</p> <p>3:00pm – 4:00pm</p>	
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**Name & Designation of Supervising Officers:** Ramatu Mohammed & Hadiza Bala

**Signature & Date**.....

**NIGER STATE ENVIRONMENTAL PROTECTION AGENCY (NISEPA)**

**WEEKLY SCHEDULE FOR SOLID WASTE EVACUATION TRUCKS**

District: **Tunga West, (Tunga B) Minna**

Vehicle Type: **Tipper (6 Tyres)**

Vehicle Number: **XA - 388 - AGR**

Parastatal /Company: **SHAMMAZK GLOBAL INVESTMENT LIMITED.**

Day & Date	Name & GSM No. of Driver	Service Locations	Duration	Comments
Monday	Mohammed Haruna	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Dr. Mua'zu Babangida Aliyu Way (Bay Clinic Road) Tunga, Dr. Peter Saleh Sarki road, Moh'd Maude Crescent &amp; Talba Crescent Tunga</li> <li>• Idris Legbo Kutigi road (Niteco road) Tunga, Nuhu Tachi road, Dr. Sheik Abdullahi Road &amp; L. Ahmed road Tunga</li> <li>• Muhammed Jibrin road (Old Alheri ) Tunga, Dr. Yusuf Mudi Crescent, Hard Resources Way Tunga &amp; Back Of Unity Block Avenue Tunga</li> <li>• Ahmadu Kago road Tunga, Motown Hotel Rd and Back Of Shiroro Hotel Avenue Tunga</li> </ul>	8:00am – 9:00am 9:00am – 10:00am 10:00am – 12:00pm 12:00pm – 2:00pm 2:00pm - 4:00pm	
Tuesday	Mohammed Haruna	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> </ul>	8:00am – 9:00am 9:00am – 11:00am	

		<ul style="list-style-type: none"> <li>• Dr. Mua’zu Babangida Aliyu Way (Bay Clinic Road) Tunga, Dr. Peter Saleh Sarki road, Moh’d Maude Crescent &amp; Talba Crescent Tunga</li> <li>• Idris Legbo Kutigi road (Niteco road) Tunga.</li> <li>• Usman Ubandoma Rd. (Kolawole) - Mustapha Babangida Rd, Soggi Guest Inn Road Tunga, Doctor Musa Ahmed Ibeto Avenue Tunga Low Cost, Garba Kuta road, Dan Dar’man Minna Close Intermediate Qrts</li> <li>• Kabala road, Alh. Baba Doko Rd (Custom Barracks) Tunga &amp; Back of Shiroro Hotel Avenue</li> </ul>	<p>11:00am – 2:00pm</p> <p>2:00pm – 4:00pm</p>	
Wednesday	Mohammed Haruna	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Dr. Mua’zu Babangida Aliyu Way (Bay Clinic Road) Tunga, Dr. Peter Saleh Sarki road, Moh’d Maude Crescent &amp; Talba Crescent Tunga</li> <li>• Idris Legbo Kutigi road (Niteco road) Tunga .</li> <li>• Assembly of God Way &amp; Central Bank Qrts Tunga . Fadama road Tunga .</li> <li>• Hydro Hotel Way, Brighter Suit Rd Tunga (Farm Centre) &amp; Neco Computer Rd ,</li> <li>• Custom Office road Tunga and Back of Custom Office Tunga</li> </ul>	<p>8:00am – 9:00am</p> <p>9:00am – 11:00am</p> <p>11:00am – 12:00pm</p> <p>12:00pm – 2:00pm</p> <p>2:00pm - 4:00pm</p>	
Thursday	Mohammed Haruna	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Dr. Mua’zu Babangida Aliyu Way (Bay Clinic Road) Tunga, Dr. Peter Saleh Sarki road, Moh’d Maude Crescent &amp; Talba Crescent Tunga</li> <li>• Idris Legbo Kutigi road (Niteco road) Tunga, Nuhu Tachi road, Dr. Sheik Abdullahi Road &amp; L. Ahmed road Tunga</li> <li>• Muhammed Jibrin road (Old Alheri) Tunga, Dr. Yusuf Mudi Crescent, Hard Resources Way Tunga &amp; Back Of Unity Block Avenue Tunga</li> </ul>	<p>8:00am – 9:00am</p> <p>9:00am – 10:00am</p> <p>10:00am – 12:00pm</p> <p>12:00pm – 2:00pm</p> <p>2:00pm - 4:00pm</p>	

		<ul style="list-style-type: none"> <li>Ahmadu Kago road Tunga, Motown Hotel Rd and Back of Shiroro Hotel Avenue Tunga</li> </ul>		
<b>Friday</b>	Mohammed Haruna	<ul style="list-style-type: none"> <li>Broadcasting road Tunga</li> <li>Dr. Mua'zu Babangida Aliyu Way (Bay Clinic Road) Tunga, Dr. Peter Saleh Sarki road, Moh'd Maude Crescent &amp; Talba Crescent Tunga</li> <li>Idris Legbo Kutigi road (Niteco road) Tunga.</li> <li>Usman Ubandoma Rd. (Kolawole) - Mustapha Babangida Rd, Soggi Guest Inn Road Tunga , Doctor Musa Ahmed Ibeto Avenue Tunga Low Cost, Garba Kuta road, Dan Dar'man Minna Close Intermediate Qrts</li> <li>Kabala road, Alh. Baba Doko Rd (Custom Barracks) Tunga &amp; Back of Shiroro Hotel Avenue</li> </ul>	<p>8:00am – 9:00am</p> <p>9:00am – 11:00am</p> <p>11:00am – 2:00pm</p> <p>2:00pm – 4:00pm</p>	

<b>Saturday</b>	Mohammed Haruna	<ul style="list-style-type: none"> <li>• Broadcasting road Tunga</li> <li>• Dr. Mua’zu Babangida Aliyu Way (Bay Clinic Road) Tunga, Dr. Peter Saleh Sarki road, Moh’d Maude Crescent &amp; Talba Crescent Tunga Idris Legbo Kutigi road (Niteco road) Tunga.</li> <li>• Assembly of God Way &amp; Central Bank Qrts Tunga. Fadama road Tunga.</li> <li>• Hydro Hotel Way, Brighter Suit Rd Tunga (Farm Centre) &amp; Neco Computer Rd,</li> <li>• Custom Office road Tunga and Back of Custom Office Tunga</li> </ul>	8:00am – 9:00am 9:00am – 11:00am  11:00am –12:00pm  12:00pm – 2:00pm  2:00pm - 4:00pm	
<b>Sunday</b>				

**Name & Designation of Supervising Officer:** ADAMU SULEIMAN

**Signature & Date**.....

## **Appendix 5: Poster and oral presentations**

Salamatu Kassah (2017). Unofficial urban waste disposal sites in developing countries: A case study of Minna, Nigeria. Poster presentation, School of Forensic and Applied Sciences, University of Central Lancashire.

Salamatu Kassah (2018). Municipal waste management in Minna, Niger State, Nigeria: Practices and Challenges. Oral presentation, School of Forensic and Applied Sciences, University of Central Lancashire.