PLANNING FOR MUNICIPAL SOLID WASTE MANAGEMENT: THE CASE OF GREATER JOS, NIGERIA

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Abstract

Among the greatest challenges of the twenty-first century is the rapid growth of cities. The growth of most municipalities has remained unplanned and uncontrolled. Unmanageable development in developing countries has given rise to environmental disorders in the built-up settlements. Municipal solid waste management in particular, is now a fear-provoking assignment for the municipal establishments who are lacking in capacity to confront the municipal solid waste issue. The main objective of carrying out this research is to see how urban planning can help improve municipal solid waste issues in Greater Jos municipal area. It defines the municipal solid waste problem and identifies a number of specific planning drivers as the factors responsible for lack of improvement in the municipal solid waste management situation. A mixed method approach was used for the empirical analysis which combined both interviews and questionnaire data from senior government officials, industry stakeholders and residential neighbourhoods, collected with observational and documentary data, in order to investigate the solid waste issue. Major problems identified in this research are: (i) municipalities are undergoing deterioration of solid waste conditions but the local, state and federal governments are lacking adequate planning to deal with the circumstances (ii) apart from quite a lot of causes of the municipal solid wastes crisis can be known, the political commitment to urban planning is lacking which serves as the basis of the deteriorating situation in Nigerian municipalities and (iii) relationship exists between poor planning and municipal solid waste management delivery of collection services and disposal amenities. Individual municipal solid waste management strategy alone was found to produce unplanned and uncoordinated management of waste issues. Collaboration to produce a joint municipal solid waste management plan has been recommended as a good practice.

Dedication

This thesis is dedicated to my LORD and Saviour, Jesus Christ for His grace and love, to the whole of my family and friends for their support and prayers towards the success of this study, and for the use and benefit of mankind.

Acknowledgement

The researcher would like to thank all who contributed in any way to the development of this research, for so willingly giving their time, and sharing their expertise and experience. I am very grateful to my first supervisory team Professors Angela Hull, Adebayo Adeloye and Paul Jowitt who helped me start the research up to the writing-up stage, before Angela Hull left the university on retirement. They provided me with invaluable insights into the conceptual issues involved in the research.

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Declaration Statement

ACADEMIC REGISTRY
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School/PGI:	**Energy, Geoscience, Infrastructure and Society**		
Version: *(i.e. First, Resubmission, Final)*	**First**	Degree Sought (Award **and** Subject area)	**Doctor of Philosophy (Urban Studies)**

Declaration

In accordance with the appropriate regulations I hereby submit my thesis and I declare that:

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E-thesis Submitted ***(mandatory for final theses)***			
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List of Acronyms and Abbreviations

ADB – African Development Bank

AEPB – Abuja Environmental Protection Board

CEC – City of Edinburgh Council

DEFRA – Department for Environment, Food and Rural Affairs

ECOWAS - Economic Community of West African Countries

EU- European Union

FEPA – Federal Environmental Protection Agency

FGN – Federal Government of Nigeria

JMDB – Jos Metropolitan Development Board

LAWMA – Lagos Waste Management Authority

MDGs – Millennium Development Goals

MSW – Municipal Solid Waste

MSWM – Municipal Solid Waste Management

MSWP – Municipal Solid Waste Planning

NEST – National Environmental Study Group

NPC – National Population Commission of Nigeria

PEPSA – Plateau Environmental Protection Agency

SEPA – Scottish Environmental Protection Agency

SSA – Sub – Saharan Africa

SWM – Solid Waste Management

UK – United Kingdom

UNCHS – United Nations Centre for Human Settlement

UNDP – United Nations Development Programme

UNEP – United Nations Environment Programme

UNO – United Nations Organization

US - United States

USEPA – United State Environmental Protection Agency

Chapter One

Introduction And Background To The Research

1.0 Introduction

This is the introduction to the thesis and presents the context of the research. It covers (i) background to the research (ii) statement of problem and research question (iii) aim and objectives of the research (iv) scope and reasons for choice of Greater Jos (v) Justification of the research and (vi) thesis structure.

Municipal solid waste (MSW) has become an important issue in Nigeria. Piles of wastes are often found by roads, rivers and many other open spaces in cities, and this is causing significant problems that are basically of planning and environment. The urban population is growing at an alarming rate. While the Nigerian population is increasing by about 2.8% per annum, the rate of urban growth is as high as 5.5% per annum (NPC, 2008). This is increasing the difficulties associated with providing an effective municipal solid waste management system. As cities grow, land use becomes increasingly complex and the wastes generated increase in volume and variety. Several studies in the field of science, engineering, economics, management, public and environmental health have shown that municipal solid waste management is an important part of urban infrastructure that ensures the protection of environment and human health (UNCHS, 1996; Onibokun, 1999; World Bank, 2002, 2003; Zurbrugg, 2003; UNDP, 2004; Ogwueleka, 2009; Hoornweg and Bhada-Tata, 2012).

The main objective of carrying out this research is to see 'how urban planning can help improve municipal solid waste issues in Greater Jos municipal area'. (See map of Nigeria showing Jos in figure 1.2). The field study location is comprised of six local government areas Jos North, Jos South, Jos East, Barkin-Ladi, Bassa and Riyom local government areas of Plateau State with a land area of 1,346 square Kilometre (Greater Jos Master Plan, 2009). In Greater Jos, there are not enough public wastes receptacles for wastes. Solid waste dumps are located on the side of the highway and when it accumulates, households and businesses pile them up in the major road median and set open fire to them without any concern for the pollution. Most of the wastes are indiscriminately dumped around market places, homes, road sides and open land. These municipal solid wastes find their way into water ways and drainage system resulting to serious environmental problems in the municipality.

However, Plateau State government in the last decades has made efforts to tackle the waste issue in the capital city of Jos but has not yielded any good results. As a result the researcher examines the salient problems bedevilling the municipal solid waste management (MSWM) sector in the municipality that when addressed will improve the wellbeing as well as environmental conditions of the inhabitants of Greater Jos and at large Nigeria. The research reported in this thesis is aimed at identifying the problems that basically stem from planning in the MSWM sector. The figure below summarises municipal solid waste management issues in Nigeria typical of Greater Jos.

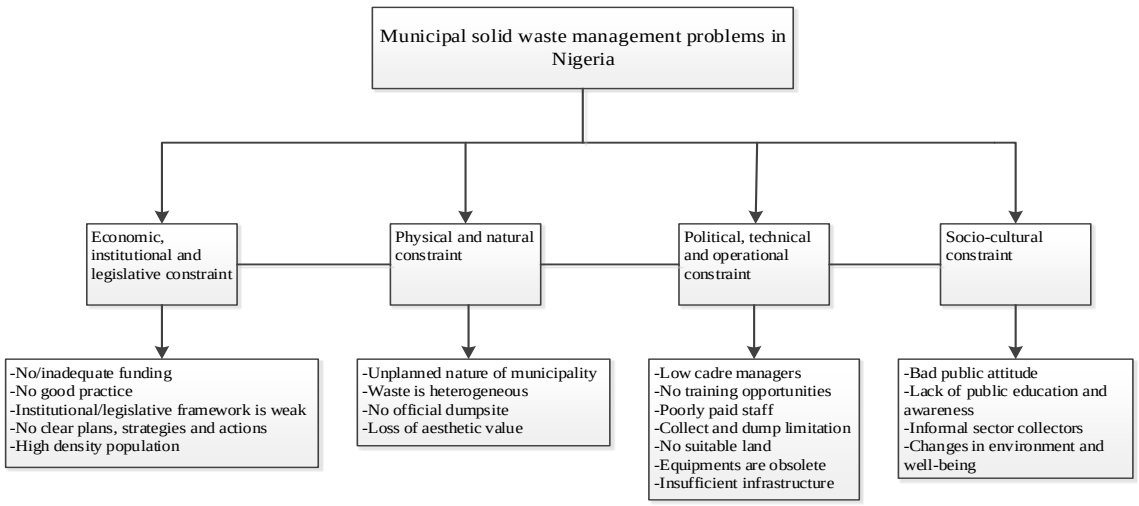

Figure 1.1: Problems affecting municipal solid waste management in Greater Jos, Nigeria

An appropriate system of MSWM will not "emerge" without the good management of municipal solid waste drivers involving numerous aspects of government, politics and public agencies. From this research, a number of specific planning drivers (chapter seven figure 7.1) have emerged from the data analysis as the factors responsible for the improvement and/ lack of improvement in the MSWM situation in Greater Jos - Nigeria. These factors are similar to those that affect efforts in other developing countries like Ghana, Kenya and South Africa.

In any municipality, it is possible to equate the standard of MSWM with the overall standard of living enjoyed by the inhabitants. Rising expectation of effective improvement mean that disposal facilities should be appropriately designed, engineered and managed. They should also be planned for the future. There is no one correct best practice to achieve proper MSWM, nevertheless there are common needs that must be addressed by all countries that wish to manage their municipal solid wastes better.

Figure 1.2: Map of Nigeria showing the strategic position of Greater Jos

Source: Google images, June 2013

While the goals of municipal solid waste management vary little from nation to nation, the approaches used to attain them must be shaped to the normal circumstances individually. Indeed, several different but related activities must be in existence before a waste management system appropriate to local circumstances will develop. It is the researcher's opinion that broad guidelines can be set out that are applicable to most, if not all nations.

1.1 Background to the research

The volume and types of solid and hazardous wastes, as a result of continuous economic growth, urbanization and industrialization, are experiencing a rapid increase all over the world (Hoornweg and Bhada-Tata, 2012). According to the World Bank published report, "What a Waste: A Global Review of Solid Waste Management" (Hoornweg and Bhada-Tata, 2012), it is estimated that the total amount of municipal solid waste generated by urban residents globally has reached 1.3 billion tonnes per year with 1.2 kg per person per year (Hoornweg and Bhada-Tata, 2012). This report further estimated that between 2012 and 2025 the global generation of municipal solid waste will increase to 2.2billion tonnes equivalent to 1.4 kg/capita/day. Poorly managed waste has an enormous impact on public health, the local and global environment, and the economy (Hoornweg and Bhada-Tata, 2012). Failure to manage waste through appropriate disposal practices in the long term is more expensive than at source efficient management in the first place (Hoornweg and Bhada-Tata, 2012).

As early as 1975, the Economic Community of West African States (ECOWAS), identified some environmental protection issues (ECOWAS, 1991) by recognising the

poor state of the environment of west African countries and the need for urgent attention in "sustainable management of resources and good governance of the environment" (EEP, 2008,1). The problem under investigation in this research is the worsening municipal solid waste situation in Nigerian municipalities. The concentration of population and business activities in most west African cities is being accompanied by a rapid increase in the volume of municipal solid waste generated from production and consumption activities. Over the years, municipal governments in the region seem arguably unable to manage their municipal solid waste.

In addition, the global nature of municipal solid waste includes: its contribution to greenhouse gas emissions; increasingly global linkages of products; urban practices; and the recycling industry. The gravity of the issues is perhaps best reflected in the level of attention given to it in the United Nations Millennium Declaration (September, 2000). Three of the eight Millennium Development Goals (MDGs) outlined in the declaration have waste or resource efficiency implications (UNO, 2007). To further illustrate this point, a four country study by the African Development Bank (2002) on solid waste management options for Africa (AfDB, 2002), revealed the following findings: no country in Africa has detailed solid waste management legislation; solid waste management in most African countries is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal of municipal waste; waste characterization data specific to cities in the countries studied are generally not available and there is a general lack of regulatory initiatives to manage and minimize waste by government.

This study encompasses a detailed examination of how Nigeria has developed and implemented its policies on waste management, in the context of quantities of MSW growing.

1.2 Statement of Problems and Research Question

Greater Jos (the study area), with a population of over one million people became the capital of Benue-Plateau State of Nigeria, a West African sub-region in 1976. Over the forty years since the city has experienced rapid population growth; as a result, there is a continuous increase in residential, commercial, industrial, and institutional land uses leading to urban expansion. This has had a direct effect on the increase in municipal solid waste generation leading to diverse and multiple environmental issues. As a result, it is becoming very difficult for municipal authorities to organize, manage effectively and

efficiently deal with municipal solid waste (NEST, 1991; Onibokun, 1999; Egbere *et al.*, 2001; Dauda and Osita, 2003; Sha' Ato *et al.*, 2007; Ogwueleka, 2003, 2009; Ndidi *et al.*, 2009).

There is no documented integrated and sustainable municipal solid waste management plan for the state. As a result, the management of municipal solid waste in the municipality from its inception has been on a short-term, "*task force"* approach which tends to emphasize a single issue solution or strategy instead of considering the entire range of relevant factors (waste hierarchy, political, institutional, economic, social, etc). This approach is crisis-ridden, unsustainable and has achieved only partial successes. Although there are discussions and plans which are mostly at conception stages to improve the waste management operations in the municipality, these activities are not joined up and lack the necessary measures that could ensure their effectiveness, efficiency and sustainability. It is against this backdrop that this research is initiated on the need for a combined municipal solid waste management system for the municipality of Greater Jos.

A cursory observation within the study area shows visible aspects of the problem manifesting in accumulation of garbage, waste-clogged drains and water bodies, street litter and stinking gutters. In spite of the concerns frequently raised by concerned groups, institutions and individuals, the solid waste situation continues to worsen thereby posing serious threats to public health and the environment. Besides, the environmental burdens associated with the worsening solid waste the situation appears to fall more heavily on the residents even though wastes management are supposed to be public funded and regulated. The problems in Greater Jos can be enumerated as follows:

1. Problems caused by the urbanization process with irregular and unplanned urban growth that is generating more wastes arising in Greater Jos without any framework for management in the Plateau State of Nigeria.
2. The existence of a multiplicity of organizations, agencies and ministries responsible for environmental management with no or inadequate funding for solid waste management development.
3. The Nigerian urban and regional planning law of 1992 aspiring to achieve physical/ environmental sustainability is silent about the management of municipal wastes.

4. Federal environmental protection laws and policies in Nigeria (e.g. FEPA Act) have neither been linked to states' and local policies nor to the Millennium Development Goals (MDGs),
5. The lack of reliable data on municipal solid waste inhibits the planning of infrastructure for waste collection, recovery and recycling in Greater Jos.
6. Greater Jos' master plans, past and arguably the present lack municipal solid waste management strategies/ plans for implementation in line with best practices of sustainable development.

This research looks at how urban planning in Nigeria can help improve municipal solid waste management solutions. Secondly, it considers whether the planning system has the capacity to help in the management of municipal solid waste. Consequently, the research seeks to test the hypothesis: *"that the planning (town planning) systems are the most effective tools for waste management".*

1.3 Aim and Objectives

This research examines the need for a liveable planning system for the management of municipal solid waste in Greater Jos. For the purpose of this research, planning systems are taken to mean the legal and administrative procedures and institutional arrangements for guiding the locations of investment in development projects and for regulating the way land is used and developed. Such systems may take many forms, as do the practices through which they are put into effect. Planning systems typically contain provisions that allow specifications of the location and type of development, which the planning authority seeks to encourage and which provide stability to the determination of legal rights to use and develop land. They may require the preparation of a planning scheme or ordinance specifying land uses and development norms in order to indicate the restrictions that apply to land and property rights. There may be provisions for requiring contributions to public costs in some form, and for land purchase and assembly by the state, so that development and infrastructure investment can proceed in line with plans.

There are two key reasons for doing this research. Firstly, the quality of aesthetic value and the environmental quality within and around the municipality are under threat, and this has recently become an urgent problem in Nigeria. There is only a limited understanding of the problem and of how to deal with it. Most recent research and policies have emphasised the importance of management issues and the planning for solid waste

issues has not been handled in any depth. Secondly, the urban management of places are crucial issues in urban studies, and much research and many case studies have been carried out not only in "developed" countries (e.g. United Kingdom, Germany, and United States of America etc.), but also in "developing" countries, in particular Sub-Saharan countries (e.g. Ghana, Kenya, South Africa etc.). However, research focusing on the planning aspect for the municipal solid waste management is still at a basic level. This research will be an opportunity to link the Greater Jos case study with the growing stream of municipality studies and will enrich the material available for international comparisons. In order to address the aim of the research, a number of objectives have been established including:

1. Examine the municipal solid waste challenges in developing countries.
2. Review international literature and identify best practice in urban planning in relationship to municipal solid waste management.
3. Investigate the municipal solid waste problems in developing countries using Greater Jos.
4. Examine the urban management system and evaluate its functions in municipal solid waste management.
5. Make recommendations and establish the future of urban planning to improve municipal solid waste management in developing country.

1.4 Research Methodology and Approach

This study exploits a mix of qualitative and quantitative investigation methodologies, in a three phase procedure, covering pre-fieldwork, fieldwork and post-fieldwork stages (see figure 1.3).

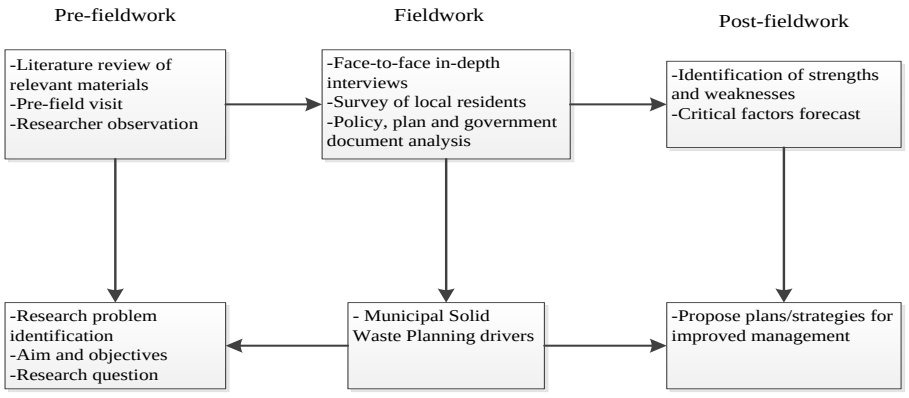

Figure 1.3: Outline of research process

Figure 1.3 is a summary of the three phase methodologies implemented for this research. The pre-fieldwork (primary) phase involved a literature review on municipal solid waste management issues in developed and developing countries, and a pre-field visit to municipal solid waste planning and management authorities in the study area. Following this, at the data collection stage, Jos North and Jos South local government areas were selected. Apart from being the former Benue and Plateau States capital city, both local government areas are main administrative and commercial foci respectively, especially for the middle-belt region of Nigeria. Using numerous strategic tools such as key informant interviews, researcher observation and household survey, primary data on municipal solid waste management in Greater Jos municipality was collected between 2011 and 2013.

Having a background in teaching planning and therefore focusing on how institutions perform, the research method is primarily qualitative looking at institutional structures of municipal solid waste management and planning authorities and their responsibilities, talking to people who have had dealings with this institution including policy makers and those who deliver policies/deal with the problems. Quantitative information was also collected to understand the scale of the problem.

1.5 Combining the two methodologies

Following the quantitative-qualitative debate, the question has arisen whether the two 'opposing approaches' can be usefully combined in a single study. In the view of Blaikie (2000) triangulation or method combination is actually difficult because of the different epistemological and ontological underpinnings of the two research strategies. Such writers as Guba and Lincoln (1985), Hughes (1999) and Blaikie (2000) have argued against the idea of combining the two research strategies in a single study with the reason that research methods carry epistemological commitments and the use of any data collection technique is not simply an issue of collecting data but a commitment to either positivism or interpretivism (Blaikie, 2000; Grix, 2004). This means that quantitative and qualitative researches are grounded in two incompatible epistemological principles. According to Guba and Lincoln (1985) combining the two approaches is inappropriate and represents failure to recognise the distinction between a paradigm and a method. They argue that the use of any data gathering technique involves commitment to the approach with which it is usually associated and this makes method combination inappropriate.

Contrary to the above position, some writers emphasise the usefulness of combining the two approaches in spite of their epistemological underpinnings (Grix, 2004; Bryman, 2004).The combination of method is variously referred to as triangulation (Blaikie, 2000; Grix, 2004), mixed methods research (Creswell, 2003) multi-strategy research (Bryman, 2004, 2008) or multiple methods (Robson, 2002). Bryman (2004), for instance, has argued that methods themselves should be viewed as mere tools for collecting data and should not be looked upon as being automatically rooted in epistemological and ontological commitments. He, therefore, views research methods from one strategy as "capable of being pressed into the service of another" (Bryman, 2004: 454). In support of this position, other research methodologists (including Denzin, 1989, Robson, 1993, Bryman and Cramer, 1997, Creswell, 2003; Grix, 2004) recognise that there is much to be gained from a fusion of quantitative and qualitative methods in a single study of social phenomena. Denzin (1989), for instance, has suggested that triangulation might be done in social research by using different methods, sources, investigators or theories while Robson (1993) also observes that a social research question can, in most cases, be attacked by more than one method. According to Robson, there is no rule that says only one method must be used in an investigation. He goes on to suggest that using more than one method in a single investigation can have substantial advantages even though it almost inevitably, adds to the time investment required. Preece (1998) also supports the combination of qualitative and quantitative methods when he observes that while some disciplines have come to be associated more with qualitative or quantitative approaches, both find a place in most fields of study.

The views of these scholars suggest that the methods of quantitative and qualitative approaches can complement each other in a single study of social phenomena. As noted by Grix (2004: 84), "as long as you are aware of how you are employing a specific method, and what this method is pointing you towards, and how this relates to the ways you employ other methods, there should be no problem". In this regard, Grix (2004) has advised that it is generally a good idea for social scientists to use more than one method of enquiry to improve the chances of getting better, more reliable data and to minimise the chances of biased findings. He argues, for example, that there is no reason why one should not employ methods usually associated with quantitative research in an in-depth case study. These arguments provide a firm basis for the combination of quantitative and qualitative methods in social science investigations. Thus, the criticisms

notwithstanding, the mixed methods strategy of social investigation is fast becoming popular among researchers (Grix, 2004; Bryman, 2004, 2008).

This section provides a summary of the methodology. A detailed description of the methodology is given in chapter five.

1.6 Field observation / Participant observation

According to Yin (1982), observations are a form of evidence that do not depend on verbal behaviour, and the method enables the investigator to observe the phenomenon under study directly. Miller and Brewer (2003) have categorised observation into 'unobtrusive observation' and 'participant observation' based on the degree of participation by the researcher, and into 'covert' and 'overt' observations based on the level of awareness subjects have of being observed. The phenomenon under study, solid waste, is one which lends itself to direct field observation. Thus, in addition to questionnaires and interviews, I also conducted field observation as part of the data collection exercise. This involved the observation of waste situations and other conditions that could affect waste management in the study areas such as the layout of settlements and road access within residential communities. Waste disposal sites were also observed to gather data on such things as standard of maintenance and environmental quality in the surrounding or nearby communities. In the course of the field observation, photographs were taken of waste scenes such as street litter, waste storage containers, the transportation and final disposal of waste. I also participated in waste collection tours with waste labourers as they went about their work in some parts of Greater Jos. The exercise enabled me to gain first-hand knowledge of the waste situation in the municipality including the waste disposal habits of the residents, the level of waste disposal services available to residents, the collection, transportation and disposal of waste and the management of final waste disposal sites in Greater Jos.

The field observations undertaken to collect data for this study were largely unobtrusive. The situations observed were mostly waste scenes like street litter, choked drains, waste containers and disposal sites and this was done in ways that did not usually attract the attention of people around. In addition since the observations covered the effects of human action (e.g. street litter) and not human action itself (e.g. littering), the reactive actions of people were largely avoided. Even where the observations covered human actions such as people throwing litter around, they were usually unaware of the observation although there were some exceptions where I directly made people aware of

my observations. However, part of my field observation can be properly referred to as participant observation such as when I joined the waste labourers on their collection tours in the municipal area. These labourers were very much aware that their activities were being observed as I interacted with them and told them about my research project. In effect, the field observations can be said to cover all the four types identified by Miller and Brewer (2003) – they included both participant and unobtrusive observation, and were both covert and overt in nature. The field observations were used to compare the actual waste situations in the municipality with the information gathered through interviews, household questionnaire survey and documentary analysis.

1.7 Reasons for choice of Greater Jos

The study covers Jos North local government area, Jos South local government area, and parts of Jos East, Bassa, Barkin-Ladi and Riyom local government areas of Plateau State (figure 1.4). According to Nigerian population and housing census data of 2006 (NPC, 2008), Greater Jos has a population of 1,315,301 million, representing 43% of the total population of Plateau State. Greater Jos was chosen as an appropriate focus area for this research because of the following reasons:

1. The researcher is from Greater Jos area and has an interest in, and knowledge of the city. Moreover, the researcher is familiar with the city's historical and current pattern of development and has relative ease of access to information.
2. Greater Jos was the capital city of former Benue-Plateau State, presently the largest municipal area in central Nigeria, a West African State, and the centre for educational, administrative, commercial activities serving as the main capital city of Plateau State.
3. In 2008, the Plateau State government through the ministry for urban development and housing decided to prepare a master plan for Greater Jos, which covers an area of 1,346 square kilometres. According to Fola Konsult (2008), this was in order to facilitate adequate planning and control of physical developments in the municipality to accommodate the increasing population. The growing issue of waste management is always linked to inadequate master planning and this can affect the present and future population.

Though the research study area is restricted to the six municipal areas of Greater Jos, it is anticipated that the findings and recommendations will have significant basis for application in several other municipalities of west African States.

Figure 1.4: Map of Nigeria (top) showing Jos and Map of Plateau State (down) showing Greater Jos (research area).

Source: Adapted from International Crisis Groups, Africa Report No 197, (2012)

1.8 Justification of the research

This research is therefore being motivated by the need to fill the above gaps in knowledge in Greater Jos, in order to gain an understanding of the challenges and issues involved in municipal solid waste management in Nigerian cities, thereby paving the way towards finding solution to the menace.

The worsening situation of municipal solid waste management in developing countries of West African cities particularly Nigeria has attracted attention among the populace. High profile government officials including ministers of States, parliamentarians and even the presidency have expressed concern about the deplorable municipal solid waste situation in cities in the country. The solid waste problem is also receiving a lot of media attention shown by the frequent featuring of waste disposal issues in newspapers, television and radio discussions. Additionally, several Non-Governmental Organisations (NGOs), institutions and individuals have expressed concerns about the deplorable solid waste situation in the cities while communities keep complaining to the authorities about waste that is engulfing their neighbourhoods and the health implications for their members. Moreover, several studies (NEST, 1991; Onibokun, 1999; Egbere *et al.,* 2001; Dauda and Osita, 2003; Sha' Ato *et al.,* 2007; Ogwueleka, 2003, 2009; Ndidi *et al.,* 2009) attributed the poor environmental conditions in the cities to low institutional capacity for urban management, poor physical planning and the lack of enforcement of development laws, poor provision of infrastructure and services for environmental maintenance and low public awareness of environmental hygiene.

Haphazard (unplanned) urbanization with accelerated growth of urban population, increasing economic activities, policy inadequacies, weak institutional and legislative framework, weak enforcement of existing legislation, low capacity and capability as well as poor funding have been identified as the problems of solid waste management in developing countries of west Africa (UNEP, 1996; Sridhar and Onibokun, 1997; Daskalapoulos *et al.,*1998; Mc Carthy, 2001; Estevez, 2003; UNCHS, 2006; USEPA, 2010; Fobil *et al.,* 2010). In Nigeria, a lot of waste is generated and the volume and types have been on the increase (NEST, 1991; Agbola and Egunjobi, 1993; Onibokun, 1999; Egbere *et al.,* 2001; Dauda and Osita, 2003; Sha' Ato *et al.,* 2007; Ogwueleka, 2003, 2009; Ndidi *et al.,* 2009; Daramola and Ibem, 2010; Fobil *et al.,* 2010; USEPA, 2010).

The urban municipal areas or sectors of Nigerian towns and cities, typical of a west African tropical environment, are places where service and infrastructure delivery especially to residents are constrained by the physical pattern of development. The

capacity of planning to thoroughly address the question mentioned above is the extent to which planning can resolve solid waste management issues. To the best of the researcher's knowledge, this has not been addressed in the literature. And this study intends to fill this gap.

The above-mentioned studies have examined a wide range of environmental issues including sanitation, water use and pollution, air pollution, the disease burdens associated with poor environmental conditions and the effects of waste disposal and other human activities on natural resource management. However, none of these studies has investigated the issue of municipal solid waste planning in sufficient detail to create an adequate understanding of the problem even though it remains one of the most visible and nerve-racking problems in the municipal areas of developing countries. Thus, the municipal solid waste situation in West African cities remains under-researched and hence poorly understood. This situation creates a knowledge gap and makes it difficult to find solutions to the worsening solid waste situation in the region and particularly Nigeria.

In view of the above, this research will be justified on the grounds that it will further an understanding of the planning for municipal solid waste problem affecting developing cities, and provide a useful starting point for addressing an otherwise intractable problem. The research will also contribute to both the theory and practice of planning for municipal solid waste management in poor countries generally. Findings and recommendations based on the Greater Jos case study are likely to be of benefit to other parts of Nigeria and West Africa.

1.9 Thesis structure

This thesis is divided into nine chapters, including this chapter – *General introduction and background to the research* – which explains the circumstances which encouraged the researcher to undertake this research and the reasons behind the choice of study. It also establishes the background to the field of enquiry, and provides an introduction to the research topic and sets out the main research aim and objectives and the research question.

Chapter Two reviews *municipal solid waste management in developed countries* Justifying what works and what does not work, with the evidence of good practices coming from some countries' success stories and perceptions. It also identified some standards for measuring successful waste management in the globe.

Chapter Three reviews *municipal solid waste management in developing countries*, organised around a comparative analysis based on similar country characteristics, comparing and contrasting them within the context of the key question. Performance indicators to use throughout the research are developed.

Chapter Four advances to look at the *strengths and weaknesses of the planning systems* in municipal solid waste management, particularly to establish the current context of solid waste planning at the municipal level in Nigeria for more detailed case study research.

Chapter Five starts with the discussion of *the research approach and methodology* and methods adopted in general, followed by a description of the actual methods that have been taken in the research in the later part of this chapter.

Chapter Six *analyses the data collected* from the municipal solid waste planning authorities, municipal solid waste management authorities and non-state actors in the study area. The chapter also examines whether different approaches to solid waste management are facilitating higher levels of integration with national legislation and policy, between neighbouring municipal solid waste planning authorities and policy makers. It also considers whether there has been meaningful engagement with the public and hard to reach communities and stakeholders.

Chapter Seven deals with the *findings* by identifying three main driving forces (government, public and politics) from the framework identified in literature review and the case study. Themes are developed and thematic analysis undertaken with quantitative analysis of residential densities assessed from the fieldwork survey.

Chapter Eight explores and develops a proposed *future possible system for municipal solid waste management in Greater Jos*.

Finally, Chapter Nine summarises the main findings, addresses the key research question and makes *recommendations* for the improvement of municipal solid waste management of Greater Jos, focused on the joint municipal solid waste management plan. Finally, it identifies opportunities for further research.

1.10 Summary

Chapter one provides the general introduction and background to the research. It also provided background information that points to the justification for research on the issue of MSWM in Nigeria; bringing it to the main local solid waste issues in Greater Jos. The research aim, objectives and methodology are explained alongside the research

questions with the hypothesis; and the thesis structure is provided. After presenting the research background, the following chapter examines MSWM in developed countries.

Chapter Two

Municipal Solid Waste Management In Developed Countries

2.0 Introduction

This chapter reviews municipal solid waste management in developed countries. Examining what works (and what does not work) from the evidence of good practices coming from some countries' success stories. It also identified some standards for measuring successful waste management across the globe. It highlights the importance of municipal solid waste management effectiveness and other relevant issues in order to achieve best practice. The first part discusses the definitions and concepts related to municipal solid waste management. The second part focuses on a global and United Nations perspective; in particular it considers the directives of the European Union, implementation/legislation/strategy in the UK institutions and responsibilities for policies, while part three reviews the practice in Edinburgh.

2.1 Solid Waste

Several researchers have written about the waste problem yet the definition of the term waste is quite rare in the scholarly literature on the topic. Debate on what constitutes waste is still ongoing within the research community (Read, 2001; Davoudi, 2009a). Contemporary definitions of solid waste are converging on the essential ingredients of the definition i.e. origin or sources of the material, characteristics and potential to cause harm to the environment. According to the Department of the Environment (DoE, 1990; DETR, 2000), waste is any substance which constitutes scrap material or an effluent or other unwanted surplus substance arising from the application of a process, or any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled. On the other hand, Igoni *et al.* (2007) viewed waste as any material which has no value to the producer and must therefore be disposed of. The basic point of agreement between the two definitions is therefore on the issue of value; they both agree this must be defined by the owner or producer of the waste. For the purposes of this investigation, however, the definition by the EU Framework Directive on Waste (91/156/EEC) has been adopted. The document defines waste as any substance or object which the holder discards or intends to discard and which falls into one of the following categories: production or consumption residue; product whose date for appropriate use has expired; contaminated or soiled materials; and substances that no longer perform satisfactorily (Europa, 2006).

2.1.1 Municipal Solid Waste

Municipal solid waste, has been defined as household waste and any other waste collected by a Waste Collection Authority (WCA) or its agents, including waste from parks, beaches, commercial establishments, offices, industries and fly tipping (Read, 1999). Other experts insist that municipal solid waste includes all non-air and sewage emissions created within and collected by private as well as public authorities in any municipality from domestic, commercial and industrial (non-hazardous) sources (Cointreau, 1982; Igoni *et al.,* 2007). Article 2(b) of the European Union Landfill Directive (EU Landfill Directive, 1999) broadened the definition further by defining municipal solid waste as waste arising from households as well as other wastes, which because of their nature and composition are similar to waste from households (EEA, 2003). This implies that municipal solid waste may often include biodegradable components such as paper, wood, textiles, food and garden waste, as well as non-degradable fractions such as glass, plastics, tyres and bottles.

The various sources of these wastes in any community may include residential houses, institutions, commercial organizations, municipal services, allotments and treatment sites (Ezeah, 2006). In essence, municipal solid waste would normally include all wastes from the neighbourhood except industrial, agricultural and hazardous wastes (Tchobanoglous *et al.,* 1993). Furthermore, the potential health or pollution risk of waste materials is used to classify wastes into hazardous or non-hazardous waste. On the one hand, hazardous waste refers to wastes with properties that make them potentially harmful to human health or the environment (DELM, 1993; US EPA, 2008). According to the US EPA (2008), hazardous wastes can be liquids, solids, contained gases, or sludge and can be the by-products of manufacturing processes or simply discarded commercial products like cleaning fluids or pesticides. Because of their potential pollution danger, hazardous waste materials require rigorous and cautious means of disposal (DELM, 1993). In the EPA's *Hazardous Waste Listings* (2008) the categories of hazardous wastes include ignitable waste, corrosive waste, reactive waste, toxicity characteristic waste, acute hazardous waste and toxic waste. Some waste is so dangerous to treat, keep or dispose of that it requires special disposal arrangements (USEPA, 2008). Examples include hard clinical waste such as human parts, contaminated swabs and sharps. On the other hand, non-hazardous waste does not pose a danger and can be dealt with easily, examples being inert materials such as uncontaminated earth and excavated waste such as bricks, sand, gravel and concrete slates (Environment Council, 2000).

Waste can also be classified by whether it is biodegradable or non-biodegradable waste. Biodegradable waste typically originates from plant or animal sources and can easily be broken down by bacterial action or by other living organisms and so has a relatively short lifespan in the environment. This type of waste is commonly found in municipal solid waste as food waste, yard waste and paper. Other biodegradable waste materials include human excreta, animal droppings, sewage and slaughterhouse waste (Lapidos, 2007). In contrast to biodegradable waste, non-biodegradable waste, which includes most plastics, metals and ceramics, are waste substances that cannot be broken down by natural processes or living organisms (Lapidos, 2007).

The classification of waste into types, as discussed above, is very important for waste management planning. Among other things, it provides useful information that enables municipal authorities to organize waste management operations including the frequency and means of collection, and appropriate disposal methods. The developed countries have made great advances in waste data generation and analysis which have enabled them to improve waste management over the years. In most developing countries, however, even the most basic data on waste such as the quantities generated and composition of the waste stream are lacking, making it difficult to organise waste management effectively (Hardoy *et al.*, 2001).

2.1.2 The concept of waste management

The business of keeping our environment free from the contaminating effects of waste materials is generally termed waste management. Gbekor (2003, 18), for instance, has referred to waste management as involving, "the collection, transport, treatment and disposal of waste including after care of disposal sites". Similarly, Gilpin (1996, 201) has defined waste management as, "purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner". On the other hand Schubeller *et al*. (1996, 7) focus on municipal solid waste management which they defined as "the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas". It can be deduced from these definitions that waste management is the practice of protecting the environment from the polluting effects of waste materials in order to protect public health and the natural environment. Thus, the priority of a waste management system must always be the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment

(Cooper, 1999). Further, Gilpin (1996) regards the business of waste management as a professional practice which goes beyond the physical aspects of handling waste. It also "involves preparing policies, determining the environmental standards, fixing emission rates, enforcing regulations, monitoring air, water and soil quality and offering advice to government, industry and land developers, planners and the public" (Gilpin, 1996: 228). Waste management, therefore, involves a wide range of stakeholders who perform various functions to help maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population and the environment. Effective waste management is, however, a growing challenge to all municipal governments, especially in developing countries.

2.1.3 The goals of waste management

In 1976, the United States Congress enacted the Resource Conservation and Recovery Act (RCRA) which authorized the EPA to regulate waste management and disposal practices. The goals of waste management that were set by the RCRA included:

1. The protection of human health and the environment from the hazards posed by waste disposal
2. The conservation of energy and natural resources through waste recycling and recovery
3. Reducing or eliminating the amount of waste generated, and
4. Ensuring that wastes are managed in an environmentally-safe manner (RCRA, 1976)

Other writers agree with these objectives of waste management. For example, Schubeller *et al*. (1996) have stated the goals of municipal solid waste management as protecting environmental health, protecting the quality of the environment, supporting the efficiency and productivity of the economy and the generation of employment and income for people. For her part, Cointreau (2001:online) argued that:

> "the overall goal of urban solid waste management is to collect, treat and dispose of solid waste generated by all urban population groups in an environmentally and socially satisfactory manner, using the most economical means available".

Similarly, the Federal Environmental Protection Agency (FEPA) (1989) has noted that waste management is essential in the present day context for the following reasons:

1. To protect human health against waste-related hazards and risks

2. To prevent pollution of the environment and its natural resources like air, water and land
3. To produce energy that could be an alternative for the fast depleting fossil fuels and other conventional sources of energy.
4. To make optimum use of the waste generated.
5. For a better and sustainable future.

It can be concluded from the above that the main objective of waste management is to protect public health against waste-related hazards and risks, and to maintain ecosystem services by preventing the pollution of the natural environment and its resources such as land, water and air as well as the aesthetic quality of the environment. The objectives of waste management are also in line with the goals of the Millennium [Ecosystems] Assessment (MA), the United Nations' 2005 study of the consequences of ecosystem change for human wellbeing. Chapter 15 of the MA report focuses on 'waste processing and detoxification' and points out that failure in waste management is the cause of the growing incidence of waste water-borne diseases, human health impairment and ecosystem damage (Millennium Assessment Report, 2005). The report emphasises the necessity of waste management at local, national and global scales in order to protect and conserve the world's ecosystems and their resources.

To achieve the goals of municipal solid waste management, it is necessary to establish sustainable systems of solid waste management which will meet the needs of the entire urban population including the poor. The systems put in place for solid waste management must be appropriate to the particular circumstances of the city and its various localities. To achieve sustainable waste management, such a system must harness and develop the capacities of all stakeholders in the waste sector including civil society, businesses, private sector waste companies and government agencies (Schubeller *et al*. 1996). Due to their low technical, financial and managerial capacities, most municipal authorities in developing countries fail to achieve the goals of waste management and are, therefore, unable to achieve the basic objective of waste management which is to protect public health and the natural environment against waste pollution (Hardoy *et al*., 2001; Pacione, 2006).

2.1.4 The principles of waste management

The principles of waste management, as identified by Schubeller *et al*. (1996, 19), are "to minimize waste generation, maximize waste recycling and reuse, and ensure the

safe and environmentally sound disposal of waste". This means that waste management should be approached from the perspective of the entire cycle of material use which includes production, distribution and consumption as well as waste collection and disposal. While immediate priority must be given to effective collection and disposal, waste reduction and recycling should be pursued as equally important longer-term objectives (Schubeller *et al.*, 1996). Cointreau (2001) has also identified ten principles that should guide a sustainable and integrated solid waste management programme. According to her scheme, such a programme should:

1. Be supportive of good governance
2. Provide economic service delivery
3. Establish cost recovery mechanisms for long-term financial sustainability
4. Conserve natural resources
5. Embrace public participation
6. Foster environmentally appropriate technologies and sites
7. Seek appropriate levels of source segregation, recycling and resource recovery
8. Conduct strategic facility planning and development
9. Build institutional capacity
10. Invite private sector involvement

In line with Gilpin's (1996) notion of waste management, this means that waste management involves much more than the practical organization of waste collection, transportation, treatment and disposal. While these are important aspects of waste management, several other issues are equally important including good governance, and public and private sector participation (Cointreau, 2001). The waste management situations in most developing countries show that the goals and principles of waste management are far from being achieved (Schubeller *et al.*, 1996; Hardoy *et al.*, 2001; Pacione, 2005).

2.1.5 Integrated waste management and the waste hierarchy

In recent years, the concept of integrated waste management has become popular as a new approach to waste management. As defined by the World Resource Foundation (WRF, cited in Environment Council, 2000:23), integrated waste management refers to "the use of a range of different waste management options rather than using a single option". In other words, integrated waste management is an approach which relies not only on technical solutions to the waste problem, but on a wide range of complementary

techniques in a holistic approach. The approach involves the selection and application of appropriate technologies, techniques and management practices to design a programme that achieves the objectives of waste management (Tchobanoglous *et al.,* 1993).

The concept of integrated waste management seems to have emerged from the realization that technical solutions alone do not adequately address the complex issue of waste management and that there is the need to employ a more holistic approach to waste management. As argued by Rhyner *et al.* (1995, 17), "a single choice of methods for waste management is frequently unsatisfactory, inadequate, and not economical". Use of an integrated approach to managing solid waste has therefore evolved in response to the need for a more holistic approach to the waste problem. In this approach, all stakeholders participating in and affected by the waste management regime are brought on board to participate in waste management. Furthermore, issues such as social, cultural, economic and environmental factors are considered in the design of an integrated waste management project (Tchobanoglous *et al.,* 1993; Rhyner *et al.,* 1995; Schubeller *et al.,* 1996; Davoudi, 2000). These elements most commonly associated with integrated solid waste management are waste prevention, waste reduction/minimization, re-use of materials and products, material recovery from waste streams, recycling of materials, composting to produce manures, incineration with energy recovery, incineration without energy recovery and disposal in landfills in that order of priority (Durham County Council, 2007). These elements of IWM are frequently formulated into a waste hierarchy model which Girling (2005, 178) has described as "a penny-plain piece of common sense that places the various strategies for waste management in order of environmental friendliness, from best to worst".

As shown in the model (figure 2.1), waste prevention and reduction are placed at the top to show that the best way to deal with waste is to prevent its production and, where this is not possible, to produce less of it. At the other extreme, disposal is placed at the bottom to show that it should be the last resort among the strategies for waste management (see figure2.1). The waste hierarchy was originally set out in the EC Framework Directive on Waste (Girling, 2005) and is a useful guiding principle for waste management planning. Integrated waste management and the waste hierarchy both inspire sustainable waste management and can reduce the environmental hazards associated with waste disposal. It is therefore important for stakeholders in the waste sector to realize that an integrated approach which constantly strives to move up the waste hierarchy can be a useful tool for sustainable waste management. In spite of efforts by municipal authorities

to improve waste management, most countries in the world still resort to strategies at the bottom of the waste hierarchy. In both developed and developing countries the bulk of solid waste collected by municipalities is still disposed of in landfills. Other instruments that encourage good practice in waste management are the proximity principle (PP) and the best practicable environmental option (BPEO) (Environment Council, 2000). The proximity principles calls for the disposal of waste as close to its source as possible. Among other advantages, this practice reduces the time, energy and expenses involved in the transportation of waste to disposal sites, and also minimize the possibility of accidents associated with the transportation of waste. With regard to the BPEO, it encourages the use of waste management strategies that achieve the most benefits in terms of cost, energy and time, and that also cause the least damage to the environment.

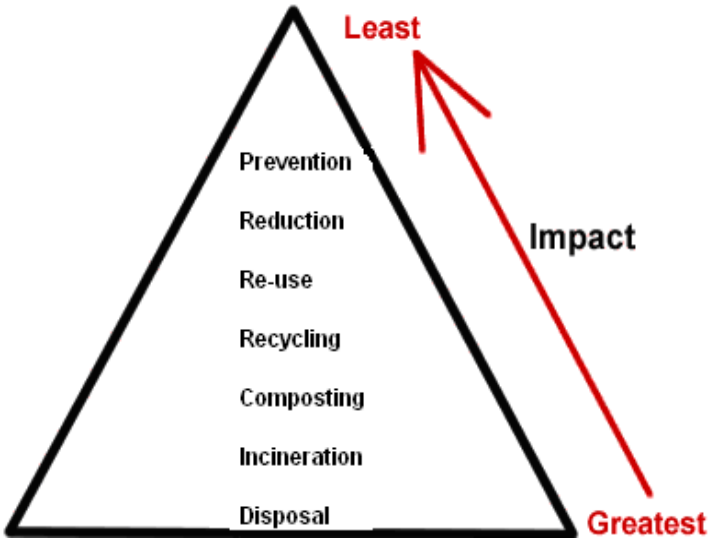

Figure 2.1: The waste management hierarchy

Source: Adopted from: Lancashire CPRE: http://www.lancashire.gov.uk/environment/lmwlp/pdf/ ; Defra, 2008

2.2 Sustainable Waste Management

Another important concept of waste management is 'sustainable waste management' (SWM). SWM is an integral part of sustainable development as set out in the Brundtland Commission's approach to development which seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987).The amount of waste generated and how it is managed has profound implications for the quality of the environment and for the prospects of future generations. Thus, in keeping with the objectives of sustainable development, SWM can be regarded as an approach to waste management that, in addition to protecting human health and the

environment, ensures that the scarce resources of the earth are conserved for both present and future generations of humanity. It therefore becomes important to minimize natural resource extraction and consumption by recycling waste materials, and conduct waste management efficiently to curtail the environmental impacts of waste disposal and protect ecosystem services for both current and future generations (Millennium Assessment Report, 2005). In line with the waste hierarchy, the best way to achieve SWM is to reduce the amounts of waste we produce (Girling, 2005). Where waste is unavoidable a sustainable approach is to encourage re-use and recycling of products to prevent them from getting into the waste stream. Finally, where waste prevention/reduction, re-use and recycling are economically impossible, waste is processed to recover their intrinsic values such as energy. SWM also seeks to increase co-ordination between the producers of goods, retailers, manufacturers, the public, local authorities and all concerned with the management of waste and reusable materials and equipment (London Waste Action, 2007).

A number of thermal-based energy recovery processes have been reported, mainly in Europe and the United States (ISWA, 2013). WtE in Europe already supplies a considerable amount of renewable energy (some 38 billion kilowatt-hours in 2006). By 2020, the amount might grow to as much as 98 billion kilowatt-hours, enough to supply 22.9 million inhabitants with electricity and 12.1 million inhabitants with heat (CEWEP, 2009). By 2009, USA had 88 WtE plants that combust about 26.3 million tonnes of MSW and serve a population of 30 million (Psomopoulos et al., 2009). Interestingly, the communities that use WtE in the U.S. have a 17.8 per cent higher recycling rate than the U.S. EPA average, showing that energy from waste coexists with high recycling (Psomopoulos *et al.*, 2009).

Managing waste is a complex task that requires co-operation among a wide range of stakeholders (Zarate *et al*., 2008; Davoudi, 2009a). Data on waste management should be collected, although complete and reliable data are extremely difficult to obtain (Wilson *et al.*, 2012; Marshall and Farahbakhsh, 2013). Waste management solutions in one region might not be appropriate elsewhere. For example, some WtE techniques might be more appropriate in some countries, while in other countries, composting organic waste and biogas capture may be more useful to deal with waste high in organic matter. Large-scale investment in a specific technology, such as WtE, might also lead to technological "lock-in," narrowing options in the future (UNEP, 2013).

Ultimately, waste management presents an opportunity, not only to avoid the detrimental impacts associated with waste, but also to recover resources, realise environmental, economic and social benefits and to take a step on the road to a sustainable future. Decision makers, responsible for planning and policy making, need to be well informed in order to develop integrated waste management strategies adapted to the needs of citizens (Guerrero *et al.*, 2013; Hardeep *et al.*, 2013). When informed decisions about waste management are made and applied to the circumstances that prevail, waste can even provide economic value.

Municipal solid waste management has not always been a high priority for local and national policy makers, and planners especially. Other issues with more social and political urgency might take precedence and leave little budget for waste issues (Memon, 2010). Thus, in many cities around the world, effective, functioning policy measures have been elusive and the resources invested in the sector inadequate (Davoudi, 2006; Konteh, 2009).

In spite of the enormous benefits associated with SWM strategies such as re-use and recycling, only a handful of countries are able to put them into practice. For instance, most of the economically developed countries are still unable to recycle much of their waste. Moreover, proposals for improving waste management in many rich countries call for more incineration rather than recycling which is just one step up from land filling at the bottom of the waste hierarchy. The fact that even the rich industrialized countries find it difficult to move up the waste hierarchy is evidence that SWM is not easy to achieve. If the rich industrialized countries are struggling to implement SWM the concept only remains a distant dream in developing countries (Chazan, 2002; Girling, 2005).

2.3 Municipal solid waste management in developed countries

This section looks at the background and at the same time introduces global best practices. The primary goal is to highlight the major issues in municipal solid waste management. To achieve this, the analysis is structured around the world's perspective. The developed countries perspective presents the waste hierarchy as the dominant concern in the EU. The United Kingdom has been used as a basis for best practice.

2.3.1 World/United Nations perspective

Urbanization has increased in speed and scale in recent decades, with more than half the world's population now living in urban centres (Tacoli, 2012; UNPD, 2012a) (see Figure 2.2). By 2050, urban dwellers probably will account for 86 per cent of the

population in developed countries (UNPD, 2012a). Rapid urban population growth has resulted in a number of land-use and infrastructural challenges, including municipal solid waste management. National and municipal governments often have insufficient capacity or funding to meet the growing demand for solid-waste management services (Tacoli, 2012). Solid waste management is the single largest budget item for many cities (World Bank, 2012; UN-HABITAT, 2010).

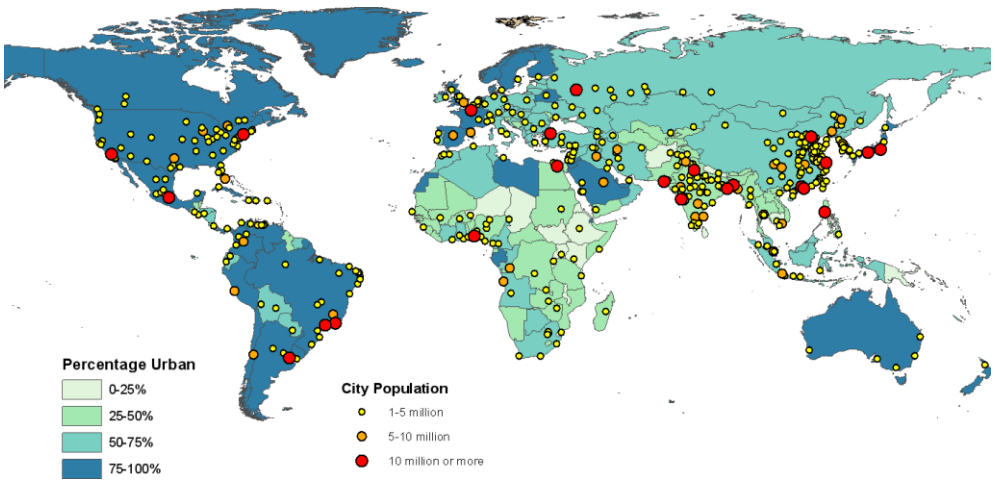

Figure 2.2: Percentage of urban population and agglomerations by size class, 2011

UNPD (2012b)

The waste hierarchy is now used globally as a communication tool to remind those who generate waste and those who manage it that preventing waste through efficient use of resources and raw materials is the best option. Re-using discarded goods without reprocessing or remanufacture is assumed to provide greater savings in resource consumption and is given priority over recycling (Figure 2.1) (Wolsink, 2010)

The United Nations Basel Convention (1989) puts the onus on exporting countries to ensure that hazardous wastes are managed in an environmentally sound manner in the country of import. The following rules apply to ensure better management practices or sound recycling system: the Polluters Pay Principles (PPP), where producers and importers have the only obligation for paying the recycling-clearance-disposal fees to the EPA, but do not assume any responsibility for recycling work. The Extended Producer Responsibility (EPR) system requires producers to have full obligation for recycling the products they produce both within and outside the manufacturing country. Integrated Product Policy (IPP) seeks to improve the environment performance by looking at all phases of the products life cycle and taking action where it is most effective. The introduction of EPR with well-defined rules for all participants, producers, users,

authorities and waste managers is essential for designing an effective waste management system.

In many countries, solid waste management is treated as a local issue, with all the finances including its annual budget, subsidies from national government, and international cooperation traditionally taken care of by local governments. However, this has been challenged by the demands for huge investments, to bring improvements in many aspects of the solid waste management chain. This further paved way for a transition by which governments started adopting various financing modes and some of the widely practiced ones as suggested by UNDP (2004) are as follows:

1. User charges: In many countries, user charges are being introduced. They are still low for residential sectors but for commercial and industrial sector, the charges can be high to meet the costs in accordance with the polluter's pay principle. However, these charges also motivate waste generators to reduce the waste. Volume-based charges for residential waste are quite common in some countries.
2. Penalty, fine and levy: This form of direct income is also becoming an important financing tool for governments to finance solid waste management. The terminology and rate of the penalty/fine/levy may vary from country to country.
3. Environmental Bonds: In some countries, these bonds are floated by local governments as a major source to arrange funds for environmental infrastructure and services including solid waste management and other developmental activities.
4. Environmental Fund: Some countries set a revolving fund to assist local governments in meeting their financing needs for environmental infrastructure and services. This fund is financed through various modes including national bonds, loans from international financing institutions and international cooperation.
5. Direct Loans: Local governments may take direct loans either from domestic or international financing institutions.
6. International Cooperation: There is an increasing trend of direct multilateral and bilateral cooperation with local governments. International agencies are providing support to local governments to improve the local environment. Various bilateral initiatives, including sister cities, are also helping local governments to seek assistance for financing their development projects including solid waste management.

7. National subsidies: This is often a major source for many local governments to finance environmental infrastructure and services.
8. Annual budget: Local governments allocate a substantial portion of their development budget to finance solid waste management. This is usually cross-subsidized from the profit-making avenues of local governments.
9. Private Sector Participation (PSP):There is an increasing trend of private sector participation in the solid waste management chain. The activities under solid waste management (collection, transportation, treatment, disposal, recycling and recovery) can be easily separated from each other enabling various organisations to be involved in one or more aspects of the chain. There are quite a few established forms of PSP based on the level of investment and ownership.

Mature databases, such as the United Nations Environment Program (UNEP) Global Environment Outlook (GEO) Data Portal and World Research Institute Earth Trends, characterize developed countries' municipal solid waste.

Increased scarcity of natural resources and the consequent rise in commodity prices have influenced the demand for recycled products. The resource value of waste has become an important driver in many countries today and provides a livelihood for some urban people (UN-HABITAT, 2010). Recycling materials such as paper, glass and plastics, as well as composting and digestion of bio-waste, becomes the obvious next preferable option. Aerobic (with oxygen) composting of MSW avoids the formation of methane associated with anaerobic conditions. The method is generally not complex and relatively cheap (World Bank, 2012). The world market for municipal waste, from collection to recycling, is worth an estimated US $410 billion a year (Chalmin and Gaillochet, 2009). However, only a quarter of the 4 billion tonnes of municipal waste produced each year is recycled or recovered (Chalmin and Gaillochet, 2009).

In developed countries, per capita waste generation increased nearly three-fold over the last two decades (USEPA, 2010), reaching a level five to six times higher than that in developing countries. With increases in populations and living standards, waste generation in developing countries is also increasing rapidly, and may double in volume in the current decade. If current trends continue, the world may see a five-fold increase in waste generation by the year 2025. A high proportion of the waste could be recycled, reused or recovered by the urban poor generating income for themselves and protecting the environment.

2.3.2 European Union Strategies and Plans

According to the EU Waste Framework Directive (Article 7), Member States shall prepare national waste management plans. The waste management plan shall specify among other things, the types, quantity, and origin of waste to be recovered or disposed of, general technical requirements, waste management arrangements for specific types of waste and suitable disposal/ treatment installations. Key stages in preparing the waste management strategy include: definition of scope and goal; baseline study including analysis of the existing situation and a forecast of future waste stream; identification of problems; identification of options and scenarios to achieve the objectives; appraisal, prioritisation and selection of the most desirable options and scenarios; financial appraisal and identification of funding sources; allocation of responsibilities and timeframes of implementation; and setting indicators to measure progress.

Figure 2.3 shows the recycling rates of MSW in the European Union in 2010 compared with 2001. A line further from the centre in the radar chart signifies better waste management. As the figure indicates, recycling performance has improved in most European countries. In a report assessing its economic implications, recycling had a turnover of EUR 32 billion in 2004, and increased by almost 100 per cent to a minimum of EUR 60 billion in 2008 in the European Union countries (EEA, 2011). From 2000 to 2008, employment growth in the recycling sector increased 7 per cent each year, with an overall increase of 45 per cent. Recycling generated more jobs at higher income levels than other forms of waste management in European countries (EEA, 2011). The general increase in recycling of municipal waste reduced the percentage of municipal waste landfilled (EEA, 2013).

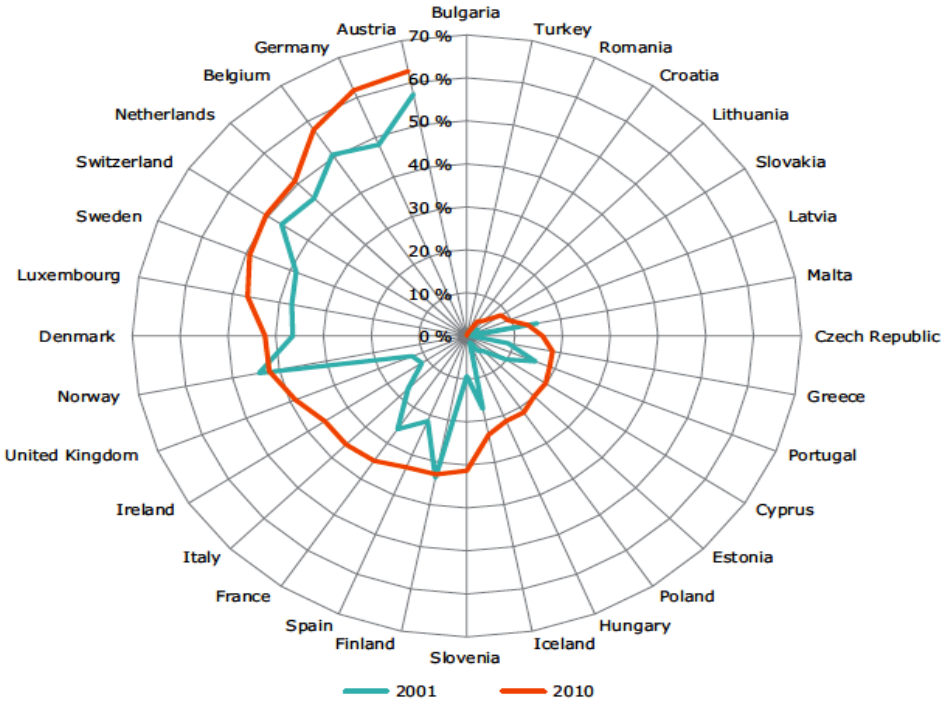

Figure 2.3: Municipal waste recycling rates in 32 European countries, 2001 and 2010

EEA (2013)

The European Union Waste Framework Directive requires the member states to recycle, compost or reuse 50 per cent of waste from households by 2020 (DEFRA, 2012). A European Commission study published in January, 2012 (Recycling and Waste World, 2012) revealed that full implementation of EU waste legislation would save 72 billion a year, increase the annual turnover of the EU waste management and recycling sector by £42 billion and create over 400,000 jobs by 2020. According to the EU (2012), the study gives an in-depth analysis of the effects of better implementation and enforcement and shows that benefits would be significant. The EU waste management and recycling sector is said to offer "economic opportunities with vast potential for expansion" (Recycling and Waste World, 2012, p.1). It further identified challenges facing many member states including lack of adequate infrastructure for separate collection, recycling and recovery; an absence of systematic control and enforcement mechanisms coupled with a lack of reliable data on waste management.

The sharing of responsibilities needs collaborations and partnership working between all three tiers of government is a crucial condition for an efficient planning system (UNCHS, 2000; Sistech, 2003; Todes et al, 2009; USEPA, 2010; SEPA, 2012; DEFRA, 2012). The table below shows municipal waste management in the European Union (progress report for the year 2009).

EU country	Percentage		
	Landfilled	Recycled/Comp	Incinerated
Malta	95.15	4.85	0
Lithuania	90.63	9.37	0
Cyprus	87.1	12.9	0
Latvia	92.16	7.7	0.13
Bulgaria	96.07	3.93	0
Czech Republic	72.21	17.31	1048
Slovenia	68.78	29.68	1.53
Slovakia	80.86	12.15	6.99
Greece	81.12	18.88	0
Romania	76.85	23.15	0
Hungary	74.49	16.09	9.42
Poland	65.2	33.96	0.84
Portugal	60.81	19.49	19.71
Spain	52.04	39.17	8.78
Ireland	58.38	37.86	3.76
United Kingdom	49.28	39.19	11.53
Estonia	61.85	37.93	0.22
Finland	46.06	35.87	18.09
Italy	49.24	38.05	12.71
France	32.33	33.73	33.94
Luxembourg	17.19	46.7	36.1
Austria	0.69	69.86	29.45
Denmark	3.86	48.08	48.06
Belgium	5.08	60.62	34.3
Sweden	1.4	50.16	48.44
Netherlands	0.67	67.4	31.93
Germany	0.37	67.34	32.3
EU27 average	37.39	42.73	19.89

Table 2:1: Municipal waste management data for 2009

Source : Eurostat (2009)

2.3.3 The role of planning

Sustainable solid waste management approaches in developed countries especially the European Union promotes: waste prevention and minimisation at the point of generation; waste re-use and recycling (EU, 2012), rather than immediate waste disposal at the point of waste generation. Directives form the majority of EU environmental legislations relating to waste and seem to work effectively. These directives are designed to impose obligations on member states, while providing enough flexibility to enable member states to implement the requirements within their own legal and administrative systems. The related daughter directives include:

i. Waste Oil Directive 75/439/EEC
ii. Landfill of Waste Directive 99/31/EC
iii. Hazardous Waste Directive 91/689/EEC
iv. Packaging and Packaging Waste Directive 94/62/EC
v. Incineration of Waste Directive 2007/76/EC
vi. Sewage Sludge Directive 86/278/EEC
vii. Batteries Directive 91/157/EEC
viii. Disposal of PCBs and PCTs Directive 96/59/EEC

The Waste Framework Directive (EU, 2012) provides a planning and institutional framework to guide implementation of the waste sector directives. In addition the Directive obliges member states to prepare waste management plans based on the principles incorporated in the Directive. The Directive calls for strategies and waste management plans at the national level without reference to waste management plans at regional or local level. However, it is further made clear that well designed municipal or regional waste management plans must follow the philosophy incorporated in the Directive.

Effective waste management and environmental protection plans require a clear definition of roles, jurisdictions, legal responsibilities and rights of the concerned governmental bodies and other organisations (Schubeler *et al*., 1996; EU, 2003, World Bank, 2003; Davoudi and Evans, 2005; UNEP, 2009). The absence of clear jurisdiction may lead to controversies, ineffectiveness and/or inaction, undermining the politically sustainability of solid waste management systems. The instrumental basis for implementing the strategic plan comprises a legal and regulatory framework which is elaborated in the form of bylaws, ordinances and regulations concerning solid waste management, and includes corresponding inspection and enforcement responsibilities and procedures at national, regional/state, and local levels (EU, 2003, 2008). These would also include provisions for the management of industrial and hazardous wastes. Regulations should be few in number, transparent, unambiguous, easily understood and equitable (UNDP, 2003) Furthermore, they should be conceived with regard to their contribution to urban physical and economic development (UNDP, 2003; Troschinetz and Mihelcic, 2009 and Pires *et al*., 2011). Regulation and controls are not the only type of instrument available for achieving waste management goals (Davoudi 2009b; Pires *et al*., 2011). Other options include economic incentives; the internalisation of externalised costs according to the polluter pays principle and non-economic motivations based on

environmental awareness and solidarity of the population. Authorities should consider the full range of available instruments within the policy framework.

According to the European Union (2012), any legal requirements of a plan or strategies should conform to at least some basic elements of a waste management planning process. The waste management planning process runs in cycles, i.e. in principle it is a continuous process, where the plan or strategy is revised at regular intervals. The process may be broken down in six phases: general considerations, status part, planning part, consultation process, implementation and plan revision as presented in figure 2.4

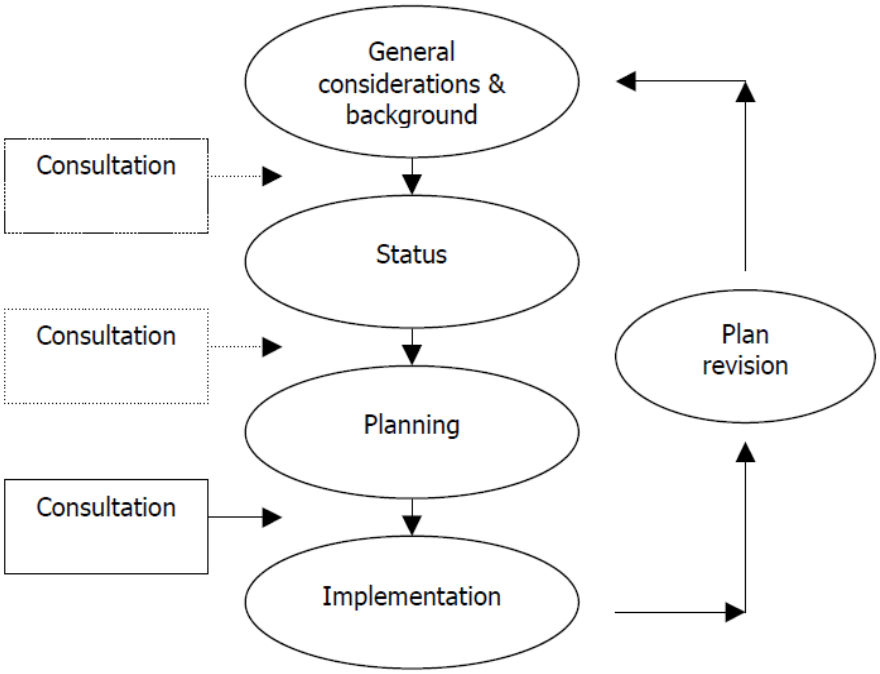

Figure 2.4: The waste management planning process

Source: EU (2003)

This seems to be an effective way of waste management for the following advantages:

1. It is tied to a framework that is linked to a national waste strategy or regional/ state plan.
2. It addresses the issue of regulatory body with defined responsibilities.
3. Putting waste prevention on top of the waste hierarchy and encouraging waste recycling and reuse at various political levels.
4. Having laws which strategize on how producers would be environmentally friendly to produce less waste in the production cycle; to take more responsibility

for the waste they produce and encourages consumers to buy environmental friendly goods.

According to the European Union (2003, 2004, 2011, 2013), and the United Nations Development Programme (2004), an effective legal instrument should have all the elements listed above.

2.4 Municipal Solid Waste Strategy in the United Kingdom

This section reviews trends in solid waste management via mainly the municipal waste management plans. Current practices in the United Kingdom are highlighted as examples of good practice. In addition, it analyses key objectives and issues which should be addressed by solid waste management systems and is organized in sections covering: financial instruments; strategies and plans; sharing of responsibilities for collection/reuse; institutional /administrative capacities and achievements; environmental and economic gains (cost). The analysis ends by identifying some major constraints in relations to sustainability of solid waste management practices. This review will form an effective information base for development of an effective solid waste management plan for urban areas.

The legislative framework and policy instruments for sustainable waste management in the United Kingdom are continually evolving (DEFRA, 2012). However the essential thrust remains the same, in that all national and local waste policies and strategies are targeted towards realising the objectives of the EU Framework Directives on waste. This implies therefore that waste laws, policies and strategies in United Kingdom are developing concurrently at three separate levels: European legislation; national legislation; and regional/local policy.

From a life-cycle point of view, an all-inclusive solid waste plan should include all essential operational units from collection, to shipping, to treatment, to recycling, and to disposal (Troschinetz and Mihelcic, 2009; Pires *et al.*, 2009). The current European regulations are promoting the hierarchy of waste management which inevitably involve a wealth of waste management practices tied to policies, institutional settings, financial mechanisms, technology selection, and stakeholder participation (Pires *et al*., 2011). Sustainable municipal solid waste management become a key issue in the United Kingdom immediately after the Earth Summit in Rio de Janeiro in 1992. This radical shift towards sustainable waste management became necessary given the unacceptable levels of inefficiencies in the system. For instance, it is the opinion of Phillips *et al*. (2001) that

for every tonne of useful product made in the United Kingdom, 10 tonnes of other resources were consumed. Best practice in waste management seeks to reduce the amount of waste produced as well as reduce the environmental impact of unavoidable or residual waste (Coggins, 2001).

In the United Kingdom, municipal solid waste management best practices are premised upon three fundamental principles. Phillips *et al*. (2001) outlined these as:

1. Best Practicable Environmental Option (BPEO). The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or the least damage to the environment, at acceptable cost, in the short as well as the long term.
2. The Waste Hierarchy. The waste hierarchy is a conceptual framework which acts as a guide to the options which should be considered when assessing BPEO.
3. The Proximity Principle. This principle holds that waste should be disposed of as near to its place of production as possible.

From the foregoing, it was established that the central focus of all waste strategies in the UK are based upon a hierarchy of preferred options to deal with waste as reflected in figure 2.5.

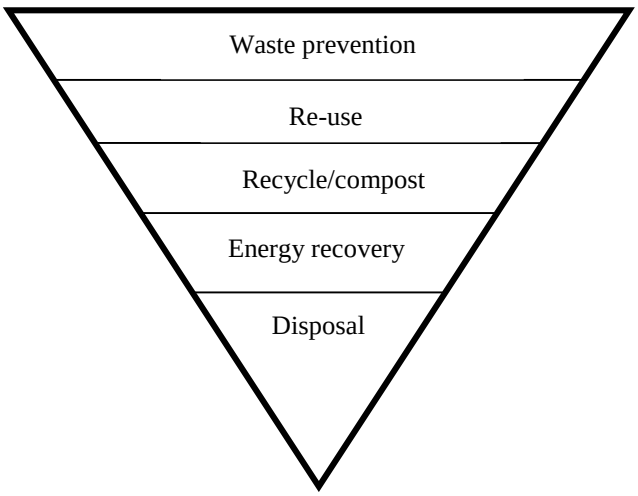

Figure 2.5 : Municipal Solid Waste hierachy

Source: Defra (2008)

The waste regime in the United Kingdom provides a quintessence of a system that makes effective monitoring of waste prior to disposal and the steps to be taken on disposal (DEFRA, 2012). The regime distinguishes between controlled (municipal, commercial

and industrial waste) and special waste. Under section 30 of the Environment Protection Act (EPA), 1990, waste authorities have three basic functions: regulation, collection and disposal. Controlled waste may not be deposited, treated, kept or disposed of without a licence. The licensing method is used as a means of controlling waste. An offence can be committed whether or not the offender has a licence, as the offence focuses on environmental protection, not with enforcing the licensing regime. The penalties are quite prohibitive: six months in jail and /or a fine up to £20,000 in the magistrates' courts, two years in jail and /or an unlimited fine in the crown court. The principle of care under the EPA is designed to satisfy the European ideology on the environment so that the polluter pays is an important form of liability on producers of waste. The producer is responsible for the proper disposal of the waste. This means that the producer must ensure it is transferred to a responsible carrier. The producer cannot escape liability simply by passing the waste onto anyone who could include a fly-tipper. This unbroken chain of waste transmission ensures that indiscriminate dumping and disposal is eliminated.

Also, the concept of recycling has acquired a moral tone and governments across Europe have succumbed to the political pressure by introducing policies on recycling which requires progressively more materials to be dealt with in this way. Financial instruments are used to encourage recycling and this is supported by environmentalists (Attah, 2005). A system of financial credits was introduced by section 52 of the EPA. It involves the waste disposal authority making payments to the waste collection authority in respect of waste which they have collected for recycling. This encourages less waste taken to landfill site or an incinerator. If a third party, e.g. a charity collects waste for recycling they receive a payment. In Japan, France, Germany, Italy and Scotland, this practice is common.

The United Kingdom developed a legislative framework in planning for its waste (Sistech, 2002) with various regulatory regimes to manage environmental behaviour (Prior, 2000). They include pollution control for discharges to water, air and land; land use planning; environmental health; and protection of the countryside including nature conservation. Empowered under various environmental legislations are government authorities who have the responsibility for enforcing policies. The Environment Agency (EA) is the overarching competent authority although polices are implemented through local planning authorities (EA, 2006). The councils have the statutory responsibility under the EPA to protect its resources by requiring planning permission for developments

ranging from minor house extensions to major industrial and retail development, in this case, as it affect land resources.

Environmental legislation confers on regulators special powers to enter an industrial premises for inspection reasons, to grant or withdraw permits, policing and enforcing standards and, if need be prosecute an industrial polluter. However, these powers according to Prior (2000), are undermined by technical enforcement issues derived from the peculiarities of the statutory framework and it serves as a serious bane to United Kingdom environmental enforcement efforts.

2.4.1 Financial instruments

Financing of the waste management system depends on national legislation and the extent to which there is a tradition for making users pay for the service. Charges are rather commonly used for collection and treatment of waste although other financing systems, such as producer responsibility, are used for some waste streams (EU, 2012a). Throughout Europe there are many methods of financing. Collection and transportation, treatment facilities and landfills are financed and operated by private enterprises, public enterprises, semi-public entities or inter-municipal partnerships.

There are four strategies in the United Kingdom. Scotland, England, Wales, and Northern Ireland have each developed a National Waste Strategy outlining ways of dealing with waste generated within their jurisdiction (DEFRA, 2007). Where appropriate, Scotland will be used as the basis for comparison and illustration of best practice in the analysis.

Though significant progress has been made since the production of various plans and strategies, the United Kingdom's overall performance continues to lag behind many mainland European nations (DEFRA, 2008). For instance, of the 27.3 million tonnes of MSW produced in England in 2008/09, 50.3% was sent to the landfill compared with 37% in France, 18% in Germany and less than 3% in The Netherlands (DEFRA, 2010). The United Kingdom's central government targets reducing the quantity of waste sent to landfills. The realization of this target is hinged on making waste management a shared responsibility for every section of society and in 2007 the national waste strategy identified the following proposed ways:

a) Producers will seek to redesign their production processes with the aim of making products that are less wasteful and take responsibility for adverse environmental impacts of their products throughout the product's life. Producers will aim at using

more recycled materials and less new extracted raw materials as industry best practice.

b) Retailers will have to reduce packaging, with preferences for market products from eco-friendly producers, and educate their customers to choose likewise.
c) Consumers – Businesses as well as households are to seek all avenues to generate less waste, and separate their waste at source for easy recycling thereby lessening adverse environmental impacts.
d) Local authorities are to provide residents with adequate education on how to reduce waste and provide convenient and sustainable waste management options for unavoidable waste.
e) Waste management industry are to access and invest in new technologies that emphasize waste avoidance and re-use while providing convenient service options for their customers where waste production is unavoidable.
f) Central government will provide the enabling environment for all stakeholders in waste/resource management to take responsibility and show leadership through appropriate actions for sustainable waste management (DEFRA, 2007).

There are range of infrastructure and support organizations for solid waste management in the United Kingdom with the Department for Environment, Food and Rural Affairs (DEFRA) as the apex government department responsible for waste and related environmental issues except Scotland. Working either through internal structures, such as WIP or external organizations such as WRAP, BREW (see below) and other third sector organizations, DEFRA co-ordinates efforts aimed at achievement of the overall objectives of government's waste strategy as encapsulated by the Waste Strategy (2007); The Waste and Resources Action Programme (WRAP) is a not for profit organization created by the government in 2000 as a one stop shop to work in partnership with other waste sector organizations, businesses and consumers to deliver greater material and resource efficiency through recycling more things more often (WRAP, 2008); Following a £3 per tonne increase in landfill tax by Her Majesty's Treasury for the year 2005/6 (currently at more than £48 per tonne in 2015), it became necessary to utilize the additional revenues generated to fund programmes that could support improvements in resource efficiency, especially in waste minimization and diversion from landfill (DEFRA, 2012). Business Resource Efficiency and Waste (BREW) is a package of programmes designed by DEFRA in partnership with business stakeholder to enhance

resource efficiency. Through this programme, businesses are incentivised to reduce the amount of waste they send to the landfills. Projects funded by BREW are delivered through established programmes and organizations such as WRAP, Resource Efficiency and the Knowledge Transfer Network (KTN), and Regional Development Agencies, (RDAs), until they were abolished in 2010. The Waste Implementation Programme (WIP) was set up in June 2003 by the Department of Environment Food and Rural Affairs (DEFRA, 2012). WIP was conceived to respond to the need to reduce municipal waste (especially Biodegradable Municipal Waste, BMW) sent to the landfill by providing adequate support to bring about waste reduction, reuse and recycling.

The objective was to help England meet binding targets under Article Five of the EU Landfill Directives. Precisely, these targets were by 2010 to reduce biodegradable municipal waste landfilled to 75% of that produced in 1995; by 2013 to reduce biodegradable municipal waste landfilled to 50% of that produced in 1995; and by 2020 to reduce biodegradable municipal waste landfilled to 35% of that produced in 1995 (DEFRA, 2012).

The measures designed by WIP to realise the above objectives include: local authority support, local authority funding, research funding for new technologies, data and information management, waste infrastructure delivery programme, efficiency initiatives, waste minimization programme, kerbside and waste awareness programme (DEFRA, 2012).

The "Third Sector" is a loose term currently used to refer to a range of value-driven, largely non-governmental organizations working in waste in England such as community based organizations (CBOs), voluntary organizations (VOs), charities, co-operatives, social enterprises etc. It is estimated that over 1000 third sector organizations are involved in waste management in England alone (DEFRA, 2012). Third sector organizations often have areas of expertise of individual strengths that are quite productive when channelled towards areas of need in waste management, such as attitudinal change programmes, recycling campaigns etc (DEFRA, 2012).

2.4.2 Sharing of responsibilities for collection/ reuse and Institutional capacities and achievements

The use of strategic development planning is the cornerstone for any national, regional or local policy on waste management. Responsibility for waste management can be assigned to several parties such as the local authority or industry. Also, in some cases

it is the responsibility of the producer to provide recycling or reuse options, when their products become waste (EU, 2012b). Such responsibilities may rest on legislation or agreements. Irrespective of the current system's distribution of responsibility, the responsibility for all waste streams should be described unambiguously, and the responsible persons, institutions etc. should be clearly identified. A time schedule for the implementation of all the activities necessary for achieving the objectives should be considered as an important part of the waste management plan. Milestone indicators may be useful, as they allow for deviations from the time schedule to be identified in time to introduce corrective measures.

The European Union, DEFRA, Scottish Environment Protection Agency (SEPA), and related organisations have the responsibilities for the management of waste data from various institutions in the European countries, United Kingdom and Scotland respectively. They also monitor and record the amounts of waste landfilled, recycled/ composted and incinerated the progress over time and observe the impact on public health. This is a breakthrough in achieving good data gathering for waste management purposes. However, in 2012 the EU Environment Commissioner reported that the EU was still battling with lack of reliable data on waste management from some quarters (EU, 2012).

An important feature in sharing of responsibilities is to conduct an environmental impact assessment (EIA) on the proposed waste management plan. This is typical in the European Union and many developing countries (Palcznynski, 2002; World Bank, 2004; EU, 2012b). An EIA as in many EU countries is automatically required for plans and programmes which are prepared for town and country planning, land use, transport, energy, waste management, water management, industry, telecommunications, agriculture, forestry, fisheries and tourism. Prior to the adoption of a plan or programme or its submission to the legislative process, the competent authority of the member state concerned will be required to carry out an EIA and, after consulting the competent environmental authorities, to prepare an environmental report. Table 2.2 summarizes the issues.

Practice	Developed countries
Policy, legislation and environmental regulation	Clear definition of roles, jurisdictions, waste framework and waste hierarchy, enforcement of regulations (Schubeler *et al.*, 1996; EU, 2003, World Bank, 2003, UNEP, 2009)
Financial instruments	Adequate funding, taxation, user charges, private sector participation (Daskalopoulos *et al.*, 1998; Taylor, 2000; Harvie and Jagues, 2003)
Plan / strategy and implementation	Conformed to waste planning process, waste framework and waste hierarchy, national waste strategy (Sistech, 2002; SEPA, 2012; DEFRA, 2012; EU, 2012b)
Institutional, administrative capacity	Clear definition of roles and jurisdictions lower administration and institutional costs (Achangkeng, 2003; SEPA, 2012; DEFRA, 2012)
Planning and stakeholder participation	Preparation of national, regional and local waste management plans, public-private partnership (Todes *et al*., 2009; USEPA, 2010; Welsh Assembly, 2012)
Coverage, collection, recycle, reuse	Recycling, composting and re-use of waste, collaborations and partnerships (DEFRA, 2012; EU, 2012a, 2012b; SEPA, 2012)
Environmental and economic gains	Economic incentives, polluter-pays-principle environmental awareness, extended producer responsibility, resources conservation, recovery, recycle and re-use socio-economics, values and attitudes structured (Palczynski, 2002; World Bank, 2009)

Table 2:2: Framework for MSWM practices in developed countries

Source: Author's review

In 2009-10 in the UK 32.5 million tonnes of local authority collected waste was generated, less than the amount generated in 1999-2000. Between these years the generation rose, peaking in 2004-05 at 36.1 million tonnes. However, over this period the population of the UK has been increasing. The recycling, composting and reuse rate for local authority collected waste has grown from 6 per cent (1.9 million tonnes) in 1996-97 to 38 per cent (12.4 million tonnes) in 2009-10 (DEFRA, 2012).

The EU Waste Framework Directive requires the UK to recycle, compost or reuse 50 per cent of waste from households by 2020. Household waste includes household bin waste and also waste from civic amenity sites, other household collections and recycling sites. Between 2000-1 and 2009-10 household waste per person decreased by 8 per cent, with each person generating 466 kg on average. The amount of waste recycled or composted has increased, and accounted for 39 per cent of household waste in 2009-10. There has been a year on year decrease in the amount of non-recycled waste per person over recent decades. It is now at the lowest level since estimates were first made in 1983- 84, most of this goes to landfill (DEFRA, EA, SEPA, Welsh Assembly, 2012).

2.5 Practices for Municipal Waste Management in Edinburgh (Scotland)

Edinburgh is the capital and one of the largest urban areas in Scotland. The 2010 population for city of Edinburgh was 486,120 (CEC, 2010).Its attributes attract people into the city for a variety of different reasons. Legislations guiding waste management in Edinburgh include: The Environmental Protection Act 1990 which looked at different environmental impacts and regulates over a range of topics including waste on land, litter, sea pollution, general controls and conservation; The Pollution Prevention and Control Act 1999; The Waste Minimisation Act 1998; The Access to Environmental Information Bill 1999; The recycling of Household Waste Bill 1999; The Producer Responsibility Packaging Regulations; The EU Waste Electronic and Electrical Equipment Directive 2006; and Integrated Product Policy; Awareness raising projects to recycling initiatives in schools and communities.

The Scottish Government has adopted Zero Waste as a goal. In 1999, the city council spent eighteen million pounds in total: four million pounds on the collection and disposal of 240,000 tonnes of municipal solid waste which were mitigated by income of three million, two hundred thousand pounds from trade waste activity (CEC, 2000). Waste collection for disposal by CEC is transported by rail through Powderhall Waste transfer station to the Viridor operated landfill site at Dunbar, East Lothian. The site has a capacity of around 15 million cubic metres. The council operates 3 civic amenity sites at Seafield, Craigmillar and Braehead and they all have a range of collection containers for waste disposal and recycling. Collection of recyclable materials include green waste, batteries, waste engine oil, scrap metal, textiles, books etc; home composters include street paper banks, kerbside paper collection service; paper and glass recycling, scrapped cars, tyres, steel/aluminium cans.

In addition, there are private waste management firms dealing with commercial, industrial organisations; advice partnerships; not- for- profit organizations; charities; Individuals and others. The National Waste Strategy and The Waste Framework and Landfill Directive require waste disposal activities to consider impacts on human health and protection of the environment. Nevertheless, barriers preventing the implementation of the policy against a 2020 target exist such as house types in the city (including space available on streets for supplementary wheelie bins) and resistant/negative attitudes by households/firms towards waste sorting and recycling. Other considerations are bio-wastes sorting, repercussions of the landfill directive, and parliamentary sustainable waste groups recommending a tax of £35 per capita on a land fill. The Edinburgh's Lord

Provost Commission on Sustainable Development (1999) provided ten specific recommendations on the level of challenge the city was facing which included (the ones relating to waste management):

1. Setting firm targets for waste minimisation and recycling and disposing waste according to the proximity principles, and
2. Having waste reduction; recycling strategy; educational campaign; waste re-use; household and community actions among its recommendations.

An Integrated Waste Management and Open Space Strategy proposed had three integrated waste management options. Edinburgh is one of eleven designated waste areas with each area having a coordinator and involving industrial, the local councils and public stakeholders. This has increased communication between developers, planners and waste managers.

Policy barriers were noted by the Commission; Building Regulations (Scottish Executive,1999) particularly with regard to Regulations 30 and 31 which refer to the Storage and Handling of Household Waste do not require any particular rule to design buildings in such a way that waste sorting is at least encouraged; "No Planning Permission or Development Control is given without consideration of all issues pertaining with waste management"; litter minimisation and waste collection/ disposal activities need to be designed in an environmentally responsible cost-effective and Best Value manner; wide ranging and continual education and awareness programme; Involving all levels of society, industry, corporate management, the public and all other relevant organisation; education and planning; and analysis of international cities.

2.6 Summary and conclusion of chapter two

In summary, this chapter discussed municipal solid waste management in the world's developed countries. It is regarded as a major issue that always needs urgent attention by all nations. The most common best practice is premised upon the global principle of sustainable waste management approaches that promotes putting waste prevention on top of the waste hierarchy at various political levels. In addition, it justifies a framework that works, with the UK as a success story, together with the development of policies with planning roles can be very critical in promoting environmentally friendly environment.

The following points were drawn from the reviews. The most visible method of managing municipal solid waste in developed countries is the Waste Frameworks and

Directives with specific objectives to all wastes management issues. Municipal solid waste management good practice drivers include efficient waste policies, legislations and institutions with precise definitions of roles and jurisdictions. There is a clear use of a waste hierarchy. There is the promotion of a growing public awareness and political interest as well as the establishment of various regulatory frameworks over time. There is adequate funding of agencies, planning instituions and administrative capacity. There is the preparation of waste management plans at all tiered levels with environmental and economic goals and private–public participation. The next chapter reviews municipal solid waste management in developing countries.

Chapter Three

Municipal Solid Waste Management In Developing Countries

3.0 Introduction

The chapter presents a detailed examination of the rapid rising populations in the cities of developing countries generating increasing waste. It presents a critical review of the waste problems in different parts of the developing world. In addition, the reasons for the failure of municipal solid waste management in developing countries provide the basis for the research framework. Finally the chapter is organised around policies in Africa, on countries with similar characteristics to Nigeria, analysing them within the context of the key question of the thesis.

3.1 The municipal solid waste problem in developing countries

Haphazard (unplanned) urbanization with accelerated growth of urban population, increasing economic activities, policy inadequacies, weak institutional and legislative framework, weak enforcement of existing legislation, low capacity and capability as well as poor funding it is argued have complicated the problems of solid waste management in the developing countries of West Africa especially Nigeria (UNEP, 1996; Sridhar and Onibokun, 1997; Daskalapoulos *et al*.,1998; McCarthy, 2001; Estevez, 2003; UNCHS, 2006; USEPA, 2010; Fobil *et al*, 2010) These are discussed in detail in this chapter.

In addition, in 1975, the Economic Community of West African States (ECOWAS), identified some environmental protection issues (ECOWAS, 1991) by recognising the poor state of the environment of West African countries and the need for urgent attention in "sustainable management of resources and good governance of the environment" (EEP, 2008, 1). Urban areas are the main focus when it comes to problems of municipal solid waste management. The ability of developing countries especially African governments and authorities to keep up with this urban growth remains minimal. In Nigeria, the average waste generation rate was 5.5 kilograms per person per day in 1997 (Onibokun, 1997). In Asia, Africa and Latin America, cities are growing rapidly, fuelled by large-scale rural-urban migration and natural increases within the cities (Onibokun and Kumuyi, 1999). According to AfDB(2002), the urban population in these regions grew more than fivefold from 346 million in 1950 to 1.8 billion in 1995, and even though Asia and Africa are relatively less urbanized, they both have very large urban populations and rapidly growing cities (Ahmed and Ali, 2004). Current projections show that most of the world's future population growth will take place in developing countries

with more and more people in the urban areas (World Bank, 2002, 2003; Hoornweg and Bhada-Tata, 2012). As noted by the United Nations, "A combination of large starting populations and a projected rate of urban population growth that remains relatively high over the next 25 years will result in a marked increase of the urban populations in both Asia and Africa. As a result, Asia will rank first and Africa second in terms of the number of urban dwellers in 2030". (UN-DESA, World Population Revision, 2005: online)

The rapid urbanization which is currently occurring in the developing parts of the world has many positive impacts including economic growth and modernization but it is also accompanied by problems of a social, economic and environmental nature. Thus, cities in theses countries not only grapple with socio-economic problems such as poor shelter, unemployment, poverty and misery, there are also mounting environmental problems including poor sanitation and water quality, slum development and a worsening solid waste situation that have become great challenges to municipal authorities (Ibiebele, 1986; Onibokun, 1999; World Bank, 2002, 2003; Zurbrugg, 2003; UNDP, 2004; Hoornweg and Bhada-Tata, 2012). In particular, the urban solid waste situation in most poor countries is worrying. The growing consumption of products among the rapidly increasing urban populations is leading to mounting waste generation. However, the municipal solid waste problem is not only limited to cities in poor countries.

The United Nations Centre for Human Settlement (UN-Habitat) in 2002, raised concerns about the solid waste situation in poor country cities in the following words: "The need for the collection and disposal of solid waste in urban settlements is far from adequately recognized. Uncollected refuse accumulates in drains, roads and open spaces, disrupting community life and creating additional problems in the operation of other public services" (Habitat 2002:online). However, the municipal solid waste problem is not only limited to cities in poor countries.

3.1.1 The municipal solid waste problem in Africa

Studies from different parts of Africa, especially West Africa have documented the scale of this municipal solid waste problem in major cities. In 1989 for example, Adelibu and Okenkule investigated the solid waste situation in Nigeria's commercial capital Lagos, where they found that: "… in many parts of the city, streets are wholly or partially blocked by municipal solid waste. Similarly, open spaces and marketplaces are littered with solid waste. In most cases, drains are clogged or totally blocked and many compounds are hemmed in by solid waste" (cited in Achangkeng, 2003, 16). Another

Nigerian city reported to have a severe municipal solid waste problem is Port-Harcourt, River State. According to Palczynski and Scotia (2002) the city which was once known as the "Garden City" for its trees and clean streets has now gained the nickname "Garbage City" because of the dire waste situation which now characterizes it. Still in West Africa, the Senegalese capital, Dakar has a very poor waste disposal situation. Home to some three million out of the 8.5 million Senegalese, the city of Dakar produces about 1,100 tonnes of solid waste each day but most of the waste remains uncollected (Palczynski and Scotia, 2002). According to Palczynski and Scotia (2002:12), "discarded paper, fruit skins, old cloths and other wastes have become part of the landscape of the West African town where just about every street is lined with waste and overflowing refuse bins go unemptied for many days".

In a four-city study of 'Urban waste and governance in Africa'sponsored by Canada's International Development Research Centre (IDRC) in 1999, which investigated the solid waste situations in Abidjan (Cote d'Ivoire), Ibadan (Nigeria), Dar es Salaam (Tanzania) and Johannesburg (South Africa), all the investigators found the solid waste situations in the cities to be abysmal. Onibokun and Kumuyi (1999) who investigated the topic in Ibadan found the Nigerian city to be contaminated with decomposing solid waste which could be found everywhere in the city including the streets, drains and water bodies. Generalizing for Africa, the co-authors observed that, "a visit to any African city will reveal aspects of the solid waste problem such as heaps of uncollected garbage, roadsides littered with refuse, streams blocked with junk, waste disposal sites constituting a hazard to residential areas and inappropriately disposed toxic waste" (Onibokun and Kumuyi, 1999, 2-3).

Similarly in Abidjan, Cote d'Ivoire (Ghana's western neighbour), Koffi Attahi (1999) found that only some 54 percent of the solid wastes generated by residents of the capital city were removed for disposal with the remaining waste piling up in mounds all over the city and clogging drains and streams. Likewise in Johannesburg, South Africa, Swilling and Hutt (1999) who took part in the IDRC sponsored four-city study reported waste collection in the city to be inadequate, giving rise to waste accumulations with implications for public health and the environment, and Kironde (1999) who investigated the topic in Dar es Salaam, Tanzania, reported that most parts of the city never benefited from a public waste disposal service. He quoted several East African newspapers including the *Sunday News* (Nov. 2, 1998, 5) and the *African Event* (Nov. 1985, 3-5) which referred to Dar es Salaam as a 'garbage city' and a 'litter city' respectively and the

Weekly Review (Jan, 25, 1985, 2-3) which referred to Nairobi as a "city in a mess" due to the appalling waste situation. Kironde also reports that in most urban areas in Tanzania, only a fraction of the waste generated is collected and safely disposed of by the municipal authorities.

According to Kironde (1999, 102), "common features of African urban areas are stinking heaps of uncollected waste; waste disposed of haphazardly by roadsides, in open spaces or in valleys and drains; and waste water overflowing into public lands". Other studies have presented similar findings. In a UNEP-commissioned study of waste management in Kenya in 2001, the investigators reported that: "In Nairobi, like many developing country cities, the solid waste sector is largely characterized by low coverage of solid waste management services, pollution from uncontrolled dumping of waste, inefficient public services, chaotic or unregulated private sector participation and a lack of key solid waste management infrastructure" … "Not surprisingly therefore, only 23 per cent of the estimated 1500 tonnes of solid waste generated daily get collected in Nairobi, a city of about three million people. Furthermore, the city is surrounded by four fast growing satellite towns which do not have waste disposal facilities" (UNEP, 2001: online). In Kumasi, Ghana, a study by Devas and Korboe (2000) showed that most areas of the city had inadequate waste collection services in addition to other environmental problems.

3.1.2 Municipal solid waste management in Africa: An overview

Until the late 1980s, municipal solid waste management in most parts of Africa had practically no nationally co-ordinated institutional or policy framework to rest on (AfDB, 2002). Though municipal authorities were often required by law to carry out this function, most of them lacked the capacity to do so (Akpofure and Echefu, 2001; Walling *et al.,* 2004). Quite often therefore waste management is very low in their priority list. In the few cases where supervisors were assigned municipal solid waste management functions within local authorities, they seldom had the full complement of qualified staff, such as planners, managers or field and technical staff to work with (Agunwamba, 1998). Since most municipal solid waste personnel in these organizations were almost always low cadre staff, they lacked the capacity to influence funding decisions. This often results in severe inadequacies in funding and consequently diminished operational capabilities (Cointreau, 1982; Henry *et al.,* 2006). As a result of increasing awareness of the deleterious effects waste has on the environment and positive changes in the socio-

economic circumstances of some countries in the region, governments are beginning to put in place policies, programmes and institutions to enhance the management of municipal solid waste at all levels (ECOWAS, 1991; Olowomeye, 1991; Chokor, 1993; IPCC, 2006).

In order to understand current municipal solid waste characteristics and management practices across the region, especially countries with similar municipal solid waste management systems to Nigeria, a country based-review is necessary in line with the principal aim of this research. Consequently, municipal solid waste institutional frameworks in three countries representing the regions of Africa: Ghana, Kenya, and South Africa are now briefly reviewed.

3.1.3 Historic Perspective on Municipal Solid Waste in Ghana

Since independence in 1957, Ghana's environmental policy, like that in most west African countries has followed European models, with market friendly, large scale industrial development (Issahaku, 2000). Ghana's regulatory authority, the Environmental Protection Council (EPC) was created in 1974, followed by the enactment of the Provisional National Defence Council (PNDC) Law 116 in 1985, later replaced with Provisional National Defence Council (PNDC) Law 207 of 1988 which made District Assemblies responsible authorities for matters relating to environmental management (Fobil *et al*., 2010).

Despite the creation of the EPC in 1974, there was no formal procedure for environmental assessment in Ghana until 1994, when the EPC changed into the Environmental Protection Agency through an Act of Parliament. This became necessary with the establishment of a fully-fledged Ministry of the Environment charged with policy issues at the national level (Ahorttor and Asiamah, 2000). Earlier in 1988, Ghana established its Environmental Action Plan, a policy document that dovetailed into Ghana's Structural Adjustment Programme (SAP) which strongly emphasized sustainability in agriculture, forestry, mining and manufacturing. Despite these strides, core issues bordering on sustainable management of municipal solid waste remains largely unaddressed in any concerted manner to date (Fobil *et al*., 2010; Hoornweg and Bhada-Tata, 2012).

According to Edoho and Dibie (2000), this situation can hardly be attributed to an absence of policy and institutional frameworks. Most possibly, the Ghanaian situation is

a result of failure of established frameworks to manage human, physical and financial resources so as to achieve desired objectives.

3.1.4 Historic Perspective on Municipal Solid Waste in Kenya

Overall responsibility for solid waste management in Kenya rests with the Ministry of Environment and Natural Resources (MENR) and the Ministry of Local Government (Njagi *et al*., 2013). The main responsibilities of these ministries as regards waste management include environmental legislation, policy formulation, monitoring and evaluation, issuance of licences and permits to waste operators and environmental standards enforcement. As in most countries, local authorities are primarily charged with the responsibility for waste collection, transfer, resource recovery, recycling and disposal within their jurisdiction (Rotich *et al*., 2006). Estimates by USAID and World Resources Institute (WRI) show that these authorities were only able to collect and dispose of 50-70% of their municipal solid waste, spending over 30% of their annual budget in the process in 1992 (KDHS, 2010).

Kenya has no engineered landfills, hence municipal solid waste disposal is carried out in open dumps with attendant deleterious environmental consequences (Njagi et al., 2013). Municipal solid waste management in Kenya is still very highly centralized with operational decisions often having to wait for senior management in most council environmental departments (Rotich *et al*., 2006). This often results in long delays before the simplest of tasks can be carried out. A few local councils in Kenya have entered into contractual agreements with private waste operators to complement the efforts of council waste departments (Njagi *et al*., 2013).

3.1.5 Historic Perspective on Municipal Solid Waste in South Africa

South Africa's premier policy document on integrated pollution and waste management, "White Paper on Pollution and Waste management**"** was published 2000. This document encapsulated the overall waste management objectives of the country (AfDB, 2002). Though the document had a clear strategy for the management of unavoidable waste, the cardinal policy thrust of the document is based on the concept of waste prevention, minimization and resource efficiency. Before the adoption of this policy document, overall responsibility for the implementation of South Africa's waste policy was scattered amongst several governmental institutions sometimes with conflicting interests and objectives. This piece-meal implementation strategy had often proved counterproductive (Hoornweg and Bhada-Tata, 2012). Under the policy a

nationally co-ordinated approach to waste management has been adopted thereby streamlining waste legislation and implementation by various organs of government. As part of this reform the Ministry of Environment, with a sub-department dealing with pollution and waste management, has been created as the apex governmental organization on waste related issues..

3.1.6 The municipal solid waste problem in other continents

The waste accumulation problem is not only limited to African cities. Asian and Latin American cities equally face daunting solid waste problems. In 1994, a survey conducted by Ghosh and others (cited in Hardoy *et al.*, 2001, 80) in Baroda, Bhilwara, Sambalpur, and Siliguri (all in India) pointed to "great inadequacies in the provision for rubbish collection as well as for water, sanitation and drainage".

The urban waste situation in Latin American cities seems to be much better than in Africa and Asia. For instance, while most African and Asian cities have very low levels of waste collection, about 70 percent of the population in many Latin American cities are reported to have waste collection services (Hardoy *et al*., 2001). This is not to say that Latin American cities have no problems with waste disposal. Arreaza, (online), for example, has observed that: "waste accumulation is one of the biggest environmental concerns in Latin American cities and is a key contributor to the urban environmental crisis that many Latin American cities face. Despite several programs and studies about the problem and potential solutions such as recycling, the concern remains" Hardoy *et al*. (2001) also report abysmal waste situations in a number of Latin American cities including Bogota (Columbia), where some 2,500 tonnes of solid waste is left uncollected every day and is simply left to rot in small tips or in canals, sewers and streets; and Sao Paolo (Brazil) where one-third of the population is living in areas without any service to collect solid waste. Furthermore, 70 per cent of waste collected in the municipality of Sao Paolo is said to be improperly discarded in terms of both the treatment process and the location of waste dumping areas. Hardoy *et al*. (1993; 2001) have provided statistics on the levels of waste collection in selected cities across the developing world (Table 3.1) which shows abysmal performances.

Country/ City	Percentage of solid waste collected	Year
Ghana (Accra)	10	1989
Ethiopia (Addis Ababa)	60	1998
India (Ahmedabad)	65	2000
India (Baroda)	05	1994
Uganda (Kampala)	10	1993
Ghana (Kumasi)	30	2000
Nigeria (Ibadan)	40	2003
Namibia (Windhock)	73	2003
Zambia (Lusaka)	10	1997
Kenya (Mombassa)	40	2000
Burkina Faso (Ouagadougou)	30	1995
Brazil (Sao Paolo)	70	1998
Nigeria (Lagos)	8	2003
Latin American cities	60-70	1999

Table 3:1: Municipal solid waste collection in selected cities in developing countries

Source: Hardoy et al., 1993, pages59-60; Hardoy et al., 2001, pages80-81; Achankeng, 2003, pages 7-8

In Sri Lanka, Perera's (2003) overview of solid waste management in major cities reported that solid waste management was a major problem. Perera described Colombo, the capital city, as "facing a crisis situation" with regard to the disposal of around 1500 tonnes of solid waste materials per day. He found illegal dumping of solid waste on roadsides, vacant lots or river banks to be some of the problems associated with solid waste management in Colombo and other Sri Lankan cities. Furthermore, Perera (2003) observed improper discharge of garbage which led to poor sanitary conditions and waste-clogged drains in the cities with associated health problems.

In 2007, a study of the urban solid waste situation in the eleven countries that form the Asian Productivity Organization (APO, 2007) showed that solid waste management is a major challenge in Asian cities. The report of the study which was edited by the Environmental Management Centre – Mumbai, India showed that:

> "despite huge expenditures in waste management, urban areas in most APO member countries (Bangladesh, China, India, Iran, Malaysia, Nepal, Philippines, Singapore, Sri- Lanka, Thailand and Vietnam) are still grappling with the challenge of preventing environmental degradation due to the non-systematic solid waste management. Solid waste has therefore

> become an important concern in the Asia Pacific Region and it needs to be resolved through an integrated community, private sector and policy based approach". (APO, 2007, 6).

Similarly, a study of waste management operations in 35 Indian cities with more than one million populations was conducted by the Federation of Indian Chambers of Commerce and Industry in February 2007 which showed that most cities in the country fared badly in handling solid waste (FICCI, 2007). China, with its speedy industrial development, seems to have left the waste problem largely unsolved. Liu (2007: online), has observed that:

> "As China undergoes its historic drive towards industrialization, it is also witnessing the rapid accumulation of urban garbage. The nation's 668 cities generate an estimated 150 million tons of rubbish each year, accounting for roughly one-third of the world total. Currently, as much as 7 billion tons of this garbage remains untreated and two thirds of China's cities have been inundated by rapidly spreading garbage mounts" (Liu, 2007:online).

3.1.7 Variations in the municipal solid waste problem

The analysis of the problems above has shown that, even though cities in developing countries generally have low levels of municipal solid waste collection and disposal, there seems to be great variations in the scale of the waste problem across regions and countries (Hardoy *et al*., 2001). Regionally, Latin American cities appear to have better environmental management than African and Asian cities. This is reflected in the high level of waste collection with up to 70 percent in some cases in Latin American cities compared with the very low levels of waste collection in African and Asian cities as shown in Table 3.1. What this means is that while all developing country cities grapple with municipal solid waste collection and disposal, some are doing relatively better than others. Regionally, Africa seems to have the worst situation with regard to municipal solid waste management (Hoornweg and Bhada-Tata, 2012).

While city authorities in developing country cities are generally unable to provide adequate solid waste disposal services within their jurisdictions, the literature on the topic also shows that there are spatial disparities in the scale of the waste disposal problem within cities. These disparities are socio-spatial in nature as waste collection services are concentrated in, if not confined to, official areas and wealthy residential neighbourhoods

while the low-income communities receive little or no attention. In particular, many writers have described solid waste collection services in the cities which show enormous disparities between rich and poor residential areas. In the IDRC sponsored study of *Urban waste and governance in Africa* (cited above), Koffi Attahi (Abidjan), Onibokun and Kumuyi (Ibadan) Kironde (Dar es Salaam) and Swilling and Hutt (Johannesburg) all reported enormous disparities in the qualities of waste disposal services provided by municipal authorities for residents of the cities that they investigated.

In the East African city of Dar es Salaam, Tanzania, Kironde (1999) found that the collection of solid waste is usually confined to the city centre and high-income neighbourhoods while other areas never benefit from public solid waste disposal. Consequently, most residents of the low income areas in the city have to bury or burn their waste or dispose of it haphazardly. From Johannesburg in the extreme south of the continent, Swilling and Hutt (1999, 179) also reported "a highly uneven distribution of resources for the delivery of solid waste service". According to them, the legacy of apartheid policies has led to massive differences in the quality of service between rich/white and poor/black areas of Johannesburg. From Abidjan in West Africa, Koffi Attahi (1999) reported an arrangement for waste removal which favours the rich with a very regular home collection service but neglects the waste collection needs of the poor, leaving them to bear the filth.

A study by Songsore and McGranahan (1993) of household environmental problems in the Greater Accra Metropolitan Area (GAMA - Ghana) also found that the areas most affected by the non-collection of solid wastes were the poor residential settlements, commercial areas and lorry stations which constitute the living and working places of the low income populations. The co-authors observed that the wealthy and formal residential areas which enjoy regular waste collection services in the city are largely occupied by wealthy and influential government officials, businessmen and professionals. Also in Kumasi, Ghana, Devas and Korboe (2000) found that the waste collection service provided by the metropolitan authorities was skewed in favour of a small group of wealthy residential areas where home collection was very regular. In poor neighbourhoods in the same city, however, most residents only had access to an erratic communal skip service, frequently located at great distances from some residential units. Moreover, many peripheral communities in Kumasi had no service, compelling households to dump their waste in any available space (Devas and Korboe, 2000).

Other examples of the spatial disparities in the quality of waste disposal services within cities abound in the literature. In Ibadan, Nigeria, Onibokun and Kumuyi (1999) found that the Ibadan Urban Sanitation Committee (IUSC) which is responsible for solid waste management in the city covered the relatively better off local government areas of the metropolis. The rest of the metropolis was without any waste collection service and residents used every means convenient to dispose of their refuse. Again in Nigeria, a study by Meekyaa and Rakodi (1990) in the towns of Aliade, Ihugh and Ugba, revealed that while refuse disposal is a local government responsibility, this was not performed effectively with refuse collection services limited to wealthy neighbourhoods. Consequently, most households had no waste removal services and dumped refuse in their backyards, burnt it or buried it.

Achangkeng's (2003) study of Yaoundé, Cameroon, also revealed that the authorities failed to remove large amounts of solid waste trapped in inaccessible residential quarters inhabited mostly by lower-income members of the population even though wealthy neighbourhoods received regular services for waste removal. In Nairobi, Kenya, a report written in 1994 noted that house-to-house collection was provided in formal settlements while in the informal settlements, collection was limited to clearing large piles of waste when they became a health hazard, and even this was not undertaken regularly. Poor areas in the city were therefore heavily littered with refuse and contaminated with rotting waste with attendant health risks (Alder, 1995, cited in Hardoy *et al*., 2001). Even though Latin American cities are reported to have better waste collection rates, Arroyo *et al.* (1999) and Ferguson (1996) (both cited in Hardoy *et al*., 2001) found that in most cities in the region, it is usually the high and middle income areas that enjoy regular waste collection service while the low-income neighbourhoods can count only on erratic services, if any at all. In Montego Bay (Jamaica) for example, waste is meant to be collected from all residential areas twice a week but the actual frequency of collection is said to vary from twice a week in formal sector residential areas to never in some of the largest informal settlements (Ferguson, 1996, cited in Hardoy *et al*., 2001).

The socio-spatial disparity in waste collection service provision is, therefore, a common occurrence in developing country cities. The abysmal waste situations in developing country cities can have enormous implications for public health and the environment. The decomposing piles of wastes, especially in communities of the poor, have the potential to attract and harbour vermin and rodents which spread diseases

(Hardoy *et al*., 2001). Moreover, solid waste materials that find their way into water courses like drains, streams and lagoons block the flow of flash waters during storms and cause extensive flooding in some of these cities (Zahari, 2007). Waste pollution in the cities also causes the pollution of both surface and underground water and cause damage to natural ecosystems (Perera, 2003).Thus, the poor solid waste situation in the cities "constitutes a disaster for human health and environmental degradation" (Achankang, 2003,7-8).

3.2 Reasons for Limited Waste Management Solutions

Several factors that militate against municipal solid waste management efforts in developing countries have been identified by researchers (UNCHS, 1996; Onibokun, 1999; World Bank, 2002, 2003; Zurbrugg, 2003; UNDP, 2004; Hoornweg and Bhada-Tata, 2012). These factors, according to the researchers, frustrated the waste management efforts of municipal authorities in developing country cities and made it difficult for them to keep their city environments clean and safe for the populations. After studying the solid waste problem in Tanzania, Kironde (1999) attributed the abysmal performance of the waste sector to resource constraints including the scarcity of financial, physical, human and technical resources for the organization of waste management operations. In a study of the solid waste problem confronting the city of Kampala, Uganda, researchers from the Namilyango College (2001) identified several causes of the waste problem including the lack of dumping sites, ignorance of the masses about the need for proper waste disposal, inefficient collection methods, poor government attitude towards waste management, the poverty of the people, corruption among public officials and the lack of trained personnel for waste management. These have posed serious constraints to the waste sector and dampened efforts towards waste management in the city. Many other writers have elaborated on how the factors mentioned above and others interact to aggravate the solid waste problem in poor country cities. What follows from here is a detailed examination of the factors responsible for the abysmal waste situation in developing countries.

3.2.1 Financial and economic constraints

Many writers have cited the scarcity of funds as a major constraint to solid waste management in all developing countries (Cointreau, 2001; Ogawa, 2002; Lohse, 2003; Pacione, 2005). Lohse (2003:4) has described the problem of municipal finance in developing countries as "the gap between financial resources and municipal expenditure

needs". According to him, this fiscal gap is widening as urban populations expand, increasing the demand for infrastructure and services including waste disposal. Lohse (2003:4) explains that one reason for the municipal finance gap is that:

> "most municipalities lack the autonomy to establish their tax basis, rate structures, and enforcement procedures, and so cannot raise revenues commensurate with their expenditure requirements".

In the context of Nigeria, Onibokun and Kumuyi (1999) have blamed the lack of fiscal autonomy among municipal governments on excessive central government control of the lucrative sources of revenue, a situation which leaves local governments with few options. Ogawa (2002) has also observed that the finance problem in developing countries is most acute at the municipal government level where the local taxation system is inadequately developed and therefore the financial basis for public services is weak. He attributed the problem of finance to the low capacity of local governments for cost recovery and their heavy reliance on state subsidies for waste management operations. This view is corroborated by Attahi (1999) who investigated the waste problem in Abidjan, Cote d'Ivoire, and found that even with an elaborate system of taxes and levies such as the drainage tax levied on landed properties, state subsidies sustain most municipal programmes including waste management. According to his study, only 30 percent of the cost of waste management is recovered in Abidjan. Zurbrugg (2002) maintains that the low fees usually charged for waste collection and insufficient funds from central municipal budgets cannot finance adequate levels of service.

Investigating 'urban waste and governance' in Ibadan, Nigeria, Onibokun and Kumuyi (1999) found that the lack of funds and other resources had turned many of the urban councils and municipal planning authorities into "purposeless bodies" and a "drain on the regional/state governments" as they are unable to perform their duties (Onibokun and Kumuyi, 1999). The authors quoted various sources to reveal the challenges facing local councils in Ibadan and other Nigerian cities:

> "they are perpetually in debt and are basically underfunded; their patterns of expenditure do not reflect a defensible set of priorities; the local governments have little concern for cost effectiveness and avoidance of waste; their financial controls are ineffective; and, their financial information often comes too late or is too obscure to be useful" (Onibokun and Kumuyi, 1999, 88).

These constraining characteristics greatly hamper the ability of local governments in the country to perform waste management and other responsibilities. Ahorlu (2006: online) has also reiterated the finance problem of municipal waste departments and how it affects waste management operations in African cities. In his paper '*Waste management in Africa – a look at institutional constraints, hazardous waste and public-private partnership options',* Ahorlu (2006: online) observed that the "provision of adequate funding for solid waste management on an ongoing basis is a major problem in African cities". In his view, the fact that the huge amounts of money required for running municipal waste management operations usually come from limited municipal budgets calls for efforts to improve the overall municipal financial systems. Cointreau (2001) has also observed that in spite of the deplorable waste situation in poor country cities, it is common for municipalities to spend 20-50 percent of their available recurrent budget on solid waste management alone. This observation is corroborated by Devas and Korboe (2000) in their study in Kumasi where they found waste management and sanitation to be the largest local public sector cost, with refuse trucks alone consuming 45 percent of the city's recurrent expenditure. On their part, Tagoe *et al.* (2005: online) have attributed the finance problem of poor city governments to a lack of good financial management and planning among municipal governments. According to the authors, the lack of financial management and planning particularly cost accounting, *"depletes the limited resources available for the waste sector very quickly and causes the solid waste management services to be unreliable, thus losing the trust of service users".*

Another reason cited for the poor financing of the resolution of solid waste is that urban environmental management in general, and solid waste management in particular, is given a very low priority in developing countries (Onibokun and Kumuyi, 1999). As a result, very limited funds are usually provided to the sector by both national and local governments and the level of service required to protect public health and the environment cannot be attained (Ogawa, 2002). Armah (1993) has also attributed the financial difficulty of municipal governments to over reliance on central government subventions for the provision of municipal service. According to him, any organization that relies so much on central government subventions to operate a waste management service is bound to fail because such subventions are often limited and unreliable. As a solution to the crippling municipal financial problem, Lohse (2003) has suggested a number of sources from which local governments may raise revenue for municipal infrastructure and service

finance including internal and external sources (see Table 3.2) but many urban governments seem unable to take advantage of the situation.

Sources				
Internal sources			External sources	
Land-based revenues	Non-land-based revenues	User charges	Intergovernmental transfers	Borrowing
Property taxes	Taxes on households, vehicles, animals, etc	Service charges (water, parking, sewerage, waste etc)	General purpose grants, regular transfers or formula-based shared taxes	From governmental sources
Land fees	License fees for various businesses and occupations.	Administrative fees such as building permits, registration etc.	Grant for specific purposes	From private capital markets (including international markets)

Table 3:2: Sources of local government revenues

Source: Lohse, (2003)

While some of the sources are already being explored, corruption and inefficiency usually constrain efforts to raise revenues (Armah, 1993; Ogawa, 2002). Besides, the technical capacities the political will to raise revenues from the sources suggested by Lohse (2003) seems to be lacking among many municipal governments across the developing world.

Closely related to the problem of finance are economic constraints which also militate against effective solid waste management in developing countries. Ogawa (2002) has observed that economic and industrial development play key roles in solid waste management because an enhanced economy provides a more sustained financial base and enables more funds to be allocated for solid waste management while a sound industrial base enables a country to produce suitable but inexpensive equipment for waste management. By their nature, however, developing countries have weak economic and industrial bases and are unable to provide the financial and logistical resources for sustainable development of solid waste management systems. In Ogawa's view, the lack of local industries to manufacture suitable but inexpensive solid waste management equipment is responsible for the importation of expensive, yet frequently unsuitable, equipment/vehicles which also drain the scanty foreign exchange of poor countries. Ogawa (2002: online) therefore concludes that "the low industrial base and limited

foreign exchange for the importation of waste management equipment are major causes of the solid waste problem confronting poor countries".

Another important way in which the low industrial base harms the solid waste sector in developing countries is the low market for recyclable waste materials (Hanrahan *et al.*, 2006). Waste recycling projects are affected by the availability of industry to receive and process recycled materials. However, the low industrial base of most developing countries fail to provide ready markets for recyclables and can therefore be regarded as an obstacle to the development of recycling projects which could significantly reduce the volume of waste lying on the streets or going to landfills. From the above analysis, the poor solid waste situation in developing country cities can partly be attributed to the low financial capacity of municipal governments and the weak industrial base of these countries.

3.2.2 Inadequate personnel/training for waste management

The poor waste management situation in developing counties has also been attributed to the general dearth of qualified personnel in the waste sector (Onibokun, 1999; Ogawa, 2002). According to Onibokun (1999) most municipal authorities are unable to attract suitably qualified personnel for the various aspects of waste management such as planning, operations and monitoring. Ogawa (2002) corroborates this observation when he notes that developing countries characteristically lack the technical expertise required for solid waste management planning and operation, and this is usually the case at both national and local levels. He argues that many officers in charge of solid waste management have little or no technical background training in engineering or management. Without sufficiently trained personnel, however, solid waste management projects cannot be effective and sustainable. Ogawa (2002) has observed that in many cases, solid waste management programmes initiated by external consultants have collapsed in the hands of local management due to the lack of expertise and loss of funding. Lohse (2003) has also observed that local governments in developing countries generally lack the required capacity and technical expertise to accomplish effective and sustainable waste management programmes. Several studies in Africa and elsewhere in the developing world confirm the dearth of qualified waste management personnel and how this results in failure to undertake effective and sustainable waste management in the cities. One example was the study carried out by researchers at the Namilyango College in Kampala (Uganda) who found that the failure of waste management programmes in

Kampala and other Ugandan cities was largely the result of a lack of trained manpower/personnel to execute waste management programmes. Kironde (1999) also found that human resources for waste management in Dar es Salaam were very inadequate in terms of managerial and technical staff and even labourers.

The lack of qualified waste management personnel has been blamed on the lack of training and poor conditions of service in the sector. Generally, employees in the waste sector are poorly paid and have very poor conditions of service which makes many people shun jobs in the sector, including labourers (Kironde, 1999). Thus, besides the difficulty of attracting professional waste management staff, it is also difficult to attract labourers to the waste sector in spite of the high levels of unemployment in poor country cities (Onibokun, 1999; Kironde, 1999). The unwillingness of people to work in the waste sector has also been attributed to meagre wages for the cleansing staff in spite of the tedious work they do. Kironde (1999), for instance, cites examples from Tanzania where wages for waste workers are very low even though they work for long hours. Majira (cited in Kironde, 1999:160-161) reports that in July1995, waste workers in Dar es Salaam, went on strike to protest against poor working conditions. These included the lack of protective gear and the fact that they were all casual workers even after a year of being employed, and therefore had no other benefits apart from receiving their low daily wages.

In Kampala, waste labourers are also said to work under very dehumanizing conditions, sometimes loading waste trucks with bare hands or using polythene bags as gloves (Namilyango College study, 2001). In Asian cities, Hanrahan *et al.,* (2006) have reported the general lack of institutional and managerial capacities for urban environmental management among municipal governments. Many other examples exist of the poor working conditions in the waste sector in developing countries and how this affects the ability of municipal authorities to attract qualified staff and labourers alike. The general shortage of staff in the waste management sector of developing countries is also connected with the low esteem accorded waste management personnel (Onibokun, 1999). In most cultures, there is a negative public perception regarding work which involves the handling of filth (Hanrahan *et al.,* 2006), a situation which may be influenced by the practice in many developing countries where households without toilet facilities dispose of human excreta together with household solid waste (Songsore and McGranahan, 1996; Hardoy *et al*., 2001). This situation leads to disrespect for waste and

sanitation work and in turn induces low morale among waste labourers (Ogawa, 2002). The lack of public appreciation and respect for waste management jobs makes many people, even the poorly-educated and unemployed, reluctant to take up employment as waste labourers. It therefore seems that developing countries will continue to struggle with the implementation of their waste management programmes unless they train and motivate staff for the sector.

3.2.3 Inappropriate technologies and inadequate process constraints

The technologies employed in municipal solid waste management in most developing countries are also said to be inappropriate and inadequate. Zurbrugg (2002) has observed that adoption of the conventional waste collection vehicles used in rich countries constrain solid waste management operations in developing countries. Apart from the high acquisition and maintenance costs involved, developing countries actually lack the engineering capacity to support the operation and maintenance of such sophisticated equipment like compactors and skip lifts. Yet, this is the equipment usually employed by municipal authorities and private sector waste contractors in many poor countries (Armah, 1993; Achangkeng, 2003). The high cost of new equipment compels many poor country municipal governments to import used equipment from western countries. Such vehicles arrive already near the end of their useful life and so frequently require repairs due to breakdowns. In the absence of spare parts and the required engineering skills to maintain the trucks, only a small part of the fleet usually remains in operation after a short period of their use (Achangkeng, 2003). In Tanzania, Kironde (1999:153-154) found that the shortage of equipment was a major problem facing the waste disposal operations of the Dar es Salaam City Council. Onibokun and Kumuyi (1999) have also noted of Ibadan and other Nigerian cities that equipment for waste management are unavailable in the desired quantities and the existing ones are difficult to maintain due to lack of expertise and funds to purchase the needed spare parts. At the time of their study in 1999, only about one-third of the 43 pieces of equipment for the Ibadan waste management office were in working order. In Uganda, the waste management department in the capital city, Kampala, was said to lack basic equipment like trucks for waste collection and equipment for maintenance of disposal sites (Namilyango College, 2001). Besides the shortage of suitable equipment, the poor spatial organization of many developing country cities, characterized by unplanned housing developments, poor road quality and poor access within settlements does not support use

of the large and heavy western type waste collection vehicles (Armah, 1993). Usually, the large waste trucks cannot gain access to many unplanned residential areas due to poor roads (Hardoy *et al*., 2001; Peter *et al*., 2014). There is, therefore, the need to design and manufacture appropriate but inexpensive waste management equipment that is suitable for the conditions in developing countries. This calls for research into waste management technologies that will suit local conditions.

3.2.4 Institutional constraints

Inefficient institutional arrangements adversely affect urban management in poor countries generally and environmental service delivery in particular (UN-Habitat, 1989; Ogawa, 2002; Zurbrugg, 2002). According to UN-Habitat (1989), it is characteristic of developing countries to have several agencies involved in the delivery of solid waste and other municipal services. Furthermore, Ogawa (2002) has observed that there are often no clear roles or functions of the various agencies involved in urban environmental management. At the same time, no single agency is usually designated to coordinate the activities of waste sector agencies (Armah, 1993; Attahi, 1999). Ogawa (2002) has, therefore, observed that the lack of coordination among the relevant urban sector agencies often results in different agencies duplicating one function. In the case of externally supported solid waste management projects, it is common for different agencies within the same country or city to act as counterparts of external support agencies for different waste management projects without any collaboration of efforts (Ogawa, 2002). Institutional inefficiencies of this nature can lead to duplication of functions, gaps in service delivery and waste of already scarce resources, or even the collapse of solid waste management programmes (UN-Habitat, 1989). Zurbrugg (2002) has also noted deficient capacities of institutions involved in urban environmental management in poor country cities. Solving the waste problem in poor cities will, therefore, require improvements in the institutional arrangements and capacity building for waste management and other aspects of the urban environment. Ogawa (2002) has suggested that in large metropolitan areas where there is more than one local government, coordination among the different local governments and among agencies in urban management is critical to achieving the most cost effective alternatives for solid waste management for the entire city. A recent study carried out in Jos observed that the presence of six local governments in Greater Jos is conflicting with the urban management and housing development (Dung-Gwom, 2007, 2008; Wapwera, 2013; Mallo, 2014; Peter and Ayuba, 2014).

3.2.5 Lack of legislation and enforcement

The lack of legislation on solid waste management has also been cited as being partially responsible for the undefined roles of agencies in the waste sector as well as the lack of coordination among them. In the report of their African Development Bank (ADB) sponsored literature-based study of solid waste management options for Africa, Palczynski and Scotia (2002: IV) observed that no country in Africa had specific waste management legislation by the turn of the millennium. Ogawa (2002) has also observed that legislation related to solid waste management in developing countries is usually fragmented and several acts (such as public health, local government and environmental protection acts) include clauses relating to solid waste management. A case in point is that of Dar es Salaam which reportedly had 58 pieces of legislation dealing in one way or the other with the environment including solid waste (Onibokun, 1999). Such rules and regulations are therefore, to be enforced by different agencies with a duplication of responsibilities and gaps in the regulatory provisions that constrain the development of effective solid waste management systems. Furthermore, some of the laws are completely out of date and therefore of little use.

The lack of adequate legislation makes it difficult to assign clear mandates to urban sector institutions connected with waste management, a situation which greatly constrains the waste sector. Besides the scarcity of legislation on waste management, Onibokun (1999) has also noted the inability or unwillingness of municipal officials to enforce existing laws on environmental sanitation including the scanty legislation on waste disposal. This situation is particularly grave in the major cities where there is a general lack of public compliance with waste disposal laws (Ogawa, 2002), if they exist at all. The non-enforcement of waste disposal laws engenders lack of fear of the law among the public and encourages negative waste handling practices such as littering and dumping of waste in drains and at roadsides. Such practices worsen the waste disposal situation and increase the burdensome tasks of waste collection, transportation and disposal for the resource-constrained municipal authorities. Thus, inadequate legislation and non-enforcement of waste disposal laws greatly constrain efforts to address the solid waste problem that currently confronts developing country cities.

3.2.6 Poor urban governance and lack of effective civil society

The low status of environmental services in developing countries has also been blamed on the lack of good governance which promotes the well-being of the people, and

on the lack of civil society action to exert pressure on governments to live up to their social responsibilities (Devas, 1999; Kwawe, 1995; Hashmi, 2007). Due to 'bad governance', municipal governments in poor countries show little regard for the wellbeing of the citizens and so renege on their responsibility to provide basic infrastructure and services to keep the cities clean, healthy and safe (Hashmi, 2007). Commonly, autocratic styles of administration by supposedly democratic regimes alienate public opinion and participation in urban management (Devas, and Korboe, 2000; Hashmi, 2007), a situation which does not augur well for effective waste management. From a governance point of view, the fact that the ordinary residents of cities, especially the poor, are denied participation in decision-making about issues that affect them. It means that their concerns may never be taken on board and their needs for such services as water, sanitation and waste disposal are therefore unlikely to be met (Devas, 1999; Devas and Korboe, 2000).

The problem of poor urban governance is further compounded by the lack of effective civil society action to compel governments to enact and enforce environmental laws, and to carry out their responsibilities to the citizenry. In fact, some writers see a fledging civil society as the panacea for the ills plaguing the developing nations of the world (Cohen and Arato, 1992; Kwawe, 1995) even though others have questioned the ability of civil society to achieve political accountability in undemocratic poor countries (Devas, 1999). According to Hashmi (2007) a strong civil society is necessary for the promotion of "a robust liberal democratic order in the Third World" where governments are generally unaccountable and unresponsive to the problems of society. Hashmi sees strong civil society as a solution to the political lassitude of developing country governments. This view is collaborated by Cohen and Arato (1992) who also regard civil society as important for the promotion of democracy and rights. Recognition of the important role of civil society explains why multilateral organisations increasingly find them useful partners in promoting good governance and poverty reduction (Hashmi, 2007) and in promoting the general interest of society, having lost confidence in the state.

According to the UNDP (2005), civil society action is critical for establishing strong safeguard policies and no government can achieve sustainable development without the active involvement of a fully-fledged civil society. In spite of the important role that civil society can play in promoting good governance and the general interest of society, civil society pressure or action is generally weak in developing countries, and even non-existent in many areas. Kwawe (1995) has observed that tax-paying citizens

have the right, and in fact, the duty to call on government to maintain infrastructure and provide services where these are lacking. However, this is generally not the case in many poor countries because urban residents lack the ability to organise themselves to pressurise local governments to live up to expectation. In Uganda, the Namilyango College (2001) which investigated the solid waste problem in the city of Kampala, partly blamed the poor environmental conditions in the city on the unconcerned attitude of the public and the failure of residents to hold the authorities accountable for the situation.

Toula (2005) has also noted that even though most residents in poor country cities complain about the poor environmental conditions in their settlements, they are often unprepared to organise themselves in groups to mount pressure on the authorities to address their concerns. There is evidence that civil society pressure can compel uncaring governments to improve services for citizens. In 2003, hundreds of residents of Koalack city in Senegal staged a series of demonstrations to complain about the lack of services in their community and vowed to disrupt government programmes if their demands were not met (Toula, 2005). Unable to stand the force of the demonstrations, the city council held a series of meetings with the protestors to discuss their concerns following which substantial improvements occurred in the city's infrastructure and services (Toula, 2005). This example shows that civil society can help shape society for the better by holding unresponsive governments accountable. But, developing countries generally lack civil society. Thus, even though other factors have been cited as causing poor environmental sanitation in poor country cities, the lack of a strong civil society is also a contributory factor.

3.2.7 Political neglect

While the various factors discussed above are important contributors to the poor solid waste situation in poor country cities, some researchers find political neglect to be the root cause of the waste problem in poor country cities. Both national and municipal governments in poor countries seem to lack the political will to manage the rapidly growing cities and to provide infrastructure and services for environmental maintenance. Several studies point this out including Onibokun and Kumuyi (1999:82) who have noted the fact that "most local governments in Nigeria do not accord high priority to waste management". The authors refer to Koehn's (1992) work in Northern Nigeria which showed that waste management and general environmental sanitation ranked very low on

the priority lists of local governments with none of them including waste management among their priority functions.

In Koehn's study, the five functions that were accorded most importance by local governments in Northern Nigeria were, in descending order of importance, education, revenue collection, agricultural services, medical services and water supply while those that were identified in the 'other important functions' category were community development, road construction and maintenance, maintenance of law and order, and market and motor vehicle parks. Surprisingly, sanitation and waste management were neither considered to be priorities nor important functions by any of the local governments that participated in Koehn's study. Onibokun and Kumuyi, (1999, 82) concluded that this would explain why the status of waste management was very poor in the country as a whole. Similarly in a study conducted by the Namilyango College in Kampala (2001: online), the researchers attributed the root cause of the waste problem in the Ugandan capital to "poor government attitude towards waste management". From the citizens' point of view, according to the study, "it is realized that little attention is paid to the environmental sanitation in Kampala so very few resources are committed to waste management". The researchers therefore blamed the issue of poor waste management on the lack of political interest in the sector. In Dakar, Senegal, Ka-Mbaya *et al*. (2006) also found a steady decline in urban environmental quality as the government had completely ignored the issue of waste management.

According to Ka-Mbaya *et al*. (2006, online) central government as well as the various municipal councils in Senegal had "relegated the issue of solid waste to the background" as though it was not important. Their proposed solution to the worsening solid waste situation in Senegalese cities was, therefore, for the country's political leadership to appreciate the importance of environmental sanitation and proper waste disposal and to commit themselves to addressing this problem. It appears therefore evident that the governments of many poor countries do not care much about environmental sanitation which is the root cause of the worsening waste disposal situation in their cities. The lukewarm attitude towards environmental sanitation is shown in the failure of these governments to implement legislation, create capacities and provide resources for urban environmental maintenance. From the analysis above, it can be concluded that the quality of solid waste management is directly affected by the level of financing and investment in waste management equipment, the level of training and motivation of waste management personnel, the level of enforcement of waste disposal

legislation and the level of public education and involvement in the planning and organisation of waste management. These factors are themselves affected by the level of political commitment to the solid waste problem.

A government that regards waste management as a priority would demonstrate its commitment by providing an enabling framework within which waste management could be organised effectively to protect public health and the environment. Strong political commitment to solving the waste problem in any city therefore is reflected in adequate investment. The poor solid waste situation that currently confronts developing countries can therefore be ultimately attributed to the low political commitments of their governments to the issue of solid waste management.

As a typical developing country, Nigeria also has a serious waste management problem in all its major cities. Urban settlements in the country are characterised with worsening waste management situations which the authorities seem unable to deal with. A survey of literature on the waste management situation in the country shows that no major research has been done on the subject using the systematic approach this researcher has undertaken in one city encompassing interviews with all types of stakeholders and participants. In addition, much of this research undertaken is very outdated but this one is an update after the UN policy initiative. It is the need to investigate the problem that has motivated the researcher to embark on this research. In the analysis chapters (chapters 6 and 7) of this research, the municipal solid waste problem in Greater Jos will be examined. The remaining part of this chapter is devoted to municipal solid waste management in Nigeria.

3.3 Municipal solid waste management in Nigeria

Nigeria is the most populous country in Africa. Over the past 50 years or so, it has had the third highest urban growth rate in the world at 5.51% per annum (Walling *et al.*, 2004). Adult literacy is higher than the average in developing countries at about 45%, comparing favourably with other developing nations such as India (57%) and South East Asian countries (56%) according to World Development Indicators (WDI) published by the World Bank (WDI, 2008). Statistics from the Central Bank of Nigeria in 2006 put the country's GDP at 176.7 billion US Dollars, growing at an average 8.3% per annum, but over 70% of the population still lives on less than $1 per day (UNIDO, 2004). The top 2% of the population earned as much income as the bottom 55% in 2000, up from 12% in 1970 (Aboyade, 2004). It has been argued that this lop sided economic performance is

the root cause of the urban slum phenomena in Nigeria as is the case in many other developing nations. One area where the urban poverty problem has had the most significant impact is in solid waste management (Agunwamba, 1998; Achangkeng, 2003).

Nigeria is located in the west African sub-region and has a total land area of 910, 768 km2. The climate varies from equatorial in the south to tropical at the centre and arid Sahel in the extreme north (NIMET, 2008). Nigeria's official population is put at about 140 million, growing recently at an estimated 2.9% per annum according to estimates by the National Population Commission of Nigeria (NPC, 2008). Administratively, Nigeria is divided into 36 states excluding the Federal Capital Territory, Abuja (Adama, 2007). Nigeria exemplifies the chronic solid waste management problems prevalent in most west African countries, as it grapples with the twin challenges of waste and population growing at rates that are unsustainable (Walling *et al.*, 2004). A primary consequence of this economic dynamic is that often certain proportions of the urban population find themselves unable to afford basic utilities such as water and sanitation. As a result, they resort to self-help settling at the fringes of cities in informal settlements often referred to as slums. Such settlements are common features of the urban landscape in sub Saharan Africa (World Bank, 2000; Jibril, 2006).

3.3.1 Institutional and Policy Frameworks for Municipal Solid Waste Management in Nigeria

Municipal solid waste management is rudimentary at best in most Nigerian cities. As a result, gross inefficiencies are common. In some local councils for instance, between 20-50% of their annual budget is said to be spent on municipal waste services, yet such services are available to less than 50% of the urban population in 1994 (Pearce and Kerry, 1994). According to Adelagan (2004), right from the inception of British rule in the 1900s, colonial economic development policies and plans contained little or no requirements to conserve the natural environment. Thus the formative years of institutional environmental regulation in Nigeria could be said to have been characterized by the absence of a clear sense of direction and commitment to waste and environmental management. Adama (2007), however, notes also that not much is documented on municipal solid waste in Nigeria prior to colonial administration. The earliest forms of environmental legislation such as the Public Health Act of 1909, and the Township Ordinance No. 29 of 1917, as well as the Town and Country Planning Ordinance of 1946,

were all introduced by the colonial administration and bear some evidence about concerns for the environment in general and efficient waste management in particular. In essence the origin of the crisis in municipal solid waste management sector in Nigeria has its root in the immediate post-colonial era (Adama, 2007). In 1988, the Federal Government of Nigeria (FGN) established the Federal Environmental Protection Agency (FEPA) in response to the serious challenges posed by environmental degradation, exemplified by the dumping of hazardous waste substances by an unidentified naval vessel around Koko port in the Niger Delta region. The Agency was mandated by the FGN decree 58 of 1988 (among other functions) to:

a) Advise the federal government on national environmental policies and priorities and on scientific and technological activities affecting the environment.
b) Prepare periodic master plans for the development of environmental science and technology and advise the federal government on the financial requirements for the implementation of such plans.
c) Promote co-operation in environmental science and technology with similar bodies in other countries and with international bodies connected with the protection of the environment.
d) Co-operate with federal and state ministries, local government councils, statutory bodies and research agencies on matters and facilities relating to environmental protection.
e) To carry out such other activities as are necessary or expedient for the full discharge of the functions of the agency under this decree (FGN, 1988).

Taking a cue from the federal government, each of the state governments in the country also established a State Environmental Protection Agency (SEPA) in the mid-1990s. At the local or municipal levels, environmental regulation and management functions were left as before to their individual environmental service departments. In essence, Nigeria like most SSA countries, for example Ghana, has a three tiered environmental / waste management structure i.e. federal, state and local environmental authorities.

FEPA was upgraded to a fully-fledged environmental department with a cabinet minister at the federal level in 2000 (Adeoti, 2001), following the coming of a new civilian administration and as a result of the rise in the profile of the environmental agenda globally. With these institutional reforms, the overall responsibility for environmental regulation and management in Nigeria is currently discharged by the Federal Ministry of

Environment, Housing and Urban Development at the federal level. Nigeria's first policy document on environmental management was launched in November 1989, enunciating guidelines for the achievement of sustainability in fourteen vital sectors including municipal solid waste (NEEDS, 2004; UNEP, 2007). This policy document has been lauded by many as a pace setter for other west African countries to copy. As laudable as this step was, the document soon attracted several criticisms mainly on account of its limited scope and deficiencies in practicality. The policy document was subsequently revised to address those concerns. With regards to the waste sector, a positive consequence of these developments was the eventual enactment of the harmful waste decree in 1990, providing a legal framework for the management of waste particularly of the hazardous genre. Further to this, as a response to criticisms of the FEPA decree, the government published an amended version in 1992 (Chokor, 1993; Akpofure and Echefu, 2001).

3.3.2 Overview of Municipal Solid Waste Management in Nigeria

Studies have been carried out on aspects of solid waste management in Nigeria. Though few were carried out on a national scale, findings from most of the studies could be applied in the other regions. A few of the studies with cross regional or national significance are reviewed below. Adelagan (2004) contended that there are no clearly formulated policies in Nigeria aimed at co-ordinating and addressing the harmful consequences of industrial development on the environment. The study maintains further that where legislation exists in the country. its enforcement had often been carried out rather poorly. While it is agreed that existing environmental legislation in the country is poorly enforced, asserting that there is no body of legislation and policies, on which management of environmental concerns may be based, amounts to an over statement. This is because several other studies on the subject agree that inefficiencies in solid waste management in Nigeria cannot be blamed solely on absence of policy and effective legal frameworks (Olowomeye, 1991; Agunwamba, 1998; Walling *et al.,* 2004).

Walling *et al.* (2004), is one of the few studies on the subject with a national perspective. The study reviews several governmental initiatives' effective and efficient management of municipal solid waste (such as FEPA and VISION 2020), and concludes like Adelagan (2004) that the federal government at that time had very little control over environmental regulation throughout the country. The study maintains further that though

local governments were intended to fund solid waste management, most have shirked this responsibility as a result of resource inadequacies and endemic corruption in the system. The study sums up the major drivers of the municipal solid waste problem in Nigeria as poverty, population growth rate, rapid urbanization and under funding of state agencies as in Ghana and Kenya. Other key literature on the subject from the 1990s to early 2000s such as Agunwamba (1998, 2003), Onibokun and Kumuyi (1999 in Adama, 2007) as well as Edoho and Dibie (2000) dwell extensively on the structure and relationships between various state agencies with waste management responsibility and highlights areas of successes and major barriers militating against their efforts at sustainable management of MSW. While Olowomeye (1991) was of the opinion that many important structures required for the efficient management of municipal solid waste in the country are still missing from the federal through to the local government levels, Agunwamba, Onibokun and Kumuyi argued that current operational difficulties in municipal waste management in the country are reflective of the general state of infrastructural and economic decay in Nigeria at that time. To this extent they argue that any effective solution must take into cognisance the overall economic position of the country. In this respect, they advocate that government must begin to adopt integrated municipal solid waste management solutions that are private sector driven as they have greater potential for long term desirable environmental and economic improvements.

More recent studies on the subject have concentrated on the analysis of the "composition" of municipal solid waste in Nigeria, designing local management solutions for its management and situating municipal solid waste as an important resource with enormous economic potentials. Igoni (2007) analysed the composition of waste samples from Port Harcourt which is representative of other southern Nigerian cities. This analysis showed that the samples contained 66.6% of volatile solids, 13.5% fixed solids 19.1% liquids and 0.8% other components. This study demonstrated that samples had a carbon: nitrogen ratio of 27:1. These results indicate that samples are ideal for composting as well as having a reasonable potential for energy recovery. The author points out that Port Harcourt, just like most cities in Nigeria, has no engineered landfills. As such, solid waste is most often disposed by burial or simply dumped in open dumps and water bodies. Similar studies have been undertaken by John *et al.* (2006) for Uyo in South Eastern Nigeria, Kofoworola (2007) for Lagos, South Western Nigeria and for Makurdi, and for North Central Nigeria by Sha'Ato *et al.* (2007). From their study Sha'Ato *et al*. (2007)

find that approximately 82% of the municipal solid waste management waste stream from Makurdi comes from households.

3.3.3 Municipal Solid Waste Composition in Nigeria

Estimates of total quantities of municipal solid waste generated in Nigeria are difficult to determine. However, estimates of waste generation per capita have been carried out in several investigations (Rushbrook and Pugh, 1999; John *et al.*, 2006; Igoni *et al.*, 2007; Kofoworola, 2007; Sha'Ato *et al.*, 2007). Continued population growth will increase waste growth. Other parameters studied according to the existing literature include moisture content; bulk density and chemical analysis (see Table 2.3). The typical composition of municipal solid waste from cities such as Kano, Lagos (see Table 2.4) and Makurdi as presented by (Sha'Ato *et al.* 2007; Kofoworola, 2007; Igoni *et al.* 2007), respectively, are equally outlined. From Rushbrook and Pugh (1999), it can be inferred that variations in the rate of municipal solid waste generation and composition can be attributed to changes in the socio-economic characteristics of the generator community. This implies that socio-economic dynamics affect both the quantity and composition of municipal solid waste generated.

According to Olowomeye (1991) the collection of solid waste is the most difficult and expensive aspect of solid waste management in developing countries. As a result of the unplanned nature of most cities in Nigeria, this task can sometimes be daunting. Ineffective collection systems often lead to waste accumulation, creating nuisance and odour problems, environmental pollution, fire hazards and generally threatening the physical well-being of the populace. The survey of existing literature reveals that two primary collection methods are obtainable in Nigeria: “Door to door” and “Depot”, or community disposal method.

3.3.4 Door to Door Waste Collection

Standard waste collection receptacles are rarely available at household level in most parts of sub-Saharan Africa (Boadi and Kuitunen, 2003). In Nigeria particularly, many low and middle income households use whatever container that is readily available, such as baskets, cans, buckets, open drums and sometimes black bin bags for waste collection. As a result of the high organic and moisture contents and high prevailing temperature, waste collected in such sub-standard receptacles decay rather rapidly giving rise to undesirable environmental consequences. In contrast however, most upper income households and government offices use standard receptacles, with covers, for collection

of their waste. Door to door waste collection requires good planning and management. Collection crews come on specified days to empty the bins for transfer to dumpsites. This system demands a minimum outlay of manpower and equipment as well as accessibility.

3.3.5 Depots/Communal Collection Facilities

In neighbourhoods where access is constrained due to bad roads, waste from households is brought to communal collection facilities sometimes called bring banks. Bring banks may be in the form of skips or other purpose built structures. Collection crews from the local government department or private waste management agencies come on set days to empty the facility. Bring banks are usually centrally located within a neighbourhood for easy access to the entire community and collection crews.

3.3.6 Municipal Solid Waste Resource Recovery/Recycling in Nigeria

Recycling via resource recovery has huge potentials for economic application especially amongst the urban poor in many developing countries (Bartone *et al.*, 1991; Sakai *et al.*, 1996; Halla and Majani, 1999; AfDB, 2002; Ahmed and Ali, 2004). In Nigeria particularly, several studies exploring municipal solid waste recycling practises have been undertaken (Agunwamba, 2003; Afon, 2007; Kofoworola, 2007). Municipal solid waste recycling is at a very rudimentary stage in Nigeria. According to Kofoworola (2007), this is because it has not received much attention from the government; as such, polices and structures regulating the practice for effectiveness are practically non-existent. There is no Material Recovery Facility (MRF) in the whole of Lagos State and the situation is not different in other parts of the country now.

3.4 Informal Sector Municipal Solid Waste Recycling in Nigeria

Despite government's apathy towards resource recovery, economic pressures often force many amongst the urban poor to scavenge waste dumps in Nigerian cities to earn a living (Roberts *et al.*, 2009). In a study on recovery and recycling practices in Lagos, Kofoworola (2007) found out that only materials with high market value such as paper, plastics, glass and metals were scavenged. In a similar study in three cities in the south eastern parts of the country (Nsukka, Onitsha and Port Harcourt), Agunwamba (2003) discovered that between 70-83% of scavengers were unemployed or underemployed urban youths (mostly males). Agunwamba (2003) stated further that while most scavengers restrict their activities to open waste dumps and landfills, some prefer to go from house to house and from bin to bin, looking for discarded but useable

materials. They are known by different names in different parts of the country: "Mai bottle" in the northern parts and "Baro boys" or "Ndi-ebulu" in the southern parts (Afon, 2007). In all cases however, materials recovered are either kept for personal use or sold to middle men who further sort them for sale to small scale industries around the city and beyond. Agunwamba's study showed that average daily earnings by the scavengers were as high as US $10 in 2003 while middlemen made even much higher profits. In a country where over 60% of the population live on less than $1 a day (World Bank, 2000), such activity poses good prospects for environmental as well as economic sustainability and poverty reduction (UNEP, 2007; UNCED, 2007).

3.5 Municipal Solid Waste Composting in Nigeria

According to Halla and Majani (1999), municipal solid waste composting reduces the amount of waste and haulage costs while at the same time creating economic and employment opportunities. Traditional Nigerian households have historically made effective use of composting as a management strategy for solid waste generated within their surroundings (Olowomeye, 1991). Olowomeye (1991) recorded that waste generated from households such as yam peels, banana leaves, maize cobs, and egg shells were usually deposited in the backyards where they were allowed to decay for subsequent utilization as manure during the planting season.

Despite this long standing composting tradition, post-colonial Nigerian communities have only made limited use of composting as an effective municipal solid waste management strategy. Lewcock (1995) in a survey of farmers' use of urban waste in Kano stated that the huge potentials for compost production in the city have not been exploited as a result of the government's apathy in providing the required structures for this purpose. This same situation is true for many other cities in the country. It is estimated that over 60% of Nigeria's adult population are engaged in agriculture as a source of livelihood while the government subsidizes fertilizer importation to the tune of 70% (New-Agriculturist, 2007). Compost production as a waste management option therefore has an added advantage of economic enhancement for Nigeria while at the same time achieving desired environmental sustainability objectives.

3.6 Municipal Solid Waste Transfer and Disposal in Nigeria

There is need to transfer all waste generated from either households or communal facilities in a safe and efficient manner to recycling facilities or final disposal site. Efficient transfer of waste in Nigeria is, however, difficult due to the peculiar

characteristics of tropical waste streams, terrain and other barriers (Olowomeye, 1991). In most parts of the country, waste transfer is still carried out haphazardly with wheel barrows, carts, open trucks, lorries, tippers and more recently by compactor trucks (Olowomeye, 1991; Afon, 2007; Coker *et al.*, 2009). As the most common means of transporting waste are open trucks and lorries, it is not uncommon to see streets littered with waste dropping from vehicles in transit. There is a need to properly dispose of all collected waste in a safe and sustainable manner so as to avoid any negative environmental and health impacts. Various methods of waste management have evolved over the years such as burning, open dumping, landfilling, composting, incineration, disposal into the sea, pyrolysis, recycling etc (Ezeah, 2006). In the study "Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria", Kofoworola (2007) noted that the inhabitants of Lagos dump their waste at any location that suits them because there are no defined waste disposal points apart from bring banks scattered all over the city.

This situation best mirrors the state of waste disposal across Nigeria. Open dumping and burning are still the most prevalent waste disposal methods in the country (Walling *et al.*, 2004). The very few landfills that exist in the country are neither engineered nor secured; as a result waste dumped at such dump sites eventually finds its way back to block access ways, drainages, farmlands and water bodies (Olowomeye, 1991; Chokor, 1993; Adelagan, 2004).

3.7 Solid waste management practices in selected cities in Nigeria

This section discusses how different parts of cities are experiencing similar problems of waste management. In addition, it points to how the various developing countries discussed earlier (see section 3.1.1) have been battling with the management of municipal solid waste issues. There is uncontrolled handling, collection, transportation and disposal of municipal solid waste in borrow pits, open spaces, etc without properly engineered and managed sanitary landfill facilities for disposal of municipal waste. To summarise the problems of municipal waste management in Nigeria are complex and include:

1. Ad-hoc plans and/or lack of integrated approach to waste management.
2. Lack of political will and priority to environmental management.
3. Human and technical capacity constraints
4. Capacity limitations.

5. Lack of adequate financial support.
6. Poor performance of private sector participants.
7. Failure to promote public environmental education and awareness.
8. Absence of waste reduction plans (particularly sorting at source, recycling and reuse etc)

Municipal solid waste management is elementary in most cities in Nigeria. The section below briefly discusses how Abuja, Lagos, Calabar and Enugu have been managing their waste.

3.8 Municipal solid waste in the federal capital city of Abuja

Abuja has an estimated population of 1.4 million people of which 405,000 live and work within the municipality (National Population Commission, 2008). It has a total land area of approximately 713 km2 which is divided into six area councils i.e. Abuja Municipal, Abaji, Bwari, Gwagwalada Kuje and Kwali. The government institution responsible for solid waste management in the City is the Abuja Environmental Protection Board (AEPB). The Board's solid waste management portfolio has the following components: city cleaning (concession to local contractors in a public private participation arrangement), street sweeping, litter control, solid waste collection and transfer and vegetation control. In the middle of the last decade the monthly volume of waste sent to landfill in Abuja stood at about 6700 tonnes (Adama, 2007). Exact figures or actual quantities of waste generated per capita and per household are difficult to come by but figures from neighbouring cities with similar demographic and socio-economic characteristics such as Accra are historically put at 0.4 kg per capita and density on a wet weight basis of 0.47 t/m3 (World Resources Institute, 1998). Open dumping and burning are still the most prevalent waste disposal methods (see Figure 3.1 and 3.7)**.** Waste generation is growing daily due to a population explosion (Imam *et al.,* 2008; Awopetu *et al.,* 2013).

Figure 3.1: A Typical Illegal Dumping Site along Goza Landfill, Abuja

Figure 3.2: A broken down dilapidated compactor waste collection truck, Abuja

Collection and disposal of solid waste is handled through the engagement of private sector participants (PSPs). The 13 districts that make up the city are subdivided into 20. The PSPs are assigned into the various collection lots and supervised by Abuja Environmental Protection Board (AEPB) staff in their daily operations. Waste collection from most households and offices within the municipal area is on a door to door basis. At household levels, waste is stored in 240L covered plastic receptacles or black bin bags. For bigger establishments, larger sized receptacles and bring banks are used. Many poorer households, especially those living in the satellite towns and informal settlements at the outer fringes of the City, use any available containers such as baskets and open buckets (see Figures 3.2, 3.3 and 3.4).

At present, there is no strategy or formal recycling programmes for Abuja. No material recovery facility exists in the city. Consequently, materials re-use and recycling activities throughout the municipality are limited to household reuse and scavenging activities of the urban poor (See Figure 3.5, 3.6, 3.8 and 3.9).

Figure 3.3: Waste collection in Abuja

Figure 3.4: Waste being transferred into the AEPB bins by household

Currently, there are two sites in the city for final dumping of municipal wastes – Goza and Azhata dump sites. The Azhata dump site is located at the outskirts of the city. It measures about 12 hectares of land and serves as dump site mainly for wastes collected from Nyanya, Jikwoyi and Karu Districts. The Goza dump site is the main dumping site for the city. It is situated 40 km away from the city centre within the Jabi-Idu industrial area, and covers about 90 hectares.

The two dump sites are not fenced and neither has a paved access road nor a dumping platform. Consequently access to the dump sites by waste trucks is almost impossible during the rainy season resulting in waste being tipped at the entrance of the site. Bulldozers are used to move wastes further inside the sites. The bad access road in the rainy season is one of the reasons why waste contractors dump waste indiscriminately and illegally along the roads leading to the sites. Parts of the dump sites have been turned to thriving shanty human communities of waste scavengers where manual sorting of wastes and commercial activities take place all year round (Interview with senior official, AEPB).

Figure 3.5: Shanty community of waste scavengers in Abuja

Figure 3.6: Shanty community of waste scavengers with AEPB inspector in Abuja

Figure 3.7: General dumping/disposal site in Abuja

Figure 3.8: Electronic waste segregated by scavengers at disposal site in Abuja

Figure 3.9: Segregated cans by scavengers at disposal site in Abuja

Source: AEPB, June, 2013

3.8.1 Municipal solid waste practices in Lagos

Lagos state generates an estimate of 9000 metric tons of municipal solid waste per day and has been characterized by a poor state of waste management. Determined to contend with the huge waste problem for which the state was known for, the government of the state in 1996 established the Lagos State Waste Management Authority (LAWMA) charged with the responsibility of waste management and sanitation in the state including strategizing the state for integrated and sustainable waste management system (See Figure 3.10)

Figure 3.10: LAWMA Compactable Waste Collection Truck

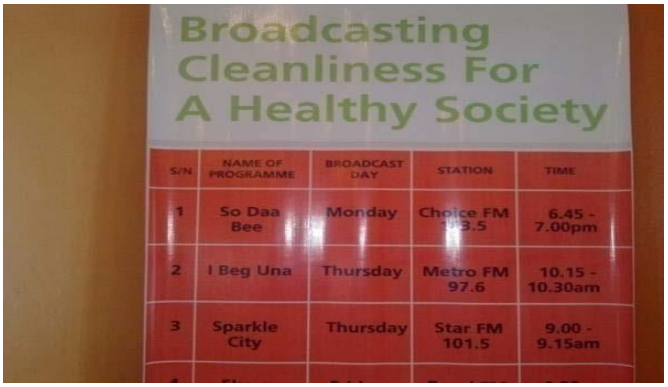

Figure 3.11: LAWMA Waste Management Public Enlightenment Programmes

LAWMA in 1996 initiated a number of programmes and strategies aimed at efficient and sustainable management of municipal waste in the state including:

1. Free distribution of waste bags to the public,
2. Public enlightenment programmes on electronic media (see Figure 3.11)
3. Procurement of state-of-the-art compact trucks for waste collection,
4. Training of scavengers and employing them to work in waste recycling plants,
5. Engagement of able-bodied street beggars as city cleaning employees as well as prosecution of sanitation defaulters and those who default in waste bill payment.
6. Prosecution of sanitation defaulters and those who default in waste bill payment.

Waste collection is directly handled by the over 450 Private Sector Participants (PSPs) engaged by and directly supervised and monitored by LAWMA. Aware of the current trend in optimal waste management, LAWMA in 2003 established nine recycling centres across the state which now recycles about 18% (1200 metric tons) of the waste generated in Lagos state. The composition is:

1. Waste to compost - 10%

2. Plastic recycling – 7%
3. Paper bailing -1%

Waste management in Lagos is said to have created jobs for about 25,000 persons. It is reported by Joshua (2013) that Lagos state has achieved an estimated efficiency of 80% in waste collection and 50% in revenue generation from waste. There is, however, no sanitary land fill in Lagos so all final wastes are tipped in various dumped sites.

3.8.2 Municipal solid waste practices Calabar

Waste management in Calabar city is handled by the Calabar Urban Development Agency (CUDA) on one hand and the Cross River State Ministry of Environment, Waste Disposal Unit on the other hand. While CUDA is responsible for street cleaning and street waste collection and disposal, CUDA is in charge of municipal waste disposal. A private maintenance firm was engaged for vehicular maintenance and waste collection by the Ministry of Environment to ensure effectiveness of the operation. There is no documented record of waste generation in Calabar and there exists no integrated waste management plan. Households and institutions generating waste are not individually charged for waste disposal by the government, while the cost of waste collection is solely borne by the state government.

3.8.3 Municipal solid waste practices Enugu

In Enugu, by the 1990s, the problems arising from the unavailability of a properly engineered disposal facility for the rapidly increasing volume and diversity of municipal solid waste generated had begun to become very visible. In response, the Enugu State Environmental Protection Agency (ENSEPA) initiated steps to construct a sanitary landfill for the final disposal of municipal solid waste generated in the city. However, the facility was only partially developed when it was commissioned in 2003 due to financial constraints (see Figure 3.12).. The result was that refuse was not treated as it should have been and so the facility did not take-off as a fully-fledged conventional sanitary landfill (Barrat and Diyoke, 2003). Practices are characterized by non-conventional landfill site (See Figure 3.13) management practices, including uncontrolled handling, collection, transportation and the disposal of municipal solid waste (especially health care wastes) (See Figure 3.14). In 2005, the practice of improper disposal of solid waste due to lack of equipment had resulted in the stoppage of mechanical compaction of solid waste, trenching of cells and the covering of in-filled cells.

Figure 3.12: Uncontrolled dumping of municipal solid waste blocking the entrance into the landfill site in Enugu

Figure 3.13: Municipal solid waste dumped outside the wall of landfill site in Enugu

Figure 3.14: Uncontrolled dumping of dangerous/hazardous waste (health care waste) by a pick-up van at dumpsite.

3.9 Framework for MSWM practices in developing countries

Most municipal authorities in developing countries are, therefore, overwhelmed by an intractable waste situation as shown by past and recent studies in major urban

centres (Onibokun and Kumuyi, 1999; Coker *et al*., 2009; Onwughara, 2010; Gasu and Gasu, 2011; Hoornweg and Bhada-Tata, 2012). Most cities in the developing world are, therefore, drowning in municipal solid waste (Zurbrugg, 2003; UNDP, 2004). While data is generally lacking in the waste sector of developing countries, available studies on the topic suggest that municipal solid waste management is generally characterized by inefficient collection methods, insufficient coverage of the collection systems and improper disposal of municipal waste (Habitat, 1997; Onibokun and Kumuyi, 1999; World Bank, 2002; Palczynski and Scotia, 2002; Onwughara, 2010; Gasu and Gasu, 2011; Hoornweg and Bhada-Tata, 2012; Peter *et al.*, 2014). Table 3.3 summarises the main issues.

Practice	Developing Countries: Ghana, Kenya, South Africa, Nigeria
Policy, legislation and environmental regulation	Absence of systematic control and enforcement mechanisms, fragmentation of policies and laws, duplication of roles (Onibokun, 1990; UNCHS, 2000; Dauda and Osita, 2003; FEPA, 2008; Oyedele *et al*., 2008)
Financial instruments	Very low priority, limited funding, inadequate taxation (AfDB, 2002; Agumwamba, 2003; Ahmed and Ali, 2004; Sha' Ato *et al*, 2007)
Plan / strategy and implementation	Absence of systemic control and plans /strategy if any (Onibokun et al., 2000; Estevez, 2003; World Bank, 2004; Attah, 2005; Ndidi *et al*., 2009)
Institutional, administrative capacity	No clear definition of roles and lack of coordination, higher administration and institutional costs (World Bank, 2000; USEPA, 2010)
Planning and stakeholder participation	Lack of planning institution for waste management and formal stakeholder participation (UNEP, 1999; Zurbrugg, 2003; Fobil *et al*., 2010)
Coverage, collection, recycle, reuse	No industry for waste issues, weak economic base for resource recovery and recycling. Informal sector scavengers used (Achankeng, 2003; UNO, 2007; Onwughara, 2010; Gasu and Gasu, 2011)
Environmental and economic gains	Conflict between economic development and environment protection, lack of socio-economic values and attitudes, lack of public awareness (Chua and Garces, 1992;Hoornweg and Bhada-Tata, 2012)

Table 3:3: Framework for MSWM practices in developing countries

Source: Author's review

The developing countries are faced with inadequate coverage in waste collection, improper transportation methods, poor disposal practices for example, open dumping of waste, burning of waste without any regards to environmental protection, inadequate

funding of waste issues, weak regulatory and institutional framework. These issues hindered effective and efficient systems for municipal solid waste management.

3.10 Summary and conclusion of chapter three

This chapter analytically reviewed the municipal solid waste challenges in developing nations and investigated the actual problem, focusing particularly on some countries and Nigeria. In particular it examines typical tropical urban environments identifying a range of themes. The following points were drawn from the reviews in this chapter. Municipalities in developing countries especially Nigeria are undergoing deterioration of solid waste conditions that needs urgent attention. Indiscriminate disposal of municipal solid waste is the existing common practice creating the most current environmental challenges in those regions. The local, state and federal governments lack adequate planning to deal with the circumstance. There are also limited funding, a lack of policy and legislation, and no waste management institution. The difficulties are compounded by socio-cultural and socio economic factors, lack of public awareness and education and no stakeholder participation. All these issues drawn from the reviews act as barriers that can hinder attainment of effective MSWM. The next chapter is on urban management incorporating the role of planning.

Chapter Four

Urban Management Incorporating The Role of Planning

4.0 Introduction

The previous chapters (two and three) presented a review of MSWM at the international levels and provided the basis for the research framework. This chapter examines the impact of town planning on Nigeria's political, professional and socio-economic development. The purpose is to explain the reasons for the past failures in the management of MSWM, and to identify the issues that can influence the current planning system. In achieving this, a chronology of the past practice and an account of key developments in Nigeria's urban planning sector (2000-to date) are presented. In addition, a review of institutional issues that influence planning efforts is done. This is in order to capture the impact of planning policy dilemmas on the process of rapid urbanization and the growth of towns.

4.1 2000-To Date: Planning in the New Millennium

The New Millennium ushered into the annals of physical planning in Nigeria a number of developments, ranging from the creation of an independent Ministry responsible for Housing and Urban Development, the two in one 2002 policy on housing and urban development and the Millennium Development Goals (MDGs) strategy of the United Nations.

This millennium has been described as the urban millennium since, for the first time, more than 60 percent of world's population will be living in urban areas. UN-Habitat (2001) notes succinctly that we are living in a world dominated by cities that are polarized, reflecting the North-South dichotomy. In terms of their radiant energy, these cities are either in the dark or in the light. The cities with radiant light are the more successful and sustainable ones found in the developed countries of the north as compare with the cities in the dark which are to be found in the developing countries of the South.

The epicentre of urbanization has now shifted from Europe, America and Latin America to the Africa and Asian continents primarily because people migrate to urban areas in expectation of a better life and in search of social security. Most often than not, the migrants end up in informal settlement and slum environment which further compound urban problems. Therefore, rapid urbanization, if left unplanned, as evident in the experiences of Nigerian cities, often leads to unsustainable development and increases in poverty, crime and insecurity in town and cities (Falade 2005). It is on this

premise, and the Nigerian government seeing the near comatose situation of its cities as evident in their observed incapacities to perform their duties, it decided to strategize on how to make cities functionally efficient by evolving in 2002, a National Housing and Urban Development policy (Agbola, 2003).

The rationale for this policy, as espoused in its goal and objective, is to enhance the management of Nigeria's metropolitan centres and make them more efficient in the performance of their socio-economic functions as centres of commerce, industry and culture and in the delivery of services to their citizens, In addition, the policy will improve on the liveability for the urban centres by making daily existence less stressful for the inhabitants. It will make the city truly the centre of social and cultural life which will promote their social and physical attractiveness. Thus, the goal of 2002 National Housing and Urban Development Policy was to develop a dynamic system of urban settlements which would foster sustainable economic growth, promote efficient and urban and regional development. It would also ensure an improved standard of living and well-being of the socio-political milieu of Nigeria (Federal Government of Nigeria, 2002).

The policy is a lucid exposition of all that is bad and ugly about Nigerian cities and urban agglomerations with well-reasoned strategies on how to make the city work again. It covers all aspects of what makes or could make a city become functional and efficient. As noted by Agbola (2003) it seems therefore, that the policy has taken advantage of the exigencies of the time to provide a rich management menu for conception, implementation and monitoring of the Nigerian urban space. There seems to be a compelling reason for the adopting of the policy not just for political reasons. These are a combination of factors, some of which include: the urgency in the provision of the policy; the stature and disposition of members of the committee that midwife the policy; the indirect promptings of the international communities especially with regard to the urbanization of poverty and the sundry effects of the poor urban economy and environment on the general economy and welfare of Nigerian citizens (Agbola,2003). Accordingly some of the provisions of the policy are being implemented. For instance, a new Ministry of Housing and Urban Development set up with the sole purpose of implementing the provisions of this policy. This necessarily conferred significant visibility on the policy, its provisions and its executors.

At the same time world leaders committed themselves to a set of millennium development goals (MDGs) in 2002 under the auspices of the United Nations. The leaders pledged at the millennium summit to launch a concerted attack on poverty, illiteracy,

hunger, unsafe water, disease in urban and environmental degradation. Against the background of a world facing an acute human development crisis, the MDGs have evolved as a major instrument for bolstering the global development agenda through strategic partnerships, based on the triple criteria of responsibility, accountability and mutuality (Osie, 2005; Ogero, 2005).

Many countries, including Nigeria, have been trying to measure the achievements of its 8 goals and the plethora of targets. However, in physical planning parlance, goal seven which is to "Ensure Environment Sustainability" through it corroborating targets such as integrating sustainable development in country policies and reversing the loss of environmental resources in half by 2015, halving the proportion of people without access to portable water; and significantly improving the lives of at least a hundred million slum dwellers by 2020. However, an initial survey of the appraisal of the Nigerian progress towards the attainment of these MDGs was most disheartening (Agbola, 2005).

4.2 Master planning as a strategic tool

Dhakal (2004) defined planning as a process of performing an orderly, managed sequence of actions to achieve the targeted goal or goals. It is generally oriented for both the present and the future. Planning can be applied in any field, but it is generally focused on resource allocation, over a set time period, for sustainable development. This is undertaken for social welfare and is supported by politics as well as resources. Land use planning could be referred to as the scientific, aesthetic and orderly disposition of land resources and the provision of basic infrastructure with the intention of securing physical, economic and social efficiency as well as the health and well-being of urban and rural communities. It aims to create convenient, equitable, healthful, efficient and attractive environments for present and future generations (Anderson, 2000; Obateru, 2004; Agbola and Olatubara, 2004).

Strategic plans are evolving long term planning documents that establish realistic plans for implementation including subsequent approvals by public agencies. A master plan encompasses the organization of large scale sites, design principles and ecological techniques to shape land use. It identifies funding sources and the strategies needed to build the various projects under consideration and makes recommendations via a management plan adopted to maintain it. Furthermore, it describes the development schedule, highlighting the order in which elements and decisions will be made. It can also establish guidelines for the many designers who will be employed to draw up specific

plans for the sites. Master plans may also include images of different land uses to demonstrate the character and key features of each site.

Once a master plan is in place it should provide a framework for local plans which will provide a more detailed basis for development control. However, in Nigeria there is a chasm between the theory and application of master planning. Most parts of urban areas are occupied by 'unplanned' slums that are in need of urban renewal.

The master plans for major urban areas (Greater Jos Master Plan, Riyom Urban Master Plan and Angware Urban Master Plan) have either not been reviewed or have not been implemented. Presently, the government is making efforts to consider the formulation and review of a number of policies to bring about controlled urban development and management. The impact of planning authorities in terms of development control can be examined by observing proportional and controlled urban development and management within any giving jurisdiction. Many factors militate against the effectiveness of planning ranging from economic, social, political, cultural and physical etc. The next section seeks to examine the effectiveness of the administrative (operational) system which includes; The Commission System and The Council - Manager System.

4.3 The Commission System

The commission system is the administrative structure identified in the ministry of Lands, Survey and Town Planning (MLSTP) and the Ministry of Housing and Urban Development (MHUD). The MLSTP is divided into 5 major departments comprising two general service departments and 3 professional departments, each headed by a director who is a career civil servant and who must be registered with the relevant professional bodies. The professional departments include: Lands, Survey and Town Planning departments, which are headed by directors answerable to the Permanent Secretary and the Commissioner. This also applies to the MHUD ministry. The Administration/Personnel Department controls the secret and open registries and also supervises the records registry of the Lands Department. The General Service Department includes: Administration/Personnel Secretary (Admin & Finance) as well as the Supplies Department. The Personnel Department is concerned with the day to day administration of the ministry and is headed by the Secretary for administration and finance and supervised by the Permanent Secretary.

4.3.1 The Council (Lands section) Local Government and Manager System for Administration

Hambleton (1978) observed that central government sets down a number of planning processes which control and influence the work of the local authorities. But in Nigeria, the 1992 URP law, stipulates the use of a local planning board. The town planning department is charged with the responsibility for development control, enforcement of planning laws and standards, plan processing, activities, property rating, maintenance of parks and gardens and city beautification. The Director of Town Planning oversees the day to day running of the activities of the department. This could be seen to have increased the level of government procedures, extending the duration of the processing and procedures of the board that need urgent attention, taking into consideration the dynamic nature of the population in the area and the master planning approach currently in operation.

4.4 The Present Urban Management Problem in Nigeria

In the face of the uncontrolled expansion of Nigerian cities since independence, planners and other stakeholders have been forced to accept that development policies for urban and rural areas have failed or have not worked as expected. For the majorities of planning officials, cities and their completely uncontrolled growth are a testimony to the failure of development and planning policy of the area involved. Cities in Nigeria have been observed to have changed in size, spatial organization or morphology, quality and distribution of public services and infrastructure and in their employment base. Urbanization in Nigeria can be seen at best as "false urbanization" that has created a crisis of immense proportions. The crisis has arisen because of the inability of the city authorities and urban managers to deal effectively with the aftermath of the rapid urbanization process and this in turn could be attributed to low entrepreneurial, technology and managerial capabilities, inadequate finance and a large number of parasitic individuals (Agbola, 2005).

Consequently, the failing of planning and planners as illustrated above is a challenge to the collective intelligence of planning professionals and a general affront to the operations of their professional calling. Despite many efforts aimed at ameliorating the urban and rural problems as seen in the epoch of physical planning since independence in Nigeria, it is not yet done. From this development, the question begging for an answer is why have these problems remained intractable in the face of plethora of physical planning tools? Much more importantly, what are we to do as planners to ensure that

cities in Nigeria are sustainable economically, liveable socially and aesthetically please to the eyes in its morphology.

Given the magnitude of the challenges of human settlements pose, Nigerian society should value and take advantage of the wisdom, knowledge and skills of key professions and stakeholders concerned with human settlement development. Here the town planner has a key role to play in this process (Onokerhoraye, 2006). However, for the would be planner or any other discipline in environmental management to be effective as noted by Agbola (2005), there is the need to redress the obvious lapses in the present process of town planning and management. Urban problems are not only changing in their scope or context, but the velocity of such changes confounds human imagination, and this is why the existing and received knowledge in planning and management tools and professional know-how are often challenged in the face of contemporary urban development. The sustainability of the global environment and human life will not be achieved unless, among other things, human settlements in both urban and rural areas are made economically buoyant, socially vibrant and environmentally sound with a full respect for cultural, religious, natural heritage and diversity.

Accordingly, it has become obvious that government alone cannot manage the environment. The growth of the population in most areas is outmatching the capacity of government to provide basic needs such as shelter, water and sanitation. Hence, the involvement of the host community in any developmental effort is imperative. In other words, community initiated self-help programmes hold the key to the effective urban service provisions in the face of modern urban system complexity, especially the dwindling municipal revenue. As noted by Tbuijuka (2006), gone is the assumption that Central governments will provide free housing for the poor. The traditional welfare state model has given way to stakeholders' partnership and participation at all levels, while free public provision has given way to affordability of services as the only tested means for sustainability and addressing the scale of the issues.

In the process of urbanization, policies and programmes for the sustainable developments of human settlements in both rural and urban areas require strong sub-national governmental institutions working in partnership with all interested parties. Such institution are weak in Nigeria, and their effectiveness is threatened by increasing problems of political and cross-sectorial approach to human settlements planning which places emphasis on rural-urban linkages and treats villages and cities as two ends of a human settlements continuum in a common ecosystem.

The premise of urban governance is to bring together the principal stakeholders at the level of political decision making, by fixing a framework for urban action. This is a continuing process through which conflicting or diverse interests of citizens are accommodated and cooperative action in their resolution actively promoted. It embraces the activities of not only formal institutions but also informal organizations as well as the social capital of citizens. Consequently, for urban governance to be considered good for future development in Nigeria's situation, it must fulfil three basic conditions. First, it must exhibit well decentralized and devolved authority structures (decentralization. Second, its decision making process must be participatory and all-inclusive (inclusiveness). Third, its implementation strategies and activities must be transparent and made accountable to the generality of the citizens of the city (accountability).

Desirably, urban governance will only progress when managers and local element representatives, who are the central actors with regards to decentralization policies, are given genuine support and responsibilities, but also if they take more account of the abilities of their local population with regard to organization and initiatives. However, as noted by Agbola (2003, 2005), there are two formidable obstacles in the way of attaining the norms for good urban governance in Nigeria. The first is the lack of a city-wide administration in many of the system of the cities. For a city to be sustainable, it must be governed by municipal authorities or mayoralties. In the Nigerian situation, there are no municipal governments. For example, eleven local governments govern the city of Ibadan, while Lagos and Kano cities have far more. Small towns such as Ijebu Ode, Minna, Ogbomoso, among others have two or more. This leads to duplication of efforts, wasteful application of resources and gross inefficiencies. City-wide administrations on the other hand would facilitate enhancement of revenues, provision of social and physical infrastructures, job creation and other income generating activities and maintenance of security.

The second obstacle as noted by Agbola (2003) is that most of the haphazard developments in Nigerian cities today are not only products of intentional planlessness by the public but a combination of collusion, greed and mostly illegal approvals by planning officials. What excuse could we possibly give for stores and houses built under high tension lines, shopping malls of questionable dimension and petrol filling stations almost on railway lines or in roundabouts? We have instances of between three and six petrol filling stations located in quick succession to each other. Are there no standards anymore? Are these standards not meant to be enforced? And if the ethos and ethics of

the profession are bastardized by the same people that are meant to sanitize them, then God help physical planning in Nigeria.

The challenges before the planners are so huge that we need to wake up to our responsibilities. Until we learn to discipline ourselves and use other people's mistakes as our own lessons by the punishment meted out to them, the profession may not be able to aggressively execute the provision of all the planning policies. Perhaps we should note that it is only the planners' mistakes that generate scapegoats among the built environmental professionals and those who live in glass houses do not throw stones.

The urban scenery in Nigeria shows a gradual occupation of available open space by heaps of solid waste. Most Nigerian towns and cities are today characterized by indiscriminate refuse dumps as mountains of wastes are created across residential and commercial areas in our cities. Existing drainages have become readily available waste disposal bins, (rivers, streams, gutters etc), negating the purpose which they were meant for. The disposal of waste into these drains could precipitate into sporadic floods with the slightest down poor.

In Nigeria, cities have become veritable centres of rural-urban influx and this interface gives some explanation to poor solid waste management which is incapable of keeping pace with the rate of generation. Wastes are generated so fast, dumped carelessly and the technology and capacity, particularly by environmental sanitation bodies and agencies to evacuate them are limited. This perhaps explains why even after monthly environmental sanitation as done in the past by various state governments and still now by some, little or nothing is seen of a clean environment. It was very clear when an assertion in the Population Report (1992) had it that many cities in these countries now spend more than 30% of the budget on refuse collection and waste disposal. The same source went on to say that despite these efforts, an estimated 30% to 50% of all solid waste in developing countries like Nigeria are uncollected and left on streets or on vacant lots.

4.5 Summary and conclusion of chapter four

Chapter four has pointed that urban planning in Nigeria is constrained by the institutions of the three tiers of government and politics, planning policy and legislation, financial and socio-cultural factors. This chapter has advanced to look at the strengths and weaknesses of the planning systems, in order to establish the current context of waste planning at the municipal level in Nigeria for more detailed case study research. The chapter concludes that planning authorities have been constrained in solid waste

management by the factors mention in chapter three section 3.2 of this research. In addition, there is no effective urban management strategy to address the problem of MSWM in the urban areas. After this, the next chapter explains the research approach, methodology and methods adopted in general.

Chapter Five
Research Methodology

5.0 Introduction

The previous chapters (two, three and four) presented a review of the municipal solid waste problems in developed and developing countries with planning appraisal on urban management provides the basis for the framework of this research. This chapter details the general approach and specific techniques to be adopted for the research, and explains the overall methodology and methods to be taken by the researcher in order to answer the research question. A mixed methods approach was applied to address the objectives for the research. The qualitative [see appendix 10.2 (2a) for in-depth interview guide] methodology – encompassed face-to-face interviews conducted with experts in planning orgaanisations and institutions in Jos, Abuja and lafia (see appendix 10.3 for list of people interviewed). The quantitative elements incorporates to an extent household surveys [see appendix10.2 (2b) for questionnaire]. The chapter begins with a discussion of the ontological and epistemological underpinnings of qualitative and quantitative research and the arguments for and against combining the two approaches in a single study. The rationale for combining them in this research is further explained. The chapter is organized in sections covering the research designs and the methods used in the selection of the research participants and for data collection. How data was analysed is also briefly explained after which issues relating to positionality and reflexivity are discussed. The chapter concludes with a look at possible limitations of the methodology employed in the conduct of the research.

5.1 Theoretical background on research methodologies: Ontology and Epistemology

To understand the philosophy that underlines the ontological and epistemological positions of a research is necessary as it forms the base for the research methodology (Bryman, 2004; Saunders et al., 2009; Gilbert, 2011). To clarify the differences between ontology and epistemology, it should be considered that ontology is “the theory of what there is” (Creswell, 2003; Bryman, 2004 and Saunders et al., 2009). It deals with nature of the phenomenon, what exists, reality and the nature of the world (Bryman, 2004, 2008, 2012). On the other hand, epistemology seeks to answer questions about: “how we may come to know, what constitutes knowledge, what relationships exist between the knower and the knowable, and how reality may be known” (Saunders et al., 2009; Gilbert, 2011).

Ontological and epistemological assumptions are interrelated and it is difficult to think of them separately (Bryman, 2004 and Grix, 2004), because considerations about the state of being usually leads to thoughts about the process by which we are aware of them. When integrating ontological and epistemological assumptions the base of different research methodologies can be obtained.

The methodological approach we follow in pursuing a research project, such as the methods we employ in collecting data and the sources we contact for such data, are all closely connected to the ontological and epistemological assumptions we hold about reality (Byman, 2004; Grix, 2004). Historically, the two dominant ontological perspectives that have inspired social science research have been positivism and interpretivism (Robson, 1993; Bryman, 2001; 2004; Grix, 2004). Positivism holds reality to exist independently of our knowledge of it (Grix, 2004) and regards the social world as something revealed to us, not constructed by us (Miller and Brewer, 2003 and Bryman, 2004). It follows from the positivist ontology that 'objective knowledge' is possible, for there is a fixed and unchanging reality which research can accurately access and tap. Positivism, therefore, subscribes to the application of natural science methods and practice to the social sciences (Denscombe, 2002 and Saunders *et al*., 2009)). Thus, the fundamental characteristic of positivism is the contention that the methods, concepts and procedural rules of the natural sciences can, and should be applied to the study of social phenomena (Bryman, 2001; 2004; Grix, 2004 and Saunders *et al.,* 2009).

The epistemological assumption that follows from positivism is that in a world made known to us through our sense experience, people simply receive the sensory stimuli and recount the response and thus contribute very little to knowledge (Miller and Brewer, 2003). In positivist thinking, therefore, the confirmation or refutation of theory can only be revealed from data gathered through the way the world is observed and experienced via our senses - in this case, 'objective, official statistics' (Miller and Brewer, 2003:237). Data for the positivist model of social research is thus called 'hard data' implying that it is untainted by the interpretative and meaning-endowing processes of the researcher or the researched (Creswell, 2003) and such data is numerate, seeking to measure and describe social phenomena by the attribution of numbers (Miller and Brewer, 2003). In the words of Weber (cited in Miller and Brewer, 2003, 237), "this gives an elective affinity between the natural science model of social research and those data collection techniques which give best access to sense-experience data". "These techniques notably include questionnaires, social surveys and experiments which

generate numerate data and supposedly render social phenomena 'objective', untouched by people's interpretative and reality-constructing capacities" (Miller and Brewer, 2003, 237). Contrary to the positivist view of social reality and how it can be known, interpretivism regards reality is a complex social construction of meanings, values, and lived experience (Cohen *et al*., 2000; Grix, 2004) and can, therefore, be better understood through people's interpretive or meaning–endowing capacities rather than through our sensory observation and experience of the world as believed by the positivists (Robson, 1993; Bryman, 2004). Data for interpretivist research is, therefore, obtained through the interpretations people give to their situations and experiences of reality. Often referred to as 'soft data', such data is usually verbal, seeking to reveal and describe social phenomena by the attribution of words (Grix, 2004; Bryman, 2004). Interpretive research, therefore, differs from the positivist or natural science model of investigation and employs research methods and data collection techniques that allow research subjects to interpret their own experiences of the world rather than those employed in positivist studies. Interpretivist data gathering techniques, therefore, include observations, interviews, documents and audiovisual materials which generate data mostly in the form of words (Creswell, 2003).

5.1.1 Qualitative and quantitative approaches

Some research methodologists believe that the differences between positivism and interpretivism is important because sticking to one of these ontological positions will lead a researcher to employ a different epistemological approach and research methodology than if he/she were to stick to the other, and that one's epistemological position can lead to different views of the same social phenomena (Robson, 1993: Denscombe, 2002). The ontological dichotomy between positivism and interpretivism has therefore generated epistemological distinctions between quantitative and qualitative research visions. In social science investigations, quantitative research usually rests upon the assumptions of positivism while qualitative research rests upon interpretivist assumptions (Bryman, 2001; Denscombe, 2002). The departure point of quantitative social research, as the name suggests, is numerical measurement of social phenomena (Bryman, 2004; Grix, 2004). Researchers who employ the quantitative approach usually use a very structured approach in which competing explanations are formulated in terms of the relationships between variables (Grix, 2004). Thus, quantitative researchers usually condense what they study into a number of key attributes which are generally taken as indicators or variables (Miller and Brewer, 2003). The ultimate goal of quantitative research, as stated by Miller and Brewer (2003: 193), is "to find as small a set of variables as possible which explain as

much as possible" and the broader philosophical thinking which informs the approach is that, to know something, one must establish general sets of relationships which are robust across as many instances or cases as possible (Miller and Brewer, 2003). Generalization is, therefore, the goal and the main reason why the researcher is interested in establishing relationships is to demonstrate that these are general features of social life (Ragin and Becker, 1998; Miller and Brewer, 2003; Grix, 2004). As Ragin and Becker point out, this kind of approach is well-suited to testing theories, identifying general patterns and making predictions. The quantitative approach is, therefore, deductive in nature and is associated with positivism and the natural science model of investigation (Miller and Brewer, 2003).

In contrast, qualitative research is seen by many as almost the complete opposite of quantitative research. In general, qualitative researchers tend to work in the interpretivist philosophical tradition, using methods of data collection which are flexible and sensitive to the social context in which the data are being produced (Grix, 2004; Bryman, 2008). The approach usually involves "in-depth investigation of phenomena through such means as participant observation, interviewing, archival or other documentary analysis or ethnographic study" (Ragin, 1994, 91), methods which do not rely on, but can involve numerical measurements. In line with the interpretivist paradigm, qualitative researchers generally seek to amass information from their studies on event, institution or geographical location, with a view to discerning patterns, trends and relationships between variables (Grix, 2004).

The language of qualitative research tends to revolve around case-studies and social contexts instead of variables and hypotheses as is the case in quantitative research. As noted by Holloway (1997; 80), "qualitative research involves the interpretation of data whereby the researcher analyses cases in their social and cultural context over a specific period of time" and may develop theories that emphasize tracing process and sequence of events in specific settings (Grix, 2004). Some researchers take extreme positions on the relative merits of qualitative and quantitative approaches in social science research (Preece, 1998). A major argument against qualitative research is that it is usually small-scale and non-representative, generating results that cannot be generalised beyond the cases investigated (Grix, 2004). This 'inability to generalise' from small samples or a few cases is seen to compromise the validity of results obtained through qualitative research. Furthermore, in the view of critics, the immersion of researchers in the social context they study leads to a lack of objectivity and a propensity to use personal opinions instead of

evidence to support arguments (Preece, 1998). Thus, qualitative research is often accused of being unscientific, unrepresentative, open to bias and even to manipulation, whether this is conscious or unconscious (Grix, 2004; Bryman, 2004).

In spite of its reputation, quantitative research has also been criticised on several grounds. One of such criticisms is that researchers working within the quantitative tradition are often reluctant to move from statements of correlation to causal statements and this can affect understanding of the social situations being investigated (Silverman, 2000). According to Preece (1998:43) the quantitative approach can also be criticised as reductionist, as using pre-conceived or half-understood concepts, and thus, is open to bias or manipulation in a different way. Furthermore, overdependence on quantitative methods can lead to a neglect of the social and cultural context in which the variable being measured operates (Grix, 2004). Critics also argue that quantitative research is not value-free, as some of its proponents suggest, because no one can be fully detached from any type of research (Silverman, 2000; Grix, 2004). Moreover, numerical measurement, which is so important in quantitative research, is said to be difficult when it comes to some facets of human action such as behavioural phenomena (Bryman, 2004; Grix, 2004). Thus, practitioners on each side of the methodological divide accuse their 'opponents' of a distortion of truth. While such "conflict" often usefully serves to highlight principles, there is usually much value in accommodation.

Following the qualitative-quantitative debate, the question has arisen whether the two 'opposing approaches' can be usefully combined in a single study. In the view of Blaikie (2000) triangulation or method combination is actually difficult because of the different epistemological and ontological underpinnings of the two research strategies. Such writers as Guba and Lincoln (1985), Hughes (1999) and Blaikie (2000) have, however, argued against the idea of combining the two research strategies in a single study with the reason that research methods carry epistemological commitments and the use of any data collection technique is not simply an issue of collecting data but a commitment to either positivism or interpretivism (Blaikie, 2000; Grix, 2004). This means that quantitative and qualitative researches are grounded in two incompatible epistemological principles. According to Guba and Lincoln (1985) combining the two approaches is inappropriate and represents failure to recognise the distinction between a paradigm and a method. They argue that the use of any data gathering technique involves commitment to the approach with which it is usually associated and this makes method combination inappropriate.

Contrary to the above position, some writers emphasise the usefulness of combining the two approaches in spite of their epistemological underpinnings (Grix, 2004; Bryman, 2004).The combination of method is variously referred to as triangulation (Blaikie, 2000; Grix, 2004), mixed methods research (Creswell, 2003) multi-strategy research (Bryman, 2004, 2008, 2012) or multiple methods (Robson, 2002). Bryman (2004), for instance, has argued that methods themselves should be viewed as mere tools for collecting data and should not be looked upon as being automatically rooted in epistemological and ontological commitments. He, therefore, views research methods from one strategy as "capable of being pressed into the service of another" (Bryman, 2004, 454). In support of this position, other research methodologists (including Denzin, 1989, Robson, 1993, Bryman and Cramer, 1997, Creswell, 2003; Grix, 2004 recognise that there is much to be gained from a fusion of quantitative and qualitative methods in a single study of social phenomena. Denzin (1989), for instance, has suggested that triangulation might be done in social research by using different methods, sources, investigators or theories while Robson (1993) also observes that a social research question can, in most cases, be attacked by more than one method. According to Robson, there is no rule that says only one method must be used in an investigation. He goes on to suggest that using more than one method in a single investigation can have substantial advantages even though it almost inevitably, adds to the time investment required. Preece (1998, 127) also supports the combination of qualitative and quantitative methods when he observes that while some disciplines have come to be associated more with qualitative or quantitative approaches, both find a place in most fields of study.

The views of these scholars suggest that the methods of qualitative and quantitative approaches can complement each other in a single study of social phenomena. As noted by Grix (2004: 84), "as long as you are aware of how you are employing a specific method, and what this method is pointing you towards, and how this relates to the ways you employ other methods, there should be no problem". In this regard, Grix (2004) has advised that it is generally a good idea for social scientists to use more than one method of enquiry to improve the chances of getting better, more reliable data and to minimise the chances of biased findings. He argues, for example, that there is no reason why one should not employ methods usually associated with quantitative research in an in-depth case study. These arguments provide a firm basis for the combination of qualitative and quantitative methods in social science investigations. Thus, the criticisms

notwithstanding, the mixed methods strategy of social investigation is fast becoming popular among researchers (Grix, 2004; Bryman, 2004, 2008, 2012).

5.1.2 Methodological Approach

As stated in chapter one, the purpose of this study is to see how urban planning can help improve municipal solid waste management issues in Nigeria, a West Africa sub-region. The varied nature of the data required and different sources from which they had to be gathered made the mixed methods, in this case a predominantly qualitative methodology, which incorporates to an extent an aspect of quantitative approach appropriate. In line with this methodological approach, research tools associated with both qualitative and quantitative approaches were combined to collect the data. These were in-depth interviews (see appendix 10.3 for people interviewd), field observation, policy and government document analysis and plans and household survey analysis (see chapter six). The choice of the mixed methods approach was informed by a number of reasons. First, it was meant to achieve the 'logic of triangulation' of Denzin (1989, 13) since no single method (such as interviewing, observation or documentary analysis) can completely capture all the relevant features of the study. Furthermore, the combination of qualitative and quantitative methods will enable the researcher to cross check the data gathered by different methods, thereby, making the results of the study valid and credible. As observed by Bryman (2004, 131) "combining different methodologies in a single study enhances the researcher's claim for the validity of his or her conclusions if they can be shown to provide mutual confirmation".

The decision to combine qualitative and quantitative methods in this study was justified on the grounds that it will make it possible for me to explore the research questions from different perspectives which will lead to broader understanding of the issues connected with municipal solid waste management in Nigerian cities. Bryman (2008) has argued that while quantitative research is associated with the researcher's perspective, qualitative research is concerned with seeing the object of study through the eyes of the people being studied. Therefore, combining quantitative and qualitative methods in the present research will make it possible for the issues relating to municipal waste management in Greater Jos to be captured from the perspectives of key stakeholders in the waste sector as well as from the researchers own perspective. Furthermore, combining different methods of data collection and analysis will provide the researcher with the opportunity to obtain in-depth information from the different categories of participants including waste disposal service users and public institutions involved in

waste management in one way or the other in the study areas. Without this mixed methodological approach, reliance on any single approach to data gathering could lead to loss of valuable information.

5.2 Selecting the study area

Greater Jos which is the first and the largest urban agglomeration in central Nigeria formed the site for this research. Detailed descriptions of this city have been given in chapter one (see figure 1.4) under 'Scope and Greater Jos planning area'. Of course, the city of Jos is not the only Nigerian city confronted by the solid waste crisis. All major cities in Nigeria including Lagos, Kano, Calabar, Ibadan and Port Harcourt face equally tragic waste situations that need to be investigated. After establishing that the waste menace was common to all Nigerian cities, a convenient random sampling was employed to select Greater Jos out of the numerous largest cities based on the 2006 Population and Housing Census report. The researcher was further motivated to focus on Greater Jos by the fact it represented a large municipal area in the Nigerian context and so provided an opportunity to investigate the problem of municipal solid waste practices at a manageable and researchable scale. A third motivation for maintaining this selection was that even though the municipalities in Nigeria are located in different climatic zones –Greater Jos is in the middle-belt region and the coldest city in Nigeria. This climatic nature was also seen to provide the first opportunity to investigate minimally the effects of climate on the waste situation in the municipality.

5.3 The research population and sample

Since all residents of Greater Jos are involved in some aspect of municipal solid waste management (they generate waste or require waste disposal services or are affected by waste disposal), the entire populations of the city is regarded as the study population for this research. In the 2006 Population and Housing Census (NPC, 2008), the broader metropolitan area of Greater Jos recorded total populations of 1,315,301. The old metropolis broadly captures the range of socio-demographic characteristics that exist in most parts of the municipality which are relevant to this study (see table 5.1).

S/No	Local Government Area	Population			
		Male	Female	Total population	Total population in per cent (%)
1	Bassa	92,649	94,210	186,859	14.21
2	Jos North	217,160	212,160	429,300	32.64
3	Jos East	43,249	42,353	85,602	6.51
4	Jos South	155,262	151,454	306,716	23.32
5	Riyom	71,984	59,573	131,557	10.00
6	Barkin-Ladi	88,478	86,789	175,267	13.33
	Total	**668,782**	**646,619**	**1,315,301**	**100.00**

Table 5:1: Plateau State 2006 census figures for Greater Jos, Nigeria

Source: National Population Commission Nigeria, 2008

For the purpose of the fieldwork, however, key stakeholders in the waste sector were identified to include: Planners at all levels (national, state, local); Politicians (policy makers); Government officials in public institutions whose functions affect waste management, waste disposal service providers and their users (**see table 5.2**)

Category of stakeholders	Participants
Planners at national, state and local levels	Academia, public institutions and private institutions
Politicians (policy makers)	National assembly, house of assembly and local government council
Public institutions with functions affecting solid waste management	Environmental protection agency, town planning department, urban development department and environment department
Waste disposal service providers/ communities near solid waste disposal facility clients and	Residents living in close proximity to waste disposal facility, businesses and institutions

Table 5:2: Key stakeholders in the study

Source: Author's selection, 2012

5.4 Collection of the data

Tools and procedures that are used in data collection and analysis are of utmost importance in a research study such as this one. The nature and size of data collected determine what tools and procedures are used for data collection as well as analysis. Figure 5.1 summarizes the process and key stages followed in this investigation.

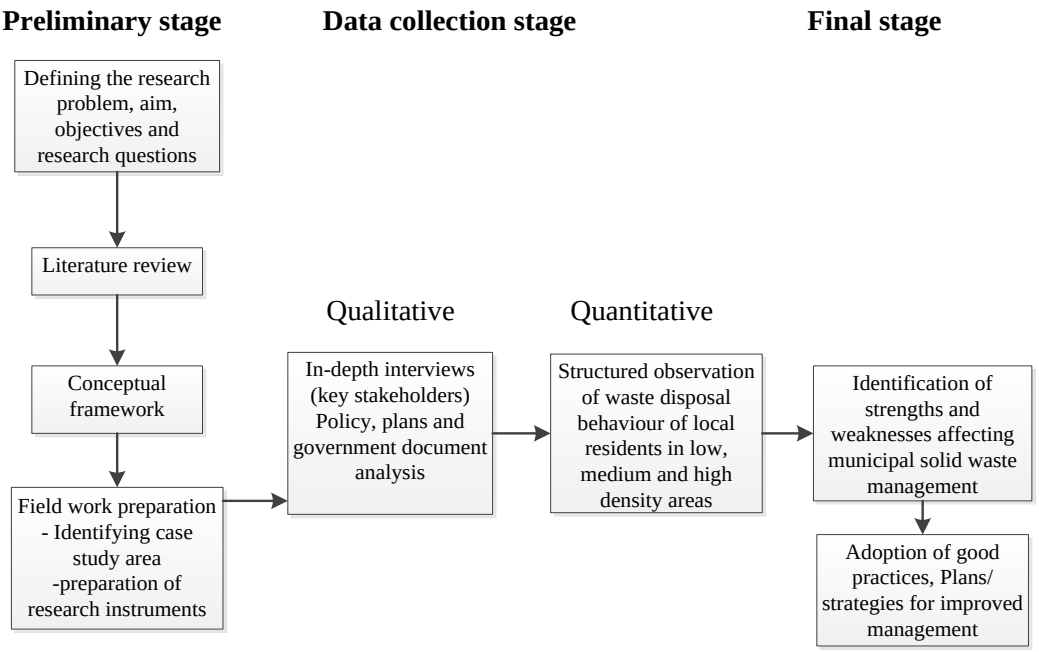

Figure 5.1: Key stages of research

Source: Author's design, 2012

The collection of data for this study was done in two phases. The first phase were scoping interviews undertaken over a six - week period from June to July, 2011. This enabled the researcher to familiarize himself with the research environment, identify key stakeholders in the planning and waste sectors and test the research instruments (interview guides and observations). In the second phase of the fieldwork (May to July, 2013), interviews was held with planners and policy makers at both public and private institutions. Face to face interviews with sixteen senior officers who are between the rank of directors and permanent secretaries in their ministries and organization who are in charge of waste management or urban planning departments or related departments, were conducted not less than one hour per interviwee (see table 5.3 for more detail).

Ministry/organization	Number of representatives and rank	Number contacted
Federal government	3: one director of town planning; one director of waste management; one general manager of MDGs.	4
State government	5: three directors of town planning; two directors of waste management.	6
Local government	2: one director of lands; one chairman of local council.	6
Policy makers	4: one national assembly member; one house of representative member; one house of assembly member; one chief of staff.	5
Private consultants/ non-governmental	5: two planners; two waste managers; one non-governmental.	5
Academia	6: one professor of urban planning; four senior lecturers of urban planning; one senior lecturer of Building construction.	7
World Bank	1: one senior manager.	1
Total	26	33

Table 5:3: Conducted interviews in Greater Jos

Source: Author's fieldwork, 2013

Questionnaires were administered to 288 householders in different residential communities that consisted of low, medium and high-incomes. This main fieldwork was carried out in Greater Jos from May to July, 2013 (see section 5.7 for more detail). Table 5.4 summarised the methodology, methods and objectives of the research.

Methodology	**Methods**	**Objectives (chapter one)**
Literature review	Qualitative	1 and 2
Use of local secondary data and materials	Qualitative	3
Policy and government document analysis and plans	Qualitative	3 and 4
In-depth interviews with stakeholders	Qualitative	4 and 5
Local case study of Jos community	Quantitative (structured observation and survey)	4 and 5

Table 5:4: Methodology, methods and objectives of the research

Source: Author's work, 2012

5.5 In-depth/semi-structure interviews

Interviewing is a useful way of collecting qualitative data because the technique is 'introspective' and allows respondents to report on themselves, their views, their beliefs, practices, interactions and concerns (Freebody, 2003). Besides, most people are more willing to talk in an interview than the case would be if they were asked to write or fill out a questionnaire (Robson, 1993).

The interview technique is associated with a number of advantages over questionnaires. Interviews were conducted on key stakeholders. This was structured to gather information from planners, policy makers and industry stakeholders on municipal solid waste management issues. This interview was done face to face by the researcher.

Interviews were combined with designed questionnaires unique to the information required. This approach helped the researcher in meeting the objectives of the research work. An interview creates the opportunity for a respondent to ask for clarification when they do not understand a question just as the interviewer can ask for elaborations on answers given by interviewees. Furthermore, there is the guarantee that all questions are answered or, at least, attempted by the interviewee (since he/she can allow enough time for the interview) which ensures a high response rate. Moreover, it becomes possible in checking the reliability of responses by asking the same question differently and at different stages of the interview (Freebody, 2003).

5.6 Developing the interview guides

Adequate preparations were done before encounters with the interviewees. In doing this, the researcher was guided by Bryman's (2012) advice on the use of the interview technique in data collection. These included: developing interview guides based on the research questions; avoiding double barrelled or multiple barrelled questions; the identification of possible interview themes or subjects; identifying the possible respondents from a given population; deciding the mode of recording the interview (note-taking, tape recording or both); seeking permission from interviewees and arranging suitable time and place for the interviews

(Bryman, 2012)

Based on the objectives set for the study and guided by Bryman's advice, interview schedules were developed for each of the different participant groups in order to address issues specific to their respective roles in waste management (see section 5.2 and appendix 10.2). In all cases, the interview schedules were semi-structured so as to allow the respondents some latitude to pursue what they considered relevant while making sure that the researcher's own questions was adequately answered. The interview schedules were divided into groups and with different sections dealing with the various issues in waste management. The questions were in themes which covered questions relevant to the stakeholders in the waste sector, the waste situation in the city, resources for waste management, constraints and participation. The interview schedule also covered issues relating to contracts, finance and logistics, personnel and constraints to their operations. Separate interview schedules were designed for public institutions in the waste sector [see appendix 10.2 (2a)]. These schedules covered relevant issues relating to their functions and how these influenced waste management in the municipality. Apart from the above, separate interview schedules were developed for businesses and

institutions that (together with householders) form the clientele for waste disposal services in the study area. The issues raised concerned their waste generation activities and means of waste disposal, available services for waste removal, payments for the service and their general perceptions about the waste situation around their premises and in the municipality. Interview schedules were also designed for discussions with a sample of informal waste collectors and residents of communities residing near waste disposal sites. The issues discussed with the informal collectors included their background, nature of their work, clientele for their services and how they perceived their role vis-à-vis other service providers in the organisation of waste management. The interviews with residents of community located near the waste disposal sites find out how their communities came to host the facilities, their concerns about the siting of the facilities in their communities and how waste disposal at the sites is affecting them.

5.7 Household survey

The researcher conducted a household survey involving selected residents (waste generators) so as to improve their waste management problems. The survey of 288 households collected data specifically on the knowledge, attitude and practices of the residents in relation to the existing pattern of solid waste collection, transportation and disposal (see more details in chapter six and appendix 10.4). Most of the efforts applied in tackling solid wastes issues in developing countries especially Nigeria have been a *'top to down'* approach without involving the communities that the facilities are to be provided. A *'bottom to top*' (bottom-up) approach which requires mobilising public support and participation is perhaps more feasible. This approach was interested in looking at people (community) - oriented affordable and indigenous technology in how they can manage their municipal solid waste. This approach was successfully applied in Ibadan, Nigeria and some countries (Tokun and Adeloye, 2005; Adekiya, 2010; Jones *et al*., 2012).

This study also aims at examining socio-economic demographic characteristic of residential neighbourhoods in Jos. Residents of Greater Jos are stratified into low, medium and high density dwellers (see tables 5.5 and 5.6). 288 households were surveyed across 8 locations employing cluster sampling technique. The analysis revealed that residents of low density zone are predominantly people of high status, those in the high density zone are mostly peasants while the medium density zone has a blend of people of high status and peasants. The occupation of householders served as basis for establishing status. It was assumed that the status of a person translates into his earning, which also

influence his choice of location and type of housing to reside. It was observed that most residents of low density zone and some parts of medium density zone live in adequate housing and decent neighbourhoods. Those in the high density zone and some parts of medium density zone live in inadequate housing that lack basic infrastructure and facilities. The high density neighbourhoods are unplanned and unsafe with poor sanitary condition. The condition of the neighbourhoods allows the researcher to conclude that such locations have suffered long neglect by government with respect to infrastructure development, provision of social amenities, and enforcement of development control standards.

The stratification of the residents into low, medium and high density dwellers, as designated by the Jos Metropolitan Development Board (JMDB) classification of various areas based on density of development, after the methods developed by Doxiadis (1976), Parizeau *et al*. (2006) and Fola Konsult (2008) is shown in table 5.5.

Sampling Zone	Number of samples collected	Geographic description (metropolis)	Demographic classification (density)	Average household size (person)	Income classification (level)
1	132	Jos-Bukuru	Low	2-4	High
2	52	Jos-Bukuru	Medium	5-7	Medium
3	104	Jos-Bukuru	High	8-10	Low

Table 5:5 Socio-demographic characteristics of sampling zone

L=Low density area; M=Medium density area; H=High density area
Population density (low = <100 persons/km2, medium = 100-400 persons /km2, high = >500 persons/km2);Income levels (low = 7,500- 30,000 Naira/month, medium = 30,000-100,000 Naira/month, high = >100,000 Naira/month). Note: £1 = 250 Naira (10/06/2013)

Tables 5.5 show the residential neighbourhoods selected for the household survey in Greater Jos. The purpose of the socio-economic demographic characteristics analysis was to overcome the difficulty encountered in obtaining the income levels of householders across the residential zones. It was assumed that a person's status translates into his earnings. Tables 5.5 and 5.6 present the classes of residents across the residential zones under study. More than eighty percent (80.6%) of the residents interviewed attended basic primary education up to tertiary level. In addition, over seventy percent (72.2%) are engaged in one form of employment or the other. The survey of households revealed that civil servants, employees of private organizations, military officers, political office holders and professional persons are mostly found in the low density zone. This class of people in Greater Jos are considered to be of high socio-economic status or "the rich". Furthermore, they have renter or ownership affordability for bungalow and duplex housing types, which happened to be common in the low density zone. Residents of

medium density zone as shown in table 5.5 are comprised of civil servants, employees of private organizations, military officers, professionals, artisans, traders, unemployed persons and retirees. The medium density zone has a blend of people of varying status. The high density zone provides affordable shelter for artisans, petty traders, unemployed persons, retirees, civil servants and some employees of private organizations. Majority of these people are considered to be the urban peasants or the economically weak class whose affordability is mostly for tenement housing. Tenement housing types in Jos often provide smaller and cheaper apartments such as single room, two rooms (bedroom and sitting room), two bedrooms and a sitting room etc. A common feature of tenement housing in Jos is the sharing of facilities by occupants of a number of apartments, which can be significant. Neighbourhoods where mud houses were found during the survey had before now existed as rural settlements in which the common and available building material was mud and grass. The houses were constructed in the traditional pattern and style with local materials. Some of the houses have become very old and the owners are gradually renovating or reconstructing them with conventional materials. Perhaps this may be the reasons why some of the houses surveyed have a combination of mud and sands crete blocks.

Zone	Residential neighbourhood
Low density	Rayfield, Jos-Jishe
Medium density	Rahwol-Gut, Lo-Pwagwom, Angwan Daba
High density	Bukuru-Bwandang, Hwolshe, Tudun-wada

Table 5.6: Residential zones in Greater Jos

Source: Author's fieldwork, 2013

5.8 Participant/direct observation

Participant observation is one of the fundamental methods used to address the objectives of the study together with other data collection methods. Observation will generate a wider range of data, if compared to the selection of data only available in written format or questionnaire survey. It is also considered significant for this study since direct contact with the neighborhood and local people involved in the case study permits the researcher to obtain information which would have been unavailable in other format. Moreover, 'soft' data such as observations and personal views have great value for qualitative research. Prior to conducting the survey, a checklist was prepared to ensure that all elements observed and evaluated were not left out. This observation survey was conducted while the researcher is in Greater Jos between May and July 2011 and May and July 2013 (see chapter six and appendix 10.5 for fieldwork summary report).

5.9 Convergence of research findings and published research (triangulation)

Published studies on municipal solid waste management in Greater Jos which can provide an ideal basis for comparison of this nature are very few. Discussions, reviews and results from previous research in municipal solid waste management have demonstrated that findings from this research can be compared by published literature from other studies on other Nigerian cities (Olowomeye, 1991; John *et al*., 2006; Nabegu, 2007; Igoni *et al.*, 2007; Sha' Ato *et al*., 2007; Adama, 2007). Comparisons from the results should be able to demonstrate a convergence with results from similar studies (Brinberg and McGrath, 1985; Dennison *et al*., 1996a, 1996b).

The principle of convergence otherwise referred to as triangulation is a key to assessing the robustness of a piece of research (Rosenthal and Rosnow, 1991). Convergence analysis assess the broad range of conditions (scope of the findings) under which the findings will hold. Convergence is achieved when there is agreement of substantive outcomes derived from the use of different and independent models, methods, and/or occasions (Adama, 2007). In this research, results from the residential survey have been used to validate the findings from the in-depth interview analysis, participant/direct observation analysis and documentary analysis results (see figure 5.2 for triangulation).

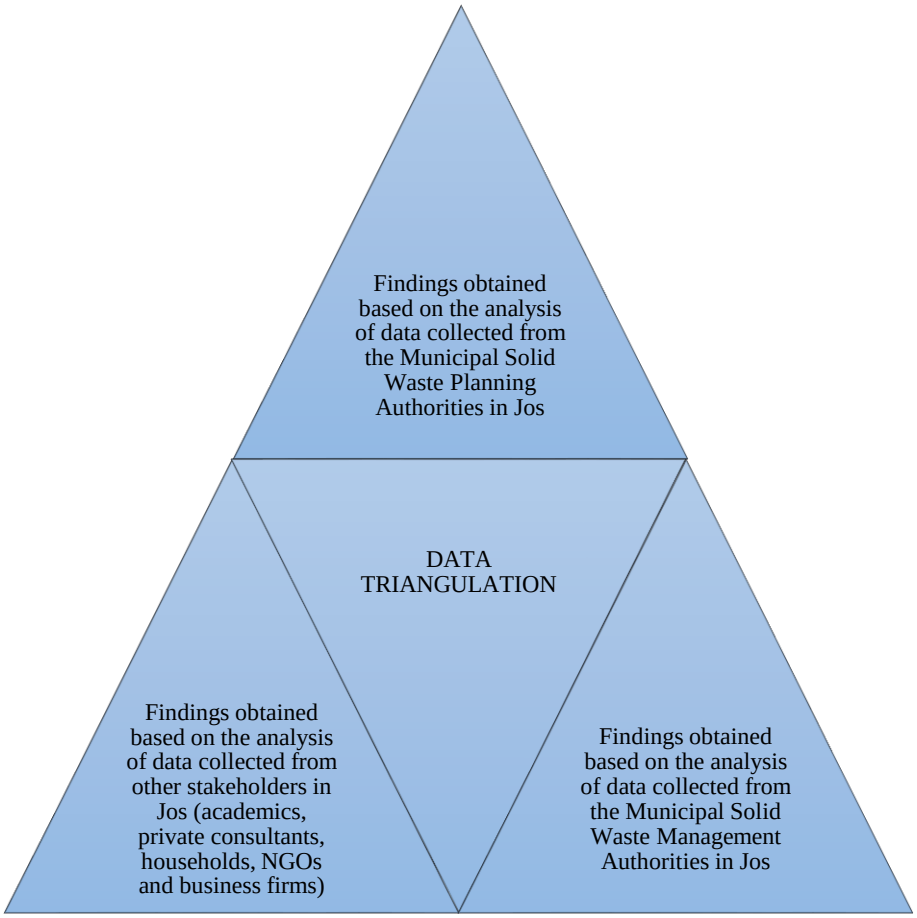

Figure 5.2: Data Triangulation

5.10 Interview and recommendations validation

It is necessary to check interpretations of interview records with respondents to ensure credibility of the research. It is good to give credit to what people say, it is also important the researcher develop and sustain a critical approach to what respondents' information. Concrete steps to validate the interview data from key respondents and the research recommendations were taken. In order to achieve this, interview transcripts and recommendations were presented for comments by some key respondents. The researcher ensures that before the information gathered was applied in the analysis, the suggested changes by the respondents were accommodated. In addition, information given by senior officials of MSW planning and management organizations was compared with what householders said and vice versa. Field observation data and documentary sources were also used against some inconsistencies. Miller and Brewer (2003) observed that checking can be made against the reports of key respondents with documentary sources like official records if assessed. Ankrah (2007) opined that having the same views from the respondents might not necessarily mean having the same idea. Rather, it is an indication of a new understanding and confers additional confidence in the research outcome. The

process of validity (see chapter eight 8.1) revealed to what extent the data and statements given by key respondents can be substantiated, predominantly issues that touched on jointed system. In addition, the researcher took note of the interview data derived from other respondents and assessed it alongside other sources. In all, the validity of the interview data was remarkably improved by this process.

5.11 Summary and conclusion of chapter five

This chapter have discussed in details the research approach, methodology and methods adopted in general, followed by a description of the actual methods that have been taken in the research in the later part of this chapter. The chapter with the help of literature review in chapters two and three identified a suitable methodology used in conducting the research in Greater Jos. This is aimed at understanding the problem, causes and issues of urban planning and management. The tools used in collecting the data were qualitative and quantitative approaches, through interviews, questionnaire survey, participant observation and analysis of documents. The researcher conducted structured and household questionnaires surveys to 26 senior officials and 288 heads of households after a pre-visit (preliminary survey). The methods used were face-to-face and door-to-door interviews conducted in Jos, Abuja and Lafia. The thirty-one experts contacted for the interviews conducted reflects the relevant work sectors and the three tiers of government thereby establishing the thread for the thesis, after using comparative review analysis. The next chapter (six) will discuss interviews conducted and illustrate obtained results from survey of questionnaire in reference to reviewed chapters two, three and four.

Chapter Six

Municipal Solid Waste Situation In Jos

6.0 Introduction

Chapter six critically examines and analyses the process of MSWM in Greater Jos using the framework derived from the literature review chapters (section 3.9). This chapter is primarily based on the interviews conducted on senior government officials and residential households in Jos, between May and July 2011 and 2013.

6.1 Framework for MSWM practices in Greater Jos

In order to understand the current municipal solid waste management issues in the study area, a review in line with one of the research objectives – to investigate the municipal solid waste problems in Greater Jos have been undertaken. This is based on data collected in November 2011 at the Plateau Environmental Protection and Sanitation Agency (PEPSA). The Director of Enforcement and Public Affairs of PEPSA was interviewed by the researcher. The compositional data was collected by PEPSA through random sampling of waste, questionnaires, observations, fact finding and analysis (PEPSA, 2011). Tables 6.1, 6.2 and 6.3 provide information on the composition of waste produced in the high and low density settlements in the municipality

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Waste component	High density (residential) %	Low density (residential) %
Fabric	3.38	0.97
Plastic	3.14	0.97
Polythene	5.79	2.41
Organic	28.97	8.69
Metals/tin	1.45	0.97
Paper	3.14	1.21
Leather	1.26	0.72
Debris	19.56	13.76
Dead dry cells	0.97	0.24
Bottles/glasses	1.21	1.21

Table 6:1: Household waste percentage of the total composition data for different settlements in Greater Jos

Source: Author's fieldwork, 2013

Waste component	Category of settlement		
	Commercial (%)	Residential (%)	Industrial (%)
Fabric	3.33	0.07	0.19
Plastic	3.15	0.19	0
Polythene	6.3	1.85	1.29
Organic	28.9	4.63	3.33
Metals/tin	1.85	0.19	0.56
Paper	2.33	2.59	0.92
Leather	1.52	0.56	0
Debris	25.56	1.48	4.45
Dead dry cells	0.93	0.37	0
Bottles/glasses	2.42	0	0.59

Table 6:2: Waste generation data for different categories of settlement in Greater Jos

Source: Author's fieldwork, 2013

Waste component	Percentage (%)
Fabric	3.69
Plastic	3.33
Polythene	3.44
Organic	36.86
Metals/tin	2.59
Paper	6.85
Leather	2.07
Debris	31.49
Dead dry cells	1.29
Bottles/glasses	2.44

Table 6:3: Solid waste component in Greater Jos

Source: Author's fieldwork, 2013

6.1.1 Solid waste storage

Collection of solid waste is the key to proper waste management as inevitably waste is stored on premises where it is generated. PEPSA is responsible for collecting waste from the metropolis and in collaboration with the state's Ministry of Environment makes containers available at strategic areas for the storage of refuse. These include "dino-bins", "walk-side bins", drum-size bins and large fibre-glass bins (see Figures 6.1, 6.2 and 6.3)

Figure 6.1: Dino-bin used in Greater Jos

Figure 6.2: Walk-side bin in Greater Jos

Figure 6.3: Large fibre glass bin in Greater Jos

6.1.2 Solid waste collection and transportation

Collection and transportation are the major costs in the waste management process. The state government through PEPSA is the sole organ responsible for the

collection and transportation of solid waste in the Jos metropolis. Private companies were at one time appointed to do this to complement the efforts of government but failed because they were more interested in the collection of money than the actual waste collection. However, informal collection workers (called wheel barrow boys) operate house-to-house collection services and often separate out recyclable materials and dump unwanted degradable waste in the public bins provided by the government. Shortage of waste collection vehicles is due to the inadequate funds allocated for the sector by the Plateau State Government (see Table 6.4). Sorting is carried out by informal sector collectors from their carts; by collection crew from waste vehicles; and by scavengers, both from street bins and dump sites (see Table 3.8).

S/N	Type	Existing unit	Number functional	Percentage (%)
1	Tippers	4	3	75%
2	Roll-On Roll-Off Skip Vehicles	4	3	75%
3	Tractors	2	1	50%
4	Automatic Compactor Trucks	4	1	25%
5	Side Loader Trucks	2	2	100%
6	Pail Loader	1	-	0%
7	Back Hoe/Bucket Loader	1	1	100%

Table 6:4: Summary of waste collection, transportation and disposal vehicles owned by government operating in Greater Jos

Source: Author's fieldwork, 2013

S/N	Type of collection point	Capacity(ton)	No	Distribution
1	Open collection point	Varies	500	Spread along streets, roads, open spaces and land patches.
2	Dumper bin or container	2-3 metric tons	80	Found around main market, old town/city, shopping complexes, hotels, along roads.
3	Garbage shed	4-6 metric tons	10	Located in the central business district

Table 6:5: Municipal solid waste collection profile in Greater Jos

Source: Author's fieldwork, 2013

6.1.3 Solid waste disposal and recyling

The disposal is a critical aspect of waste management due to the fact that improper disposal can result in water pollution, the breeding of disease vectors, dangerous reptiles and rodents, fire hazards due to methane gas emissions, etcetera. The Jos metropolis lacks officially acquired and developed waste disposal sites as such, waste is crudely disposed of at private barrow pits made available to PEPSA on a temporary basis. The open dump system is used in Jos for the disposal of solid wastes. When the wastes are unloaded, they

trigger unpleasant and hazardous smoke from the associated fires. A great percentage of the waste in Jos is disposed into open drains by inhabitants. During the rains, this is carried by flood water from drains into the streams. The use of the River Dilimi and its tributaries for waste disposal purposes has caused the river to be full of solid waste congestion, rendering it unhygienic and an eyesore. Thre is no formal recycling in Greater Jos. Sorting is carried out by informal sector collectors from their carts; by collection crew from waste vehicles; and by scavengers, both from street bins and dumpsites.

6.2 Population projections and planning implications for waste generation and management in Greater Jos

These issues need to be seen in the context of population change in the city. The Jos-Plateau was initially a mining area. The Jos-Bukuru axis grew because of the combination of mining and a consequent increase in trading activities. At the onset of the creation of Benue-Plateau State in 1967, the Jos-Bukuru area, with Jos as the state capital, started to witness phenomenal increases in its population growth due to high in-migration from different parts of the country and as the state to the capital. The in-migrants included those seeking employment, thus population grew rapidly

By 1976 Plateau State was created out of the former Benue-Plateau State. The present Benue State and parts of present Nassarawa State were similarly carved out of the former Benue-Plateau State whose capital was Jos. This led to considerable out-migration from Jos and its environs by indigenes of the established Benue and Nassarawa States to their respective states. This had a profound impact on the population in the Jos-Bukuru axis in particular and on the Plateau State in general.

A second prominent effect on population was the decline in mining activities on the Plateau. Most of the mining companies in the 1960s closed up their production and processing industries in the Jos, Bukuru, Korot and Bisichi areas of the metropolis. A third factor in the decline of the population influx into the Jos-Bukuru area was related to the decline in manufacturing industries and hence employment opportunities. Nevertheless the closeness of Greater Jos to Abuja attracts people working in the Federal Capital Territory to live in Jos because of the low cost of living. Looking to the future this study expects an average annual growth rate of 5 per cent to project the city's population and hence estimate waste generation in 2025. This is based on the current trend of rapid urbanization in developing nations and Nigeria in particular. A 4 percent rate was assumed for the ten years between 2015 and 2025. The National Population Census figures of 2007 in table 6.6 shows the projected population figures for the five

local government areas that fall within the Greater Jos up to the period 2025. A projected total population of 2,739,574 is expected for Greater Jos by the year 2025.

S/No	Local areas	2007 population		2025 population	Percentage (%) of total population
1	Bassa	186,859		389,293	14.21
2	Jos North	429,300		894,197	32.64
3	Jos East	85,602		178,346	6.51
4	Jos South	306,716		638,869	23.32
5	Riyom	131,557		273,957	10
6	Barkin-Ladi	175,267		364,911	13.32
Total		1,315,301		2,739,574	100

Table 6:6: Projected Population Figures for Greater-Jos 2007-2025*

*5% Growth rate was assumed for the 7 years, 2008-2014, and 4% for the last 10 years, 2015-2025.

Source: NPC 2007 and Author's projection 2013

The implication of the estimated population figure for Greater Jos indicated above is that even with the conservative growth rates of between 4 and 5 per cent; the population would have doubled itself within a period of 17 years between 2007 and 2025. The probable implications are that the urban infrastructure, facilities, housing and employment opportunities will be overstretched.

Will there be any adequate provisions in solid waste planning and management to accommodate the anticipated increase? The anticipated additional population by 2025 will be 1,424,273 entailing new residential environments to be created and old ones restructured. Using 0.5kg/person/day for per capita wastes generation for Nigeria (NEST, 1991) in 2007, Greater Jos was generating about 657,650.5kg of waste using the population figure of 1,315,301 people. The generation quantity is expected to be 1,369,787kg in 2025. If we assume an average household size of 6, then it is expected that there will be an additional 237,379 gross number of households within the Greater Jos area by 2025 as shown in table 6.7.

S/No.	Local areas	2007 population	2025 population	Additional population	New households/expected housing units**
1	Bassa	186,859	389,293	202,434	33,739
2	Jos North	429,300	894,197	464,897	77,483
3	Jos East	85,602	178,346	92,744	15,457
4	Jos South	306,716	638,869	332,153	55,359
5	Riyom	131,557	273,957	142,400	23,733
6	Barkin-Ladi	175,267	364,911	189,644	31,607
Total		1,315,301	2,739,574	1,424,273	237,379

Table 6:7: Projected Population Figures and Housing Need 2007-2025

***An average of 6 persons per household is assumed for computation.

The difference in the actual row and column totals of the expected new households/ housing units is due to rounding off of the figures. With the projected population figures of about 2,739,574, commercial activities in both wholesale and retail trade are expected to increase tremendously (see Figure 6.4). These statistics set the context for municipal solid waste planning.

Figure 6.4 5: Greater Jos central area

6.3 Municipal solid waste planning authorities

In the framework set out in Table 3.3 key issues for waste planning were identified as the absence of systematic control and enforcement mechanisms, fragmentation of policies and laws, duplication of roles, insufficient funding, absence of systematic planning and institutional fragmentation/coordination. This are now considered in relation to Greater Jos in the next two sections. The municipal solid waste planning authorities are listed in figure 6.5. The planning authorities are structured to carryout implementation and enforcement of plans and development control within their respective tiers (federal, state and local) of government (figure 6.5). In addition, they are also involved in enforcement of waste management plans, standards and regulations. This is in accordance to detailed information given by senior officials of the respective planning authorities. For instance, the Jos Metropolitan Development Board has the responsibilities

of carrying out development control and plans implementation in Greater Jos. It also carries out surveillance on environment within the same metropolis through enforcement of environmental standards and regulations clauses. This was confirmed through an interview with a senior official of the development board. The official said that in 2003, before the formation of PEPSA they had been fully in charge of solid waste management in Greater Jos (Jos-Bukuru metropolis). The senior official further explained that some of their environmental health officers were transferred to PEPSA in order to assist in the administration of waste management in the state. On the issue of whether they have a waste management plan or policy for SWM in Greater Jos, the senior officer only claimed that they used the Public Health Ordinance of Northern Nigeria to execute their work.

Figure 6.5: Analysis of Data Collected from Municipal Solid Waste Planning Authorities

The Ministry of Lands, Survey and Town Planning (MLSTP) whose responsibilities are similar to that of JMDB in terms of development control and planning (see figure 6.5), also claimed from the interview conducted that they are involved in the overall standards and regulations through siting of waste management points and environmental surveillance in Plateau State.

Another Ministry with the responsibilities of waste management plans in Greater Jos municipality as seen in the Greater Jos Master Plan (2009-2025) is the Ministry of Housing and Urban Development (MHUD). It claims to have control over the implementation of all plans (including solid waste plans) in Greater Jos. This was evident when a senior officer interviewed narrated how they produced the current Greater Jos master plan by awarding the contract to a private consultant planner. The senior officer claimed that the provision for solid waste management is included in the master plan. On how it managed the municipal solid waste in Greater Jos, the senior official directed the researcher to PEPSA. The senior official claimed that apart from implementation of the Greater Jos master plan, they are also responsible for carrying out development control and enforcement of environmental standards and regulations.

In addition, the federal government presence in the state is through the involvement of the Federal Ministry of Lands, Housing and Urban Development (FMLHUD), a ministry having responsibility for municipal solid waste management only in the federal landed properties of Greater Jos municipality. This was also very clear from the in-depth face to face interview with a senior director of planning in the ministry. He noted that the federal ministry is in Greater Jos to enforce environmental standards and regulations within the residential estates of the federal government. When asked if they are strictly involved in municipal solid waste issues of the state, the senior director said they are in one way or the other since they have their estates located in Greater Jos municipality.

Furthermore, the senior director who is a planner, claimed to liaise with the Federal Ministry of Environment (FMOE) in Jos, using environmental officers in taking care of sanitation in their various estates in the municipal area. However, the senior director quickly claimed that the implementation of the waste management plans for the municipality is a responsibility of the Plateau State through the democratically elected government of the State. On whether, they collaborate with the State government in areas of solid waste management, the senior director said absolutely no, but they are supposed to be involved by the state government in preparing any waste management plan. According to the officer of the FMLHUD, this can improve on solid waste management issues in the municipality.

At the local government level, six local government areas as shown in Greater Jos Map (chapter 1 figure 1.4) have an individual lands section that deals with solid waste management. This is in line with the Nigerian federal government constitution. But

because of the lack of adequate funding, they are not able to plan and manage waste within the Greater Jos municipality. This is evident in the former Jos-Bukuru metropolis which constituted the former Greater Jos; the two local government areas (Jos North and Jos South) have not been part and parcel of the waste management authorities of Greater Jos after its first creation in 1976.

An interview with a senior officer of one of these local government councils found that they claimed that although they have the power, funding is inadequate, since they receive revenue allocation money from the federal government through the State government. The senior officer said if given all the necessary financial and material resources backing, they can manage effectively municipal solid waste within their municipality. However, the officer noted, "As of present, we have enough staff to do the work, the senior official claimed, …for now, the six local government councils that constitute Greater Jos area are out of the organization of municipal solid waste management in the area"

At present, in terms of the collection of waste in the local government areas, the majority of the residents collect their waste in closed containers, but according to what was observed, the attitudes of the Greater Jos residents, with regards to disposal of refuse at dump sites, indiscriminate dumping of waste is still taking place. This is as a result of no designated dumpsites or authorized collection points at the various local government levels. This is due to the failure of government at the third tier levels to provide designated collection points.

As observed by the senior officer, there is only one major dumpsite for Jos located at Dong village within Greater Jos, which is in a long distance from the residents. This encourages the emergence of many unauthorized dump sites (Author's field work, 2013).This can be seen in figure 6.6..

Figure 6.6: Indiscriminate dumping of solid waste in Greater Jos municipality

In terms of knowledge about legislation on solid waste, the senior officer of the local council said the inhabitants at the local level lacked any knowledge about specific legislations like solid waste management but they are only aware of the general monthly sanitation exercises conducted by the state government. This could be one of the reasons why there is no compliance to any specific legislation by the residents.

The Ministry of Housing and Urban Development claimed to have control over the implementation of all plans (including solid waste plans) in Greater Jos. This was gathered from a senior officer interviewed who narrated how they produced the current Greater Jos master plan by awarding the contract to a private consultancy firm. The senior officer claimed that provision for solid waste management is included in the new master plan which is yet to be approved. On how to managed the municipal solid waste in Greater Jos, the senior official diverted the attention of the researcher to PEPSA. The senior official claimed that apart from the implementation of Greater Jos master plan, they are responsible for carrying out development control and enforcement of environmental standards and regulations (figure 6.7).

6.4 Municipal solid waste management authorities

The MSW management authorities in Jos have been identified to be NESREA, PEPSA, MOE, FME and MDGs (figure 6.7). On the management of solid waste, they have individual responsibilities different from each other but aimed at controlling the standard of environmental laws and implementation. At the federal level NESREA and FME are represented but the enforcement of standards of regulations is done by NESREA using the policy formulated by FME. The presence of NESREA in Jos is to regulate all environmental concerns on the Jos environment including its jurisdiction. Even though the agency is also working on the Jos environment, the Plateau State MOE is the parent ministry in charge of policy making on environmental regulation and standards for the

state. The FME and the state Ministry of Environment use the federal policy on environment to implement environment laws. These laws include MSW within different tiers of government.

In the case of Greater Jos, PEPSA is the main agency responsible for managing solid waste. Although it has similar roles, functions and responsibilities with NESREA, it does not work with NESREA formally. This is because it was created by the Plateau State edict on environmental protection and so it derives its power from the state government rather than from the federal government. Presently, they are in charge of conducting the monthly environmental sanitation in the state. In the area of staffing the director in charge of personel said that it is inadequate and they use staff from the MOE to discharge some of its functions. The MOE is responsible for its funding but has been grossly under funded (a director in the ministry confirmed that to the researcher) and so it cannot discharge very well most of its responsibilities, so there is a lack of operational vehicles qualified trained manpower. On the other hand, NESREA is present in the state due to the inadequacies of FEPA to implement and enforce Nigeria environmental policies. This was stated by the Plateau State NESREA coordinator who claimed that MSWM issues in Greater Jos is part of their function, and so they have field staff that go out on a daily basis to carry out environmental surveillance within the Greater Jos municipality. He cited some cases that they handle in the state that relates to the violation of environmental standards. On the issue of their relationship with PEPSA, the senior official claimed there was no formal relationships with that each agency.

At the MOE, the director in charge of solid waste management monitoring department outlined some of their functions to be, the sole overseers of environmental management in Plateau State not only Jos. On Greater Jos municipal waste management issues, he said that they are using PEPSA as their foot soldier, which is their main enforcement agency. As of present, their department have designed a MSWM plan for the state and have submitted copies to the government for approval. In the content of MSW plan for Jos, she said the basic aim of their proposal is to have one waste management authority that will control every municipal solid waste in the state similar to that of the Lagos Waste Management Authority (LAWMA). They have already attended workshops in (LAWMA) on the proposed waste management body. The purpose of doing this is to use waste as a resource, using the "waste to wealth" concept and thereby handling issues like waste minimization, waste recovery and recycling. The director

added that, a company in Germany has been contacted by them for a collaboration relationship in running waste management in the state.

As of present, there is no private participation in the MSWM industry in the state, this is because in the past they have tried involving private contractors but it failed. One of the reasons given was the lack of competent contractors handling the waste in Greater Jos and also inadequate funding in order to pay the contractors. She also explained that, though they use the policy on environment that comes from the federal government, FME operates at different tiers of government. She explained further how the federal government is responsible for directing the federal ministry of environment affairs on environment and the state government directs the state MOE. On her ministry relationship with the planning authorities in Jos who are responsible for SWM, she claimed that they don't perform their statutory functions. On the issue of the new Greater Jos master plan, the senior official claimed that their ministry have not been contacted, even though they know that there is a new Greater Jos master plan.

Another MSWM authority is the MDG office in Jos. When contacted by the researcher, a senior officer in the organization claimed they have not started dealing with the issue of MSWM in the State, but will be ready to welcome any such move by the state government. Also, asked whether they operate in the state by collaborating with the other SWM Agency, the senior officer said they are independently sponsored by the World Bank through the Presidency in Nigeria.

Figure 6.7: Analysis of Data Collected from Municipal Solid Waste Management Authorities

6.5 Non-state actors

The non-state actors are those stakeholders (see chapter five table 5.3 and appendix 10.3) on MSWM who have more of independent authority over the administration of waste (figure 6.8).The academics (six interviewed); residential households (288 heads of household surveyed); non-governmental organizations, business firms and private consultants (five interviewed) formed these actors. Analysis of residential households showed a lot concerning the contributions of this case study. A professor of planning from the University of Jos whose resident falls within the residential households surveyed, described the situation of the waste issues to lack of political will by the government to tackle the issues (Author's interview, 2013).

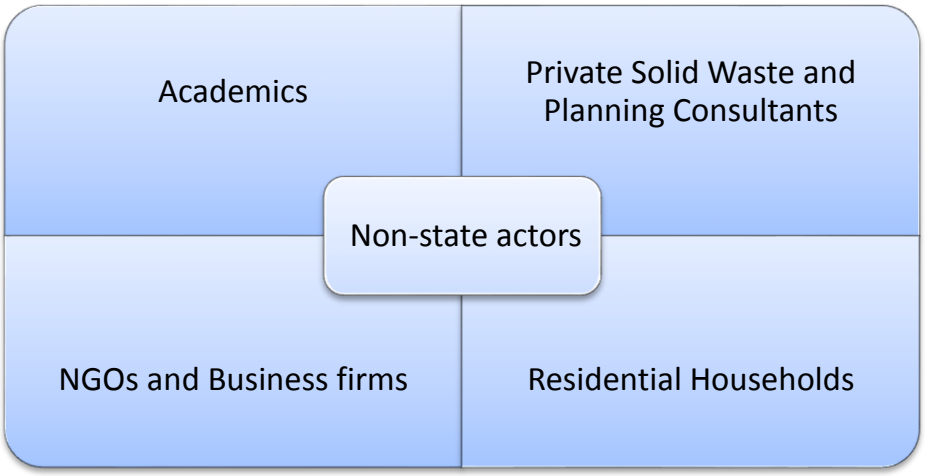

Figure 6.8: Analysis of Data Collected from Non-State Actors in Municipal Solid Waste Management (well captured in descriptive statistics - appendix 1: household survey of municipal solid waste in Greater Jos municipality).

Consequently, urban residents are facing differentials in access to opportunities, income, consumption, location. Income inequalities manifest in discrimination in access to basic infrastructural facilities like wastes and livelihood opportunities. Inequalities are present in the urban space with municipalities divided by visible borders that split the high income (planned areas) from the medium and low-income (slums-where more than 70% of the urban population lives).

One of the objectives of this study is to examine the relationship between municipal solid waste management and residential zones in Greater Jos. Inequality exists in the living situation of residents through residential zones (chapter five - table 5.5 and 5.6). From the household survey analysis, it is revealed that residents of low density areas are predominantly people of high status, those in the high density areas are mostly labourers while the medium density zone has a blend of people of high status and labourers. The occupation of householders served as basis for establishing status. It was presumed that the status of a person transforms into his earning, which also influence his choice of location and type of area to reside. It was witnessed that most residents of low density area and some parts of medium density area live in adequate residential houses and decent neighbourhoods. Those in the high density area and some parts of medium density area live in inadequate residential areas with non-existence of basic infrastructure and facilities.

The high density areas are unplanned and unsafe with poor sanitary conditions (see appendix 10.4). Outcomes from the condition of these neighbourhoods showed that there were a significant difference in the management of the municipal solid waste across

the residential zones. Relationships exist between poor planning and municipal solid waste management, and there is a relationship between poor enforcement of planning regulations and municipal solid waste management. It was concluded that such locations have suffered a long neglect by government with respect to infrastructure development, provision of social amenities, and enforcement of development control standards.

6.6 Households' perspective on the waste disposal process

The pattern of the waste disposal in the city are assessed from descriptive statistics derived from the household survey. From the household survey analysis, it is revealed that 45.8 per cent of the residents are in low density areas living in adequate residential houses and a decent neighbourhood. 3.61 and 18.1 per cent respectively are in high and medium density areas living in inadequate residential areas with non-existence of basic infrastructureand facilities. This situation encourages indiscriminate disposal practices by the residents. The categorisation of this densities is explained in chapter five section 5.7.

Figure 6.9: Residential Zones

6.6.1 Type of Household Waste

Most respondents in the area have indicated food waste (76.4 per cent) as the item generally produced through household consumption. The analysis also shows 9.7 and 13.9 per cent are materials that are not organic. For example papers, plastics and polythenes. See figure 6.10 for more details.

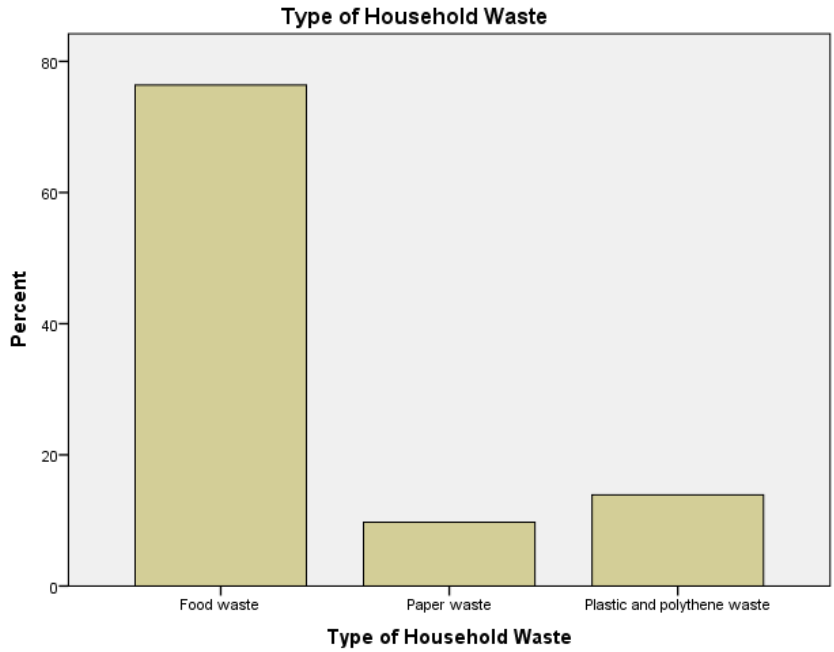

Figure 6.10:Type of Household Waste

6.6.2 Household Waste Disposal Type

Figure 6.11 shows the different types of waste storage by households which include the closed container (48.3 per cent) which were either wheeled bins or barrel. These are the common practices in the communities. A greater proportion of the low-income and middle-income householders disposed their waste using various containers like open container, polythene bag/sack and others – such barrels, empty cartons or buckets (see figure 6.11). Usually, the waste remains for long periods and gets scattered leading to roads, gutters and drain blockage.

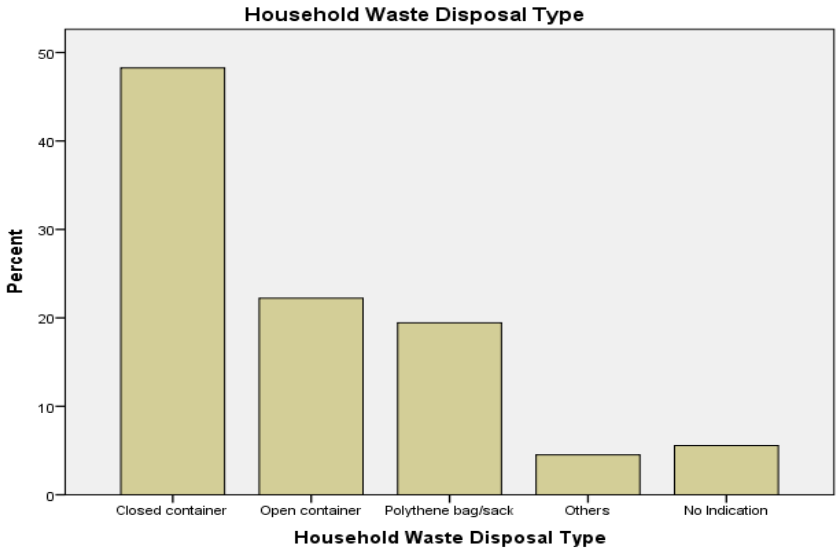

Figure 6.11: Household Waste Disposal Type

6.6.3 Household Waste Collection Type

About 34.7 per cent of the householders indicated their waste collection arrangement as house-to-house collection (home collection. 19.4 and 16.7 per cent indicated roadside collection and communal container collection provided by the PEPSA. 29.2 per cent dump their waste in the community, drains, bushes, burning or by burying in their backyards (see figure 6.12). Households without services were mostly found in the low-income areas. It is common to see residents dumping waste at a location that is convenient to them or engage informal waste services.

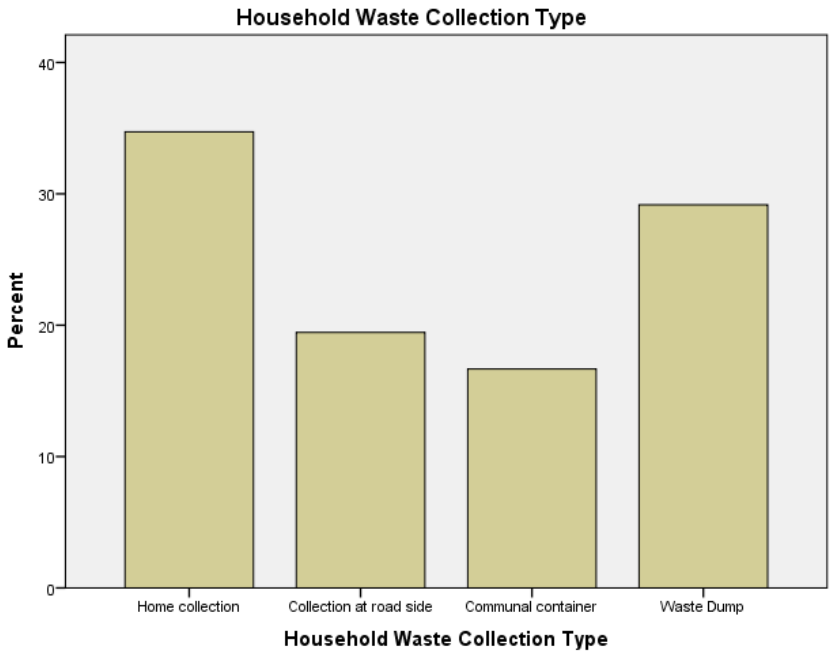

Figure 6.12: Household Waste Collection Type

6.6.4 Household Waste Service Provider

PEPSA is the main service provider having 61.1 per cent, followed by those without indication with 27.8 per cent. Other providers are Ministry of Environment- 1.4 per cent, scavengers – 4.2 per cent and private waste – 5.6 per cent (see figure 6.13).

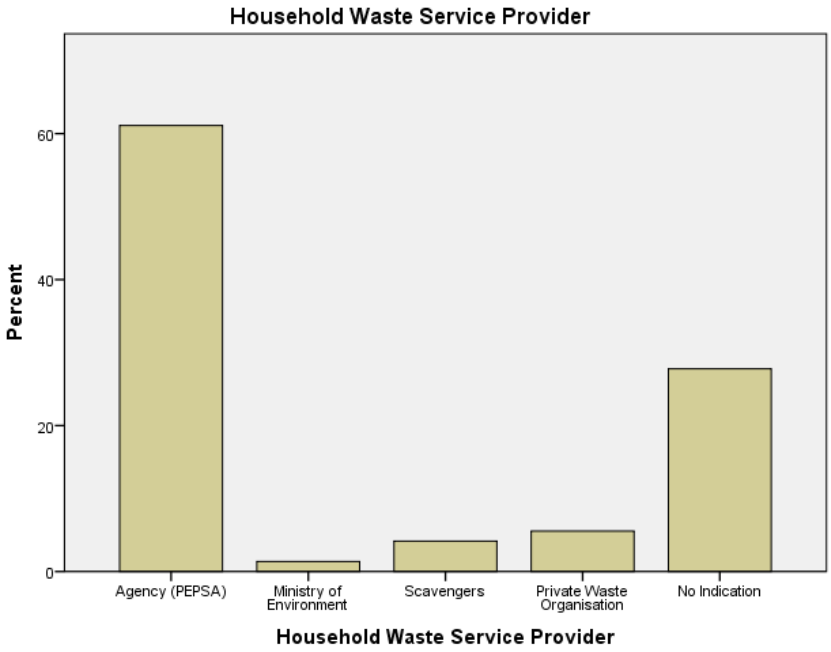

Figure 6.13: Household Waste Service Provider

6.6.5 Distance of Collection Point from Home

From the analysis (figure 6.14) shows that 13.5 per cent of the householders walk less than 10 metres to a collection point from their residents. 96.5 per cent walk more than 10 metres from their houses to a collection point (see appendix 10.4 for more detail).

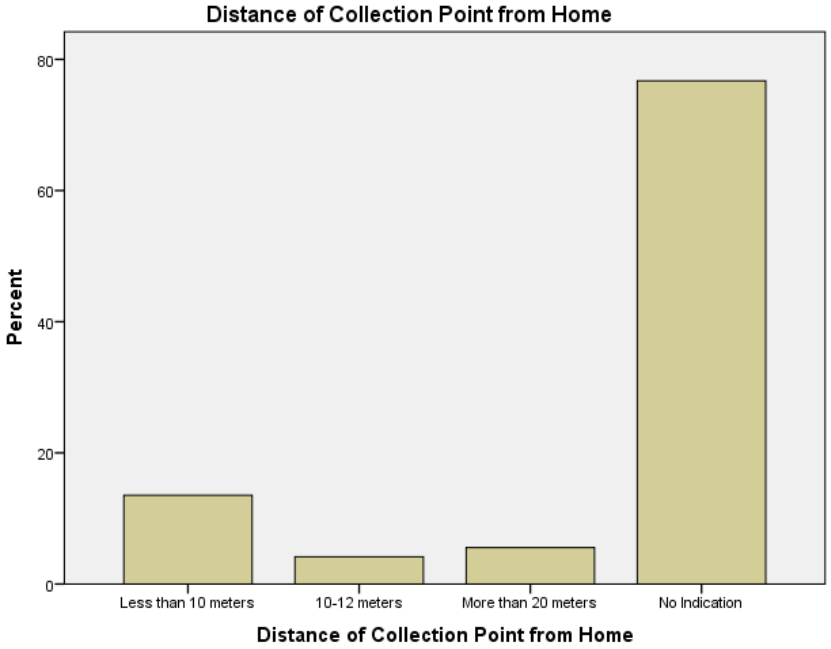

Figure 6.14: Distance of Collection Point from Home

6.6.6 Sanitary Condition around Waste Container

Figure 6.15 shows the summary view of householders that 73.6 per cent of residents are not satisfied with their neighbourhood sanitary condition around waste containers. It shows that there is a positive relationship between status of income and sanitary condition in terms of cleanliness (see appendix 10.4 – Neighbourhood sanitary situation). In addition, this shows that residents of low-density areas are more satisfied with their waste sanitary situation than their medium and high densities counterparts.

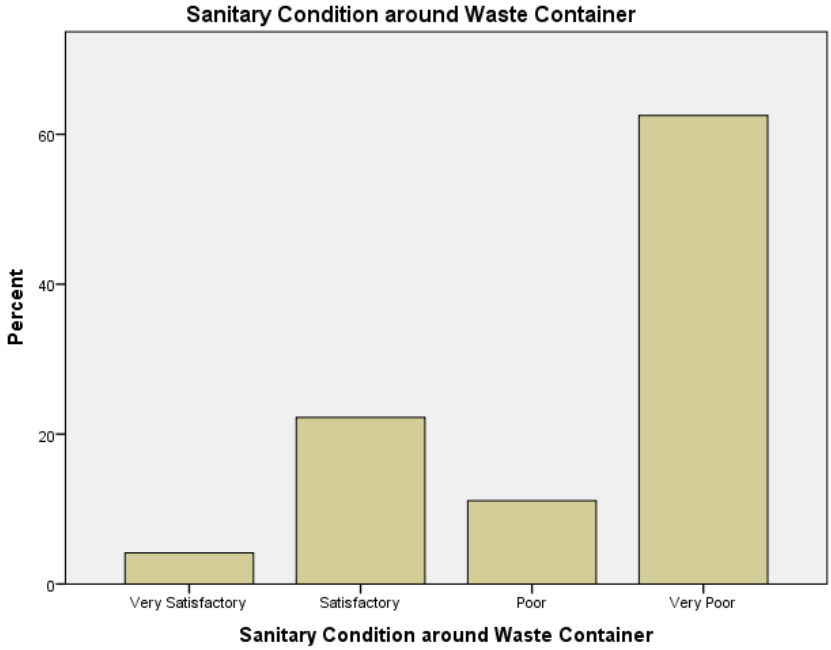

Figure 6.15: Sanitary Condition around Waste Container

6.6.7 Quality of Waste Disposal Service

Figure 6.16 shows that 55.6 per cent of the householders are satisfied with the quality of services provided. This is from majority of the higher-income communities of Greater Jos, rather than their lower- income counterparts who constitue the remaining 44.4 per cent.

Figure 6.16: Quality of Waste Disposal Service

6.7 Summary and conclusion of chapter six

The chapter analysed the data collected from the municipal solid waste planning authorities, municipal solid waste management authorities in line with results in terms of table 3.3 framework. The chapter also examines whether different approaches to solid waste management are facilitating higher levels of integration with legislation and policy, between neighbouring planning authorities and policy makers and meaningful engagement with the public and hard to reach communities and stakeholders.

From the analysis in this chapter, waste management authorities in Greater Jos are struggling with situations of mounting of waste for disposal. The authorities (both planning and management) failed to provide adequate collection of waste for the municipality. Poor residential areas (low-income and middle-income householders) have no provision for solid waste disposal and removals arrangements. While the population of Greater Jos continued to increase, the authorities have not located suitable waste management plans, and they are not able increase their capacity for services provided. The situation is not encouraging and the future is not guaranteed to be better, in terms of waste management issues. The next chapter (seven) advances with the discussions of findings of this research.

Chapter Seven

The Jos Municipal Solid Waste Management Process in a Wider Context

7.0 Introduction

The research has revealed that municipal solid waste authorities are unable to plan and organize adequate collection and safe disposal of the municipal solid waste generated by the residents in the Greater Jos area (see chapter six).This chapter now considers the processes identified within a broader policy perspective.

A number of specific planning factors emerged from the literature review that are set out in table 3.3 (chapter three) as responsible for the weak municipal solid waste management in developing countries. This chapter discusses the planning factors under three key (government, politics and public) inter-dependent elements that interact in any municipal solid waste management. More specifically these key elements can be defined as: Policy, legislation and environmental regulation; Financial instruments; Plan / strategy and implementation; Institutional, administrative capacity; Planning and stakeholder participation; and Coverage, collection, recycle, reuse. This can be illustrated in the figure 7.1. It draws again on the interviews with key public officials but also with the informants from the private sector and academia.

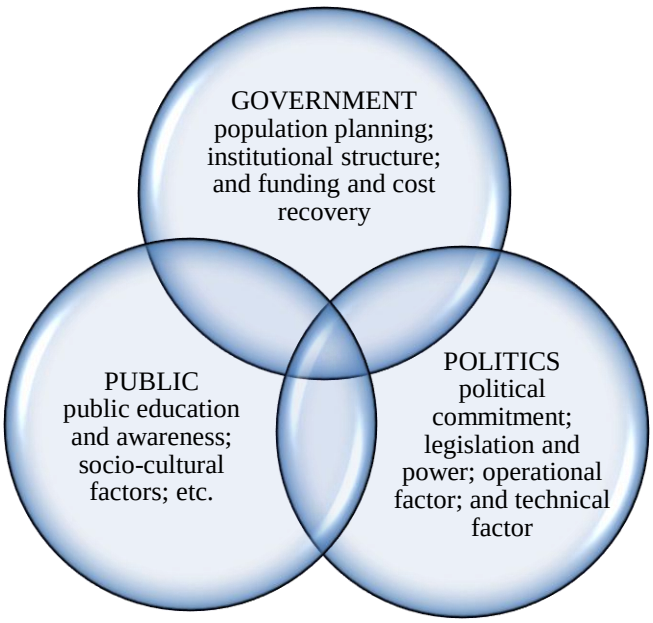

Figure 7.1: Key drivers of Municipal Solid Waste Planning (MSWP) in Greater Jos.

This section discusses how the three key elements interact in contributing to the improper management of municipal solid waste situation in Greater Jos.

7.1 Government

7.1.1 Planning for Population Change

In 2008, Plateau Environmental Protection and Sanitation Agency (PEPSA) estimated that each person in the area produced 0.5 kg of solid waste in a day and the various municipal authorities have since employed this figure to calculate the quantities of municipal solid waste generated within their jurisdictions. The PEPSA's estimate of 0.5kg per head per day has also been quoted by several studies including PEPSA (2008, 2013).

It is difficult to establish the accuracy of the per capita daily waste output calculated by the PEPSA and the subsequent estimations of waste generation made by the Greater Jos master plan. The half-a-kilogramme per capita per day waste output measurement was the national average in 2000, some twelve years before this study and the situation could have changed over the years since population dynamics have significant influences on the level of waste generation in human settlements. For instance, changes in lifestyles and consumption patterns among the population could bring about changes in the types and levels of waste generation. It is also known that urban residents generate more waste than their rural counterparts due to their higher consumption of products (Onibokun, 1999). If it holds true for Nigeria that cities in the country have higher levels of waste generation than rural communities, then the per capita daily rates of waste generation in Greater Jos, which is a major municipal area in the country, could actually be higher than the national average of 0.5 kg. In this case, the estimated levels of waste generation for the municipality could be incorrect.

In fact, because the total populations of this city have not been accurately determined, any attempt to measure the total daily waste output for the municipal area (even if the per capita output is known) becomes problematic. It can, therefore, be concluded that either the municipal's functional population or its per capita waste output (or both) have been probably underestimated by the municipal authorities.

It is very likely that the calculations of solid waste generation made for Greater Jos will likewise be erroneous and that the waste authorities are working with inaccurate data. The lack of accurate waste generation and characterization data is one of the factors that seriously constrain effective planning and organization of municipal solid waste

management in Nigerian municipalities. Proper waste audits would need to be carried out to determine the actual rates of municipal solid waste generation for the various municipalities in the country and this should be checked against the national average figure which may no longer be valid due to reasons stated earlier in chapter three. This situation greatly affects the planning and organization of solid waste management in Nigerian municipalities.

The scarcity of data notwithstanding, one thing that is clear is that municipal solid waste generation is on the increase in Nigerian municipalities. In Greater Jos, senior staff of the planning authorities and waste departments attributed the rising volumes of solid waste and rising volumes of economic activities in the municipality.

7.1.2 Institutional structure

The six local government authorities in the Greater Jos municipality have been marginalised in the area in which the Plateau State government is taking the lead in municipal solid waste management. This is manifested in different state institutions created with the functions of solid waste management. The diagram below **(**figure 7.2**)** explained the institutional structures in Greater Jos with their roles and responsibilities which differentiate it from other local government urban centres, but is common with developing countries' municipalities.

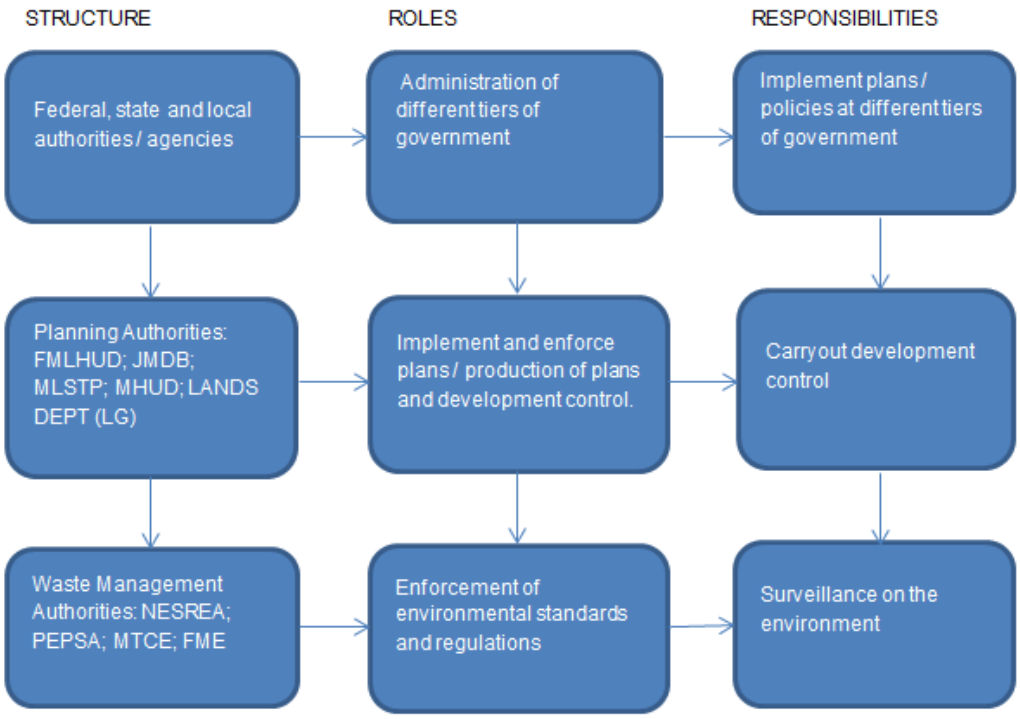

Figure 7.2: Institutional arrangements for municipal solid waste management in Greater Jos

Note that:

FMLHUD – Federal Ministry of Lands, Housing and Urban Development
JMDB – Jos Metropolitan Development Board
MLSTP – Ministry of Lands, Survey and Town Planning
MHUD – Ministry of Housing and Urban Development
LANDS DEPT (LG) – Local Government Area Lands Department
NESREA – National Environmental Standards and Regulations Enforcement Agency
PEPSA – Plateau Environmental Protection and Sanitation Agency
MTCE – Ministry of Tourism, Culture and Environment
FME – Federal Ministry of Environment

From figure 7.2 it can be seen that each institution has its roles and responsibilities in the management of municipal solid waste without formal channels of contact with each other. This further brings the possibility of not having any influence on each other but there is always conflict at various levels. The planning authorities under the 1946 ordinance has outlined the tasks of planning authorities in relation to their activities ensuring that there is no bridge in the distribution of basic infrastructure and development control. This include the operations of the local government authorities which often run

at cross-purposes thereby limiting the effectiveness of the planning authorities within the municipal level (Author's fieldwork, 2013). In addition, each planning board, ministry, agency and department of solid waste management has its own role and responsibility that are similar to others. Hence, functions are overlapping and responsibilities not fully discharged. The implication of this institutional functions mentioned in figure 7.2 is that the planning authorities roles reflected in the planning process, for example enforcement of development standards right from the plan production stage into its implementation are also carried out by the waste management authorities (see figure 7.3). This indicates having similar functions through roles and responsibilities in the board, ministries, agencies and local government departments, yet they are not interrelationally operating either in higher or lower levels of government depending on the case (Author's fieldwork,2013)

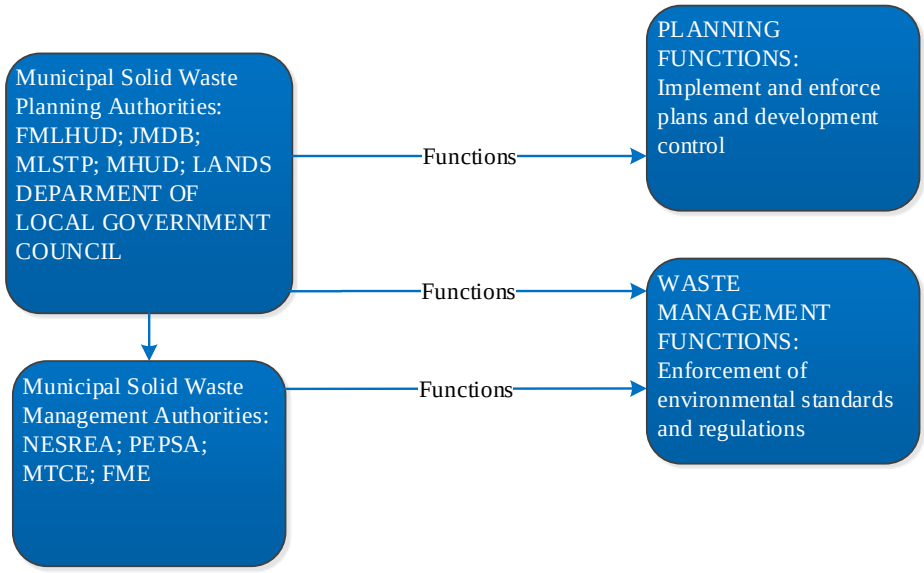

Figure 7.3: Overlap functions of planning and management authorities in Greater Jos

7.1.3 Funding and cost recovery

To make municipal waste management efficient, therefore, governments and other service providers are supposed to have a reliable and sustainable means of obtaining funds to cover the costs of the service (see section 3.2 in chapter three). However, this study has shown that solid waste management in Greater Jos municipalities is generally constrained by shortage of funds which makes the organisation of solid waste collection and disposal difficult for the authorities entrusted with the responsibility of providing the service (Author's fieldwork, 2013). Most municipal authorities in Greater Jos are,

therefore, unable to provide adequate service to keep the city clean in order to protect the public and the environment against contaminating effects of urban waste. (Author's interview wth the local government director of lands, 2013).

i. Nature of the finance problem

From the data gathered for this research, it suggests that shortage of funds is a crippling constraint to municipal solid waste management efforts in Greater Jos municipalities. From the perspective of the service providers, it is the most important cause of the problems of municipal solid waste situation in urban areas in the country. Due to the dwindling capacities of local authorities to cope with the growing problem of waste accumulation in their area, most urban residents sometimes involve the private sector in waste management through contracts and franchises. The local governments in Greater Jos seem unable to raise sufficient funds to pay for the services of the contractors. In fact, according to some senior government officials in the study area, the six local government authorities (see chapter one) that constitute Greater Jos cannot take care of the municipal waste management due to inadequate funds (Author's interviews, 2013).

ii. Causes of the finance problem

The data gathered for this study shows that the perennial financial difficulties of the local government authorities are caused by a number of factors. These include the overdependence on federal government subventions and their inability to mobilise revenue from local sources, the government policy of exempting communities from the payment of waste disposal levies and various corrupt practices in the public sector (Author's interviews with senior officials, 2013).

A major reason for the low revenue base of municipal governments in Nigeria is the lack of capacity to generate local revenue. The data gathered show that there are several local sources for municipal governments to generate revenue for waste management and other services including property taxes, licence fees for various businesses, parking fees, market dues, building permit fees and other administrative charges. Generally, however, the authorities are unable to take advantage of these sources (Author's interviews, 2013).

Another cause of the financial predicament of municipal authorities in Greater Jos is the decision by the Plateau State government to exempt communities from the payment of waste management levies (Author's interviws with the householders, 2013). Waste collection in the planned (usually high and middle-income) and unplanned residential

areas and for formal sector businesses and institutions is usually provided free of charge. The residents dump their waste in central containers to be lifted by waste management workers who are paid by the Ministry of Tourism, Culture and Environment.

According to PEPSA, about 90 percent of its waste collection activities take place in residential and commercial areas, so their exclusion from the payment of waste management levies constitutes a huge financial loss to the waste management agency. As noted by a director, "you need to recover the operational cost of waste management in order to provide a good service. How can we do this when 100 percent of our service is delivered free of charge?". In the environment institution, the head of the waste management monitoring unit raised a similar concern. According to him, "The whole communities produce waste but they don't want to pay levies. They don't pay anything for waste disposal". Traders in the numerous open-air informal markets also have a central container service and do not pay directly for waste disposal apart from the daily market dues they pay which do not go to the waste management agency anyway. This leaves the whole of the urban residents not paying for waste management. Thus, while most of the operational costs of waste management in Greater Jos municipality are incurred in waste collection, residents do not pay levies for waste management. This situation denies the municipal authorities the much needed funds for waste management. Recent developments, however, seem to suggest new thinking on the funding of waste management operations in the municipality (Author's interviews with senior officials, 2013).

Contrary to the government's position of exempting communities from waste disposal levies, stakeholders in the waste sector have been advocating a policy change to allow them to collect waste disposal levies from all residents in the urban areas. According to the director of waste management monitoring unit of the environment ministry, the ministry has also sent a proposal to the government to consider the use of the 3R's principle and introduction of the polluter-pays-principle(PPP) or pay-as-you-throw (PAYT) in the waste sector to facilitate the mobilization of revenue from all waste management service users in the various local areas. Also, most of those who were interviewed suggested for more resources and said the resources should come from both government and residents of the municipality.

From the in-depth interviews with some stakeholders conducted in Greater Jos, there appears to be growing consensus among stakeholders in the waste sector for a more pro-active approach to raise revenue for waste management in Greater Jos which is in

line with Achankeng's idea that the most effective way of obtaining revenue to cover the cost of waste management in any city is a system of direct charges to all service users. The inability of municipal governments to raise adequate funds to meet their expenditure needs can further be attributed to poor financial administration at federal, state and local government levels. It is commonly known that various corrupt practices by public officials such as bribery, kickbacks and intentional undervaluation siphon monies from the system.

At the federal level, the administration lacks transparency and the formula for its distribution of revenue allocated to local government is not clear to the wider Nigerian population. According to the formula for allocating money, the amount allocated to each state depends on the size of its population, its poverty index and capacity for local revenue generation. However, it is not clear how these variables are determined for the states since there are no updated data on them. For example, the last population census in the country was in the year 2006 and there is no means of determining the current populations of the various states except to make calculations based on the 2006 census figures. Such calculations, however, cannot be deemed to be accurate due to population dynamics. For the same reason, accurate information cannot be obtained on the poverty indexes of the various states. In addition, corruption is also said to be rife among revenue officials in the municipalities, as mentioned by a senior official. It is commonly known that many revenue officers either connive with tax payers, from whom they receive kickbacks, to under invoice their business operations while others take advantage of the illiteracy of market traders and other rate payers to issue tickets for less than the amounts they collect and pocket the difference.

The issue of corruption is a difficult subject to investigate but it is generally believed amongst stakeholders in the waste sector that issues relating to the financing of waste management in Nigeria are not isolated from it. From the discussion so far, the financial woes of municipal waste management departments can be attributed to several factors including their overdependence on unreliable government sources, low capacity for internal revenue generation and various corrupt practices among both national and municipal government officials.

iii. Effects of the finance problem on the organisation of municipal solid waste management

At the waste management Ministry in Greater Jos, I asked the director of waste management, how the shortage of funds affected solid waste management operations in the municipality. Her response was: "it really affects our operations". On how the problem of inadequate funds could be solved, the director was of the view that: "the polluter-pays principle is the best solution to the problem. Everyone who generates waste must also pay for waste disposal …. We don't have the funds to provide free service… and that is why we are pushing for cost recovery programme (recycling etc.) … and if the government allows us to implement it, we will have no problem with waste at all" (Author's fieldwork, 2013).

Officials at the municipal solid waste management department corroborated the view that inadequate funding for waste management affected their ability to collect waste from the municipal environment. On how the shortage of funds affected waste management operations in the municipal area, the director of waste management in one of the agencies was of the view that "it affects everything; it affects collection, it affects equipment and also acquisition and dump sites. That is why we cannot collect all the waste from this town (Greater Jos) …" It is evident from the views expressed by the municipal authorities in Greater Jos that the shortage of funds greatly affects the quality of the solid waste management service delivered (Author's fieldwork, 2013).

7.2 Politics

7.2.1 Political commitment

The data gathered for this study suggests that the lack of political commitment to waste management is the root cause of the problem of solid waste situation in urban areas in Jos. This is shown by the fact that in spite of the magnitude of the solid waste problem in the municipality and its impact on the physical environment, the government accords it very low priority. Thus, even though over the years there has been a lot of public outcry about the worsening waste situations in the municipal area, the government has not taken any serious steps towards its solution apart from using "task force" on environmental sanitation. The political neglect of the waste problem is shown in a number of ways. These include: the non-existence of a solid waste policy for the municipal area; inadequate public education and awareness on solid waste management issues; and the

inadequate allocation of resources for solid waste management. What follows is a discussion on this claim of a low political commitment.

7.2.2 Non-existence of a solid waste policy

One way in which successive governments in Plateau State have demonstrated low priority for waste management is their failure to formulate a solid waste management policy for the municipal area. What comes closest to a waste policy in the state is the Plateau State Environmental Sanitation Edict of 2007, a document which only makes passing comments about waste and contamination of the environment, without adequately addressing the important subject of solid waste and its management. This is in spite of the fact that Nigeria was party to the declaration of the MDGs (Goal 7 of which enjoins governments to 'ensure environmental sustainability'), and the Agenda 21 Plan (Chapter 21 of which entreats all governments to promote 'environmentally sound management of solid wastes and sewage-related issues'. These objectives cannot be achieved by any government that trivialises waste management to the extent of not formulating a solid waste policy that can be implemented to protect the physical environment.

The lack of a comprehensive waste policy for the State poses major constraints to effective planning of municipal waste management in the urban areas. Among other things, the government's own position on what constitutes solid waste, its characterisation and how it should be managed is unknown. As a result, municipal authorities charged with the responsibility for waste management within their jurisdictions have no guiding framework for the organisation of waste management. Furthermore, the lack of a waste policy for the state makes it difficult to identify who the key stakeholders are in the municipal solid waste sector and their respective responsibilities for the organisation of municipal waste management in order to avoid gaps and duplication of roles. There is also no indication of how municipal solid waste management operations should be funded. Moreover, the situation also makes it difficult for municipal authorities to enforce standards, regulations and penalties on solid waste management to bring offenders to book and promote a positive environmental attitude among the citizenry.

For example, interviews conducted with JMDB and PEPSA solid waste management departments officials showed that there are no national laws on solid waste planning while local government by-laws on solid waste are scant. Due to the lack of any national policy backing for the local government by-laws on solid waste management, the police and the courts often regard waste disposal offences as too trivial to merit their

attention. In part, the solid waste management challenge in Nigerian cities can, therefore, be attributed to the failure of successive governments of the country to formulate a municipal waste policy to provide a framework for the organisation of waste management activities.

7.2.3 Inadequate public education and awareness

Nigerians have a very poor attitude towards environmental sanitation in general and solid waste management in particular. This is in which people discard waste anywhere, a situation which greatly contributes to waste accumulation in the municipality (Author's fieldwork, 2013). This view was supported by a senior official of the Plateau State office of NESREA in an interview when he observed:

> "It seems the public is not well-informed about the consequences of poor solid waste management, and that is why people just throw waste around. So we need to do a lot to educate the public in order to improve awareness about environmental sanitation".

Some of the waste consultants also blamed the poor waste management attitude of the populace on lack of environmental education. In Jos metropolis, the managing director of a planning firm, observed:

> "the way people handle waste in this city will tell you that they don't have any education on solid waste collection. … The government should therefore put in a lot of effort to educate Nigerians on solid waste collection and disposal. Otherwise we are not getting anywhere. We will continue to live in filth".

A private waste consultant of a solid waste company in a neighbouring state to Greater Jos, also argued that "… we have this [solid waste] problem because many people don't know that how they discard the waste will affect them and warned that "…if we don't educate Nigerians about waste, as I see it, logistics alone cannot solve the waste problem. … We have to change our waste management behaviour so we need education". At the office of a senior official in one of the local government councils within Greater Jos, the director of waste management noted that "we all produce waste and waste affects us all so it is necessary to educate people on proper waste management. I think that will help very much to change our poor attitude towards waste". Among the solutions that he proposed to the problem was public education on environmental sanitation, which shows

his conviction that people's attitude is an important factor affecting solid waste collection and disposal.

In Greater Jos, most of the respondents who participated in the household survey were of the view that the public was not well-informed on the importance of proper municipal solid waste collection and disposal and suggested public education as a means of addressing the problem. Among the 288 respondents who participated in the residential household survey in Jos municipality, 97 percent were of the view that very poor attitude contributed to the improper solid waste collection and disposal attitude of the population. It is therefore clear, that there seems to be consensus among stakeholders that a poor public attitude or the lack of education on environmental sanitation is very much responsible for improper management of municipal solid waste by the people.

The lack of environmental awareness among Nigerians can, in turn, be attributed to the government's low commitment to municipal solid waste issues which makes it fail to plan for the populace and the need to live in harmony with the environment. This is because there is no visible evidence of government effort to plan for the population on the need for sound solid waste management practices and living in harmony with the environment. In Greater Jos, one of the head of the department of solid waste management acknowledged how useful television and radio could be in sensitising the public on the need for proper solid waste collection. However, he was also quick to note that "…the problem is that we don't have the money to pay for television and radio programmes to sensitise the public about waste disposal … so we concentrate our efforts on the collection…". Similarly at a federal government solid waste management department in Jos, the environmental health officer, agreed that "public education can help to change the [solid waste management] attitude of the people" but also worried about the high cost involved in carrying out such educational programmes on television and radio.

The above analysis shows how the government of Plateau State has demonstrated a very low level of commitment to municipal solid waste management. The government's lack of commitment to the solid waste problem is shown by the non-existence of a municipal waste policy for the state, the lack of public education on municipal solid waste management collection and disposal, the failure to develop the required expertise in solid waste management and inadequate allocation of funds for the planning and organisation of solid waste management operations in municipal areas in the country. The low political commitment to solid waste management in the Greater Jos suggests a lack of a sense of

urgency of the solid waste problem and its negative impacts on public and the physical environment.

7.2.4 Legislation and Power

Because the government's municipal solid waste management system is not providing the services required by its people adequately, and the demand for such basic services is increasing, private sector participation in waste management activities was used between 1999 and 2007 in Greater Jos (PEPSA, 2013). This period was however, hampered by the inadequacy of government policies in regulating the involvement and operations of the private sector in addition to the apparent disregard for the socio-economic and cultural inclinations of the general public in the formulation and implementation of municipal solid waste management programmes (Author's interviews with senior officials, 2013).

7.2.5 Operational factors

The Nigerian municipal authorities approach to solid waste management always regard solid waste as an issue that can be taken care of with funds and logistics. This explains why the stakeholders in municipal solid waste management regard funds and logistics as the worst obstacles to municipal solid waste management in developing countries. Apart from money and equipment, the day-to-day organization of waste management activities needs human resources, if municipal solid waste projects are to succeed. In Greater Jos, the shortage of staff especially in the waste management agencies emerged as a very critical factor working against efforts to manage municipal waste. There were not readily available data on the situation of staff but the senior officials in all the agencies admitted they lacked key personnel in planning, finance, environmental health, engineering and administration. This situation makes it difficult for the agencies and ministries to operate a full scale management services.

Satisfactory waste management requires a wide range of qualified professionals and researchers (Author's fieldwork, 2013). However, Greater Jos lacks expertise in the various aspects of municipal solid waste management. For instance, an interview with a senior official in one of the municipal waste department shed light on the situation. He noted that:

> "Qualified municipal waste managers are few in this region (central Nigeria) and everyone is trying to get them; so planners are best needed in

this area. But the qualified (planners) ones are not many … Some of us are still here because we like to sacrifice our comfort to help the system".

Due to the lack of waste experts, it becomes difficult for municipal solid waste departments in Greater Jos to gain professional advice on such things as the suitability of technology, planning, equipment and the siting, design, construction and maintenance of waste management facilities. Furthermore, it emerged from interviews with the municipal waste departments in the area that they lack researchers among their staff to investigate issues relating to solid waste management such as the types and quantities of waste generated, their sources and characteristics. As a result, municipal solid waste agencies in the country lack the necessary data to facilitate the planning and organisation of solid waste management. Besides, the acute lack of funds for solid waste management in the country is also linked to the shortage of qualified finance and accounting staff that will identify local sources of tax revenue, fix tax rates and employ creative measures to mobilise revenue for urban finance.

From the data gathered, other professionals who are lacking in the waste management sector include environmental health personnel, administrators and legal and security personnel to help with the enforcement of existing by-laws on municipal solid waste management. The dearth of professionals in Nigeria's municipal solid waste sector has been attributed to low remuneration for public sector jobs (Author's fieldwork, 2013). Like other public institutions in the country, the municipal solid waste institutional department is therefore, suffering from the situation where poor conditions of service make jobs there unattractive especially to well-qualified and technical staff. The dearth of technical staff for waste management and other urban sectors in Nigeria has also been attributed to the failure of the country's educational system to promote technical education (Author's fieldwork, 2013).

The country's institutions of higher learning seem to have failed to introduce relevant courses to train management personnel for the built environment including urban and environmental management. Among the country's institutions of higher learning (such as universities and polytechnics), the University of Jos is the only one with a masters course in urban and regional planning. However, the focus of courses offered by the department is on geography and planning while urban or town settlement planning and management are neglected. According to a senior professor (who is a former Dean of the Faculty of Environmental Sciences), students of the Geography and Planning

Department shy away from courses related to physical planning because they think such courses will only lead them to the public sector where conditions of service are generally poor. Over the years, Nigeria has, therefore, failed to produce enough qualified personnel to plan and manage the increasing number of rapidly growing urban centres.

While higher educational institutions in the country usually blame their inability to offer relevant programmes on a lack of funding (usually mentioned in matriculation and graduation speeches of Vice Chancellors), which shows government neglect, their curricula usually fail to show that they appreciate some of the basic problems that confront the country. It is evident to even the casual observer that land use, settlement planning and urban and environmental management (including sanitation and solid waste management) are critical challenges in the country. As centres of learning and research, tertiary institutions in the country ought to play crucial roles in creating understanding of, and finding solutions to these problems through both research and training of personnel for the urban development sector. The failure to train personnel for municipal solid waste management shows that both the government and higher educational authorities in Nigeria lack any sense of urgency of the worsening municipal solid waste situation in the country and the commitment to address the issue.

Apart from the lack of professional staff in the urban sector, operational staff (semiskilled and unskilled labour) are also lacking in the municipal solid waste institutions. The data (Author's interviews with senior officials) gathered for this study shows that operational workers such as drivers, waste collectors, sweepers and waste disposal site labourers are all virtually absent or in short supply in spite of the large number of job seekers who roam the streets. In Greater Jos, the municipal solid waste agencies are all unable to employ enough workers due to the lack of funds to pay their salaries. Considering the important roles to be played by both professional and operational staff in the organisation of municipal solid waste management, the shortage of personnel in the waste sector can be regarded as a major contributory factor to the poor solid waste situation in the study area and other Nigerian cities. It can be deduced from this analysis that the lack of adequate operational staff is partly responsible for the inability of municipal authorities to keep to their schedules for municipal solid waste planning and collection in the cities.

7.2.6 Technical Factors

In Greater Jos, the shortage of suitable equipment, the poor spatial organization of many municipalities, characterized by unplanned housing developments, poor road quality and poor access within settlements does not support the use of the large and heavy western type waste collection vehicles. A senior official in a planning board confirmed this. He cited an example in 2003, Plateau state government imported automated compaction trucks for JMDB to serve Jos-Bukuru metropolis. Apparently, after a few years of operation, only two out of the five trucks remained operational (Author's fieldwork, 2013). This rapid breakdown is attributed not only to the poor maintenance culture of the agency, but because the trucks were designed originally for relatively dry and low-density solid waste inherent to cities of more developed countries, as opposed to the high-density, often wet and sandy, solid wastes generated in Jos metropolis. Consequently, the combination of the extra weight, abrasiveness of the sand and corrosiveness caused by the moisture content resulted in the rapid deterioration of the trucks.

Moreover, the use of uncovered vehicles, such as tipper trucks and pick-up vans, in municipal solid waste collection and transportation presents a serious challenge to the sustainable operations of municipal solid waste management in Greater Jos municipality. This is because the vehicles are not manufactured for the purpose of waste collection and, thus, are not equipped with the necessary cover and compaction facilities. This practice often leads to waste spillage along the roads to the disposal sites, which, in turn, undermines the effectiveness of the whole process (Dauda and Osita, 2003). These reasons, among others, highlight the importance of planning to select appropriate modes of waste transportation. It is noteworthy that due to the high density of municipal solid waste being produced in Greater Jos, compaction trucks are unlikely to be the most efficient and effective option of transportation. However, it was suggested by a private planning consultant who had served for over thirty years with the Plateau State government that a selective approach could be used to target the areas that produce low density waste materials, such as commercial areas where paper and packaging materials represent a significant portion of their solid waste.

Recognising the diverse nature of settlements in the municipality, a senior official in a management ministry is of the opinion that a combination of various transport methods is necessary to achieve optimal performance. In low density, higher income areas like government reserve areas (GRA), as well as commercial and institutional areas, the

use of motor vehicles could perform optimally. These vehicles should be covered either by design or by incorporating cover materials. Conversely, push carts and wheel barrows, often used by informal solid waste collectors and scavengers, could be utilised in high density areas that are poorly accessible, instead of being totally neglected.

Presently, these (non-motor vehicle) modes of municipal solid waste transportation are neither recognised nor encouraged by the government and the formal private sector. If formalised, regulated and properly coordinated with relatively advanced municipal solid waste management techniques, these low technology options can be utilised effectively in providing efficient service delivery and creating jobs, as identified by a senior director in the state planning ministry.

7.3 Public

7.3.1 Public education and awareness

As observed by a senior planning consultant, "There are no conferences, seminars, workshops and training by the state in creating awareness and topics that relates to environmental protection and management are not included in schools curriculum" (Author's fieldwork, 2013).

It has become very clear to point out here that public awareness is lacking in the management of solid waste in Greater Jos. This is evident in an interview conducted by the researcher with a senior officer in the state ministry, on who is responsible for waste management in Greater Jos. The senior officer's response was: "….awareness is lacking in the general public about who is responsible for what. There are a lot of problems of resistance in enforcement by any authority" (Author's fieldwork, 2013).

While this poor environmental attitude among the populace can partly be attributed to the lack of fear of the flimsy by-laws (which are also hardly enforced), This view was supported by a senior official of the Plateau State office of NESREA in an interview when he observed:

> "It seems the public is not well-informed about the consequences of poor solid waste management, and that is why people just throw waste around. So we need to do a lot to educate the public in order to improve awareness about environmental sanitation".

7.3.2 Public and government attitudes

Interviews with senior waste management officers in Greater Jos suggested that the attitude of most residents of Greater Jos municipality towards municipal solid waste

in itself is generally poor, in that they discharge solid waste materials indiscriminately. Also, the majority of inhabitants are largely unaware of the implications of poor environmental quality, and even those who do understand the consequences are yet to appreciate the fact that protection of environmental quality is not only the responsibility of governments; everyone has a role to play. Also, most residents do not understand the potential of waste management options, such as waste minimisation, resource recovery and recycling. Consequently, the residents do not appreciate the value of municipal waste management services, except for the very small amount of recyclables such as cans, plastics, bottles and papers stored in homes and later sold to scavengers.

Another social issue within the study area is the negative perception of solid waste workers by some members of the general public. Senior officers of municipal authorities reported that many of their staff (municipal waste workers) have complained about derogatory remarks from the public; whereby, they are often regarded as poor, dirty and second-class citizens simply because they deal in valueless materials and have nothing better to do. This perception can potentially affect the morale of the waste workers as much as the general public. While the municipal waste workers can feel less confident in their work, and therefore perform less efficiently, some members of the public may feel that the whole process is not important and not worth contributing to its success. These issues indicate a clear need for more aggressive public enlightenment efforts as a major step towards a successful municipal solid waste system in our municipalities. This is very evident in the lack of keeping our environment clean except through the monthly environmental sanitation ‘task force’ programme, where the public must be forced to clean the surroundings.

For the households in Greater Jos, there are few or no receptacles to use for regular waste disposal for both tenants and landlords. Figure 7.4 show how residential household solid waste is collected from an informal (unplanned) neighbourhood called Jishe.

Figure 7.4: Municipal solid waste collection in Jishe in Greater Jos

Source: Fieldwork, September, 2013

In order to confirm from a one time senior director of town planning ministry in Plateau State, this question was directed to him: Where do residents of this (Jishe) residential neighbourhood dump their waste? He responded: "…there are no designated sites in this residential zone to dispose municipal solid wastes. Residents dump their waste anywhere – carelessly and haphazardly either along neighbourhood streets or anywhere is suitable for them" (Author's fieldwork, 2013).

Apart from dumping wastes on the physical environment, in Greater Jos, a senior professor of the built environment in a federal university observed: "It is very important to take into consideration the new technology and skills in municipal solid waste management that must be studied and understood before implementing any change in order to bring an orderly environment". He went further to say: "…municipality (Greater Jos) is critically affected by population increase without corresponding social amenities being provided to meet the expanding informal settlements – this too can encourage unplanned and irregular dumping of municipal solid waste" (Author's fieldwork, 2013). This also corroborate with what Dung-Gwom (2008) saw in an earlier study of the 'nature of peri-urban development in Jos. There is a huge gap between socio-cultural behavioural pattern, municipal solid waste policy formulation and implementation which exacerbate the challenges of management of municipal solid waste in Nigeria municipalities.

There is only one open landfill dumpsite at Dong settlement in the north of Greater Jos municipality which is about 10-12 kilometres from the centre of Greater Jos. This dumpsite has been in use from 2007 to date for municipal solid waste disposal in Greater

Jos. The municipal solid waste of the entire municipality is being transported to the final dumpsite as represented in the figure 7.5.

Figure 7.5: Main dump site at Dong settlement in Greater Jos

Source: Fieldwork, June, 2013

The main dump site which is about 30 hectares is not fenced as is bounded by farmland, human settlement and water body as depicted in figure 7.6.

Figure 7.6: Final dump site at Dong in the centre of farmland, settlement and water body

Source: Fieldwork, June, 2013

The quantity of municipal solid waste generated in Greater Jos municipality is 680 metric tons per day and less than half is collected by PEPSA (Author's fieldwork, 2013). The remaining balance is not collected due to lack of adequate manpower and infrastructure as shown in table 7.1:

S/N	Type of collection point	Capacity(ton)	No	Distribution
1	Open collection point	Varies	500	Spread along streets, roads, open spaces and land patches
2	Dumper bin or container	2-3 metric tons	80	Found around main market, old town/city, shopping complexes, hotels, along roads
3	Garbage shed	4-6 metric tons	10	Located in the central business district in Jos

Table 7:1: Municipal solid waste collection profile in Greater Jos

Source: Author's field survey, 2013

The existing dump site location in Dong settlement is causing serious pollution to the inhabitants. In an interview with a community leader of Dong settlement, complaints about the dumpsite emitting foul odour to the community were noted. The leader said they have complained to the state Ministry of Environment several times without any response from them. The community leader used the opportunity to tell the researcher to appeal to government in order to relocate the dumpsite to a proper sanitary landfill area that is not unscientific and crude. In addition, the leader complained of the dumping of municipal solid waste on their farmland and water body, which consequently can affect their health and animals. This is represented in figures 7.6 and 7.7.

Figure 7.7: Solid waste undergoing decomposition at main dump site in Greater Jos

To the dumpsite, the road condition is very poor and encourages dumping at different points. The burning of municipal solid waste at the dumpsite is very high **(**see figure 7.8**)** always polluting the environment and indicating an improper and unsanitary

municipal solid waste conditions at the final dump site – Dong. This can create serious pathological problems that can affect the whole settlement.

Figure 7.8: Incinerated solid waste at main dump site in Dong settlement in Greater Jos

The fragile geo-ecological nature of Greater Jos made it difficult to design and plan for economically viable systems for municipal solid waste management (see figure 7.9).

Figure 7.9: Dumpsite for Jishe-Greater Jos (unplanned settlement)

Open dumping (see figure 7.10) and open spots of municipal solid waste is daily responsible for the negative impacts that is related to municipal solid waste planning key drivers earlier discussed.

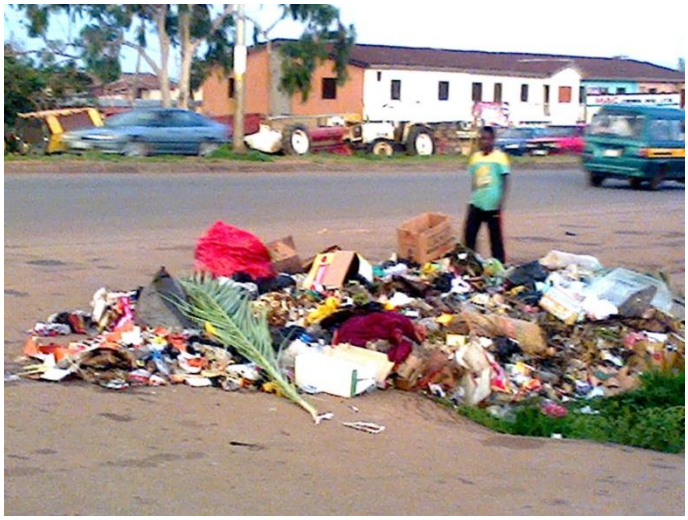

Figure 7.10: Scavenger (informal collector) near dump point in Greater Jos

The result of this is that generation of income is still lagging behind hence the complete dependence on federal and state governments municipal for funds. This is so pronounced in the case of PEPSA and corresponding institutions like NESREA, where all of their budgets come from the state or federal government (Author's fieldwork, 2013).

7.2 Summary and conclusion of chapter seven

This chapter discussed on the findings as a result of the analysis of MSW situation in Greater Jos (see chapter six). The limitations of the management process identified in the previous chapter have been reviewed within a more comprehensive political economy. This chapter has shown how three key forces (government, politics and public) constituted factors responsible for the abysmal waste situations in Greater Jos (see section 3.9). Management of municipal solid waste depend on these drivers (see Figure 7.1) in order to deliver a good service. Above all, this chapter identifies lack of political commitment to the solid waste problem thereby manifesting itself in: financial and investment constraint; inadequate personal/training and motivation of waste management personnel; lack of enforcement and waste legislation; and poor public education and involvement in the planning and organization of waste. The next chapter looks at the proposed future possible system of solid waste management in Greater Jos based on the literature review and these findings..

Chapter Eight

Future Possible System Of Municipal Solid Waste Management In Greater Jos

8.0 Introduction

The last objective of this research is to develop the future of urban planning in improving municipal solid waste management in developing countries using Greater Jos. This chapter produces a 'plan' that can be viewed as a benchmark agains the current reality. It shows how this waste issues (see chapter six and seven) relates to the ones in developing countries. The preparation of a MSWM plan in providing the foundation for an efficient solid waste collection and disposal administration cannot be overemphasized. Planning is critically important to solving the MSW problem that require massive investment in equipment and logistics. Without planning, it is almost impossible for MSWM operations to be effective. Cointreau (1982) rightly pointed out that waste management activities require specialist expertise. Thus a municipal waste management could benefit from a planning department that is specialist and forward looking. Municipal waste management can wobble from one crisis to another with no control without planning. It is the principal function of a planning section of department of town planning. to give advice to senior management on proper ways they can avoid any problem in the future. Therefore, planning comes first before management.

In any successful plan implementation, improvements will also require some change in habits of waste management staff and householders. Based on the research findings and drawing from the experience of the developed world and other developing countries, it recommended that a joint MSWM 'plan' (see figure 8.2) be adopted as a guiding framework within which to conduct municipal solid waste management in Greater Jos. This will promote democratic engagement and decentralisation among the MSW planning and management authorities. In particular, it was discovered that solid waste drivers from the main findings included: lack of institutional, legal, planning and policy framework that supports urban waste management in the municipality (see chapter three table 3.3); PEPSA , NESREA, MOE and other ministerial organizations and agencies are using general purpose waste management that is not specific to a single municipality or urban centre; there is no single plan or strategies for waste management issues in Greater Jos except a 'task force'; and there is an issue of lack of funding that has constrained every attempt to make any plan or proposal for waste management by these

institutions and organizations (see chapters six and seven). A good MSWM plan will not be efficient and effective if it does not have the collaboration and support of the general public (communities, neighbourhoods and individuals). In this regard, municipal authorities in Greater Jos should ensure a provision of a comprehensive, integrated and sustainable network for the various strategies of solid waste management in the order presented by the waste hierarchy (see figure 8.1).

This chapter suggests areas that the joint MSWM 'plan' should address in improving MSWM in Greater Jos. It is not a definitive list but a summary of very important issues that need to be included. From the sketch below, the plan has two important layers: the municipal solid waste planning and management authorities hosting the institutions and agencies responsible for waste management with their individual MSWM strategy; and the non-state actors in MSWM to make the process as inclusive and transparent as possible. The challenges facing the city and its waste planning/management can be seen from te following statistics and facts.

- 657,650.5kg of waste generated in 2007.
- 86% of the total waste generated is household waste
- 1,369,787.0kg of waste is forecast to be generated by 2025
- 80% of existing waste management facilities are landfill sites.
- Over 50% of all waste managed in the area is sent to landfill sites.
- By 2025 there are like to be no landfill sites to dispose of hazardous waste.
- Landfill sites in the area have a limited capacity.
- There are no alternatives to landfill.
- Informal recycling of household waste only.

8.1 Validation of recommendations

Validation is necessary as a concern in research. The primary aim is to check the possible factors that may affect the research validity. In pursuing to assess the validity of the recommendations of this research that has produced the joint MSWM plan, the researcher conducted interviews to a selected key senior officials and industry stakeholders. Professor of Urban and Regional Planning, University of Jos, Nigeria; Director of Town Planning, Ministry for Housing and Urban Development; Planning consultant and former Director, Ministry of Lands, Survey and Town Planning; Director of Town Planning, Federal Ministry of Lands, Housing and Urban Development; Director of Lands, Ministry of Local Government and Chieftaincy Affairs; Private Waste Operator

and Planner; Development Planning consultant for Greater Jos Master Plan; Chief of Staff, Governor's Office; Director of Public Relations and Enforcement, PEPSA; Director, NESREA; General Manager, Millennium Development Goals (MDG) Office and Director of Waste Management, Ministry of Tourism, Culture and Environment were consulted on the plan (see appendix 10.3). This was undertaken through telephone interviews after the main fieldwork and analysis. This was in order to seek their views and confirm from them on the suitability of the 'plan'. There is a substantive agreement of the outcomes resulting from the key respondents on the MSW plan as the best solution.

Good practice recommendations have been proposed to reorganize current MSWM practices in developing countries in line with global best practice.

8.2 Municipal planning guidance

In 2009 the area through the Plateau State Ministry of Housing and Urban Development produced the new Greater Jos master plan which has the status of supplementary planning guidance, having been adopted by all the relevant local authorities. The 'plan' is a broad strategic policy statement which covers the whole of the municipality and contains a chapter providing land use policies on waste. Therefore, the plan policy statements should be in consistent with the main principles set out in new master plan as regards to waste. The new Greater Jos master plan is therefore clearly relevant to the issues covered in this 'plan' and should be referred to by local authorities when preparing their waste policies in their local plans.

8.3 Key planning principles

There are four key principles that have to be taken into account when assessing the provision/allocation of new waste management facilities in Greater Jos. These key principles have been adopted by the European Union, the UK Government and the other developed countries Government. The four key principles are: sustainability; proximity; self-sufficiency and the waste hierarchy. This are explained below.

8.3.1 Sustainability

A commitment to promoting sustainable development is at the heart of the decision making process and is a fundamental consideration for assessing all types of development including possible sites and proposals for new waste management facilities. There are techniques which have been developed to assess the sustainability of possible developments for waste management facilities which include Best Practicable

Environmental Option Assessment (BPEO) and Sustainable Waste Management Options Assessment (SWMO). These techniques are numerical models which allow quantitative comparison and have been utilized in the development of the combination of methods and facilities which will provide a land use planning framework for the area, and are discussed later in the 'plan'.

8.3.2 Proximity

This principle recognizes that the transport of waste can generate significant impacts on the environment. The overall objective is to locate facilities as close as practicable to the sources of waste and to other compatible waste related uses and therefore to limit transport requirements.

8.3.3 Self sufficiency

This principle requires that most waste should be treated or disposed of within the area where it is generated. Greater Jos should therefore provide, as far as possible, facilities with sufficient capacity to manage the future forecast levels of waste that are likely to be generated within the area.

8.3.4 The Waste hierarchy

This principle is a theoretical framework for ranking different broad methods of managing waste. In land use planning terms and for the purposes of this 'plan' the waste hierarchy should be one of the main considerations in assessing the likely acceptability of a particular type of new waste management facility. The waste hierarchy in ranking order is as shown in figure 8.1.

Figure 8.1:The Waste Hierarchy

8.4 Types of wastes

The types of wastes that will be dealt with in this 'plan' include:

8.4.1 Municipal Solid Waste

Most of this waste is household waste such as kitchen waste, garden waste, glass and paper which is generated by the general public. The six planning authorities in the area have the responsibility of managing this type of waste. JMDB is not a Waste Authority and the responsibility for management of Municipal Waste within the area is that of the Waste Authorities of Plateau Environmental Protection and Sanitation Agency.

8.4.2 Commercial and Industrial Waste

This includes waste such as packaging and by-products resulting from production processes which is generated wholly or mainly at trade, commercial and industrial premises.

8.4.3 Special and Hazardous Wastes

This category includes wastes which are classed as special wastes and hazardous wastes such as industrial effluent residues, asbestos etc. Many of the types of wastes included in this category will be classed as hazardous wastes. The future management of this type of waste should be identified by state government as being an important issue

for Greater Jos. While the capacities are comparatively low within the area the facilities required are very specialized and require special attention when considering allocation.

8.4.4 Construction and Demolition Waste

This is waste which is generated as the result of repair, maintenance and the redevelopment of mainly roads and buildings and includes materials such as brick, concrete, hardcore, topsoil, glass, plastics and metals. It also includes excavated site materials such as soils, gravel or clay, some of which may have contaminants which might make it necessary to dispose of the materials in a hazardous landfill site, even though the level of contamination may be low or of low risk.

8.4.5 Agricultural Waste

Significant volumes of agricultural wastes are generated in the region but only a very small proportion of this waste is expected to be classed as controlled waste in future legislative changes. The agricultural waste which is expected to become controlled includes packaging materials associated with agricultural feed, silage wrap and sheep dip.

8.4.6 Waste Not Covered in the 'Plan'

These are other types of wastes which are not covered by the 'plan'. They are subject to different legal controls and these include: radioactive waste; sewage; agricultural slurry waste; slate and other mineral wastes.

8.5 The Joint MSWM 'Plan' for Greater Jos

The 'plan' proposal is divided into three parts. Part one contains the purpose of the plan, the waste issue, challenges, planning guidance, the key planning principles, types of waste, existing waste generated in the area, existing waste management facilities and their capacities, landfill capacity and the landfill issue, forecast of future waste generated in the area, and hazardous waste. Part two has an assessment of the possible combination of waste management methods, and the last part is the land use planning framework.

The vision for the MSWM 'plan' is to provide a sustainable land use planning framework in response to the need to change the way that solid waste in Greater Jos is managed, by helping to facilitate an integrated and adequate network of new and modern waste management services. These will contribute to re-use and recycling opportunities for the solid waste generated in the municipality for the benefit of the environment and

for the people of the municipality whilst providing new local employment and economic growth.

Figure 8.2: Joint Municipal Solid Waste Management Plan for Greater Jos

Source: Author's proposal, 2015

In order to achieve the vision and change the way that Greater Jos deals with its solid waste the 'plan' is intended to address the following aims:

a) Specific to Planning

- Provide a land use planning framework to enable individual authorities in the area to allocate sites in their local development plans for new waste management services.
- Treat waste as a resource by contributing to the re-use, recycling and composting opportunities for waste generated in the area and to allocate sites for disposal of waste which is not or cannot be re-used, recycled or composted.
- Reduce the amount of waste that is landfilled.

b) General

- Ensure that waste issues are considered in the assessment and determination of planning applications for all types of development.
- Reduce the rate of growth of waste generated in the area.

- As a minimum, meet targets set by ECOWAS and the Nigerian Government for managing waste
- Raise public awareness on waste issues

8.6 Preparation and purpose of the Plan

The Jos Metropolitan Development Board (JMDB) has been the coordinating authority responsible for managing the production of a general master plan for the area. For this purpose it stands as the main organization to coordinate the production of the Joint MSWM plan. The 'plan' will have the following purpose:

8.6.1 Assist in the allocation of new waste management facilities

The principal purpose of the 'plan' should be to provide a land use planning framework for at least ten years that will assist in the provision of a comprehensive, integrated and sustainable network of new waste management services which will deal with the future waste forecast. The 'plan' will provide guidance on how the individual planning and management authorities in the area will plan for the future sustainable management of waste. It can do this by forecasting what waste will be generated in each local area as well as to provide a broad commentary on the different waste management methods and facilities that will be available.

While not specifically allocating sites, the 'plan' will provide the relevant information to allow each planning and management authority in the area to allocate sites, or to come to cross border arrangements, so that specific waste management facilities can be provided within the area to adequately handle, treat, distribute, and dispose of future waste generated in the municipal area, in a more sustainable way. The 'plan' will also assist commercial enterprises, municipal authorities and the voluntary sector to provide additional waste management services. This is the only way to ensure that the municipal's waste is dealt with in a more holistic and sustainable way. The 'plan' will therefore contribute towards ensuring that the area meets the various statutory and non-statutory targets set by MDGs relating to waste management.

8.6.2 Assist in the planning assessment of new waste management facilities and encourage a more sustainable approach to development

The information in the 'plan' regarding different waste management facilities will assist in the assessment and determination of planning applications for such facilities. In addition to this, the 'plan' will also contribute to ensuring that waste is considered as a

material for planning consideration in assessing and determining all types of development.

8.6.3 Raise general awareness on a broad range of waste related issues

The preparation of the 'plan' will raise awareness about waste issues. The 'plan' will pass through separate publicity and consultation exercise and will therefore contribute to raising awareness of waste issues.

8.6.4 A start towards a strategic municipal approach to waste planning

The 'plan' will be the first of its kind for the area and has should be produced in accordance with an ambitious timetable. The researcher acknowledges that there are certain areas of the 'plan' that require additional research. For this reason JMDB and the municipal authority should be committed to a full review of the information contained in the 'plan', as well as formally monitor the implementation of the framework for a period of three years. Over the next three years the review process will build on the information and associated framework contained in the 'plan'.

8.7 Waste issue

Greater Jos, along with the rest of the Nigerian municipalities, has historically had a poor record of managing waste in a suitable way when compared to the UK and other developed countries. Greater Jos municipality currently has an over reliance on dumping most of its waste at unsanitary landfill sites. Some of the waste which is landfilled is capable of being re-used, recycled, composted or treated in different ways to produce energy derived fuel.

It is not a sustainable long term option for the area to rely on landfilling as at present because Jos is a tin-mined area. There is a need therefore to develop a number of modern alternative waste management facilities to sort and segregate the waste so that re-use, recycling and composting opportunities can be made available. Increased segregation of waste means that more waste can be re-used and recycled as raw materials which can be made available for different types of industrial production.

Those types of waste which are not or cannot be re-used, recycled or composted will need new and modern waste management facilities which can treat the waste before what is left is sent to sanitary landfill. It is accepted therefore that landfill facilities will still be required in the future, but only as part of a more sustainable network of waste management facilities. Whilst there are sound environmental reasons why authorities

should change the way they deal with waste, they must change to comply with the various NESREA and government legislation requirements.

8.8 Assessment of Possible Combinations of Waste Management Methods

There are two possible combined assessment methods of waste management facilities that could be provided to deal with the waste generated in the Greater Jos.

8.8.1 Strategic Environmental Assessment (SEA)

Strategic Environment Assessments have been introduced by virtue of the Strategic Environmental Assessment Directive which applies to plans and programmes that will be adopted. The objective of the SEA Directive is:

> "to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans….with a view to promoting sustainable development"

A Strategic Environmental Assessment is an environmental appraisal at the level of broad strategies, policies, plans and programmes. It is distinct from the more familiar Environmental Statement which is submitted in support of a planning application for a particular development on a particular site under the Environmental Impact Assessment (EIA) Regulations (Environmental Impact Assessment Regulations : Nigeria). An SEA by contrast enables choices to be made between a range of options by examining the different environmental consequences of each to allow consideration of the effects of different combinations of types of developments. For example a SEA could assess the combined effect of a number of technologies necessary to implement an integrated waste management plan. Sustainability appraisal should also be undertaken in developing this 'plan'.

8.8.2 Health Impact

Health impact assessment is a means of taking into account potential health effects of policies, programmes and other developments on people, whether positive or negative. Health risks are quantified by considering the level of hazard, the pathways to a receptor, and the likelihood of a potential receptor being adversely affected by the hazard. Information that is required includes: the type and quantity of emissions; the location; the nature and scale of populations that could be effected by any emissions; how persons

could be exposed to the toxic substance; and the impact on the health of persons exposed to toxic substances potentially emitted from waste management operations.

The first three aforementioned points are very dependent on the location and siting of each facility. For the purposes of this 'plan' it is possible to provide a generic qualitative assessment of health impacts for the broad types of facilities which could be planned for the area. A summary of these generic impacts of the broad range of different waste management facilities can be provided in the following:

a) Landfilling:

UK Epidemiological studies (British Medical Journal 17 August 2003) found that there is no increase in the rates of cancer in people living close to landfills but that there is an extremely small increase is the incidence of birth defects in babies whose parents live close to landfills, although no proven link has clearly been established.

b) Energy from waste:

A UK research project (National Society for Clean Air, June 2001 – Public Acceptability of Incineration) found that toxin and carcinogens are a fraction of what they were over 10 years ago and new stringent emission limits can mean that the potential for health impacts to the local population is extremely small. Other studies as referred to in Wise about Waste have concluded that the relative health impacts of dioxins, metals etc. from modern incinerators is exceedingly low.

c) Recycling and transfer facilities:

These facilities are likely to generate some dust and biological impacts, the significance of which will be dependent on the materials to be handled.

d) Composting:

A report by the Health and Safety Executive of the UK titled "Review of bio-aerosols from composting sites" states that bio-aerosols released during the composting process can cause or exacerbate certain respiratory conditions. A US study (Department of Environmental Quality, US State of Oregon) into composting wastes that may include animal parts and by-products concluded that pathogens are effectively destroyed, good design can prevent the contamination of ground and surface water, and workers at composting facilities have not been affected adversely over the 20 years prior to the study.

e) Anaerobic Digestion:

Anaerobic digestion is a process similar to enclosed composting and therefore the health impacts are likely to be similar.

f) Mechanical Biological Treatment (MBT):

MBT is the combination of a recycling facility, composting facility and some plant may also incorporate energy from waste component. The health impacts could therefore comprise a combination of those related to each facility.

g) Treatment:

Treatment can comprise physical, thermal, chemical or biological processes. However, the convenient options within this 'plan' are materials recycling; energy from waste and anaerobic digestion facilities and these should be modeled to manage the waste stream. The health impacts therefore relate to the specific management technologies. A study of planning and health including the health impacts of a range of waste management technologies should include a practical tool to inform decisions.

8.9 The Land Use Planning Framework

The framework of new waste management facilities required to be provided for the area and reflect the needs of the municipality and the individual Authorities within the area. The framework for planning in terms of total capacities of the different types of waste management facilities are:

8.9.1 Securing capacities in joint plan

The total infrastructure capacity requirements for the different types of waste management facilities need to be secured by the individual authorities in the area are to be specified in the planning framework. "Securing capacities" is about an individual authority identifying how and where the waste forecast to be generated in their area will be managed having regard to the capacities which have been specified for that authority. Whilst the framework will identify capacity requirements for all the different types of waste management facilities, this will not necessarily mean that each authority will need to provide all of these different types of facilities. Therefore, "securing capacity" in the MSWM strategy does not necessarily equate to the allocation of sites/facilities within each authority to deal with the the different types of waste management facilities. This 'plan' therefore should allow a degree of flexibility for the individual authorities to secure the capacities specified in the framework.

8.9.2 Waste and planning in general

Whilst the principal purpose of this 'plan' is to provide a framework to facilitate the allocation of waste management facilities in the area, waste issues also need to be taken into account in the consideration of all types of developments. Master plan development policies should highlight the need to provide details at the design stage of development schemes, which specify how much and what type of waste is generated as part of the redevelopment and construction stages. Furthermore, master plan development policies should encourage the sustainable use of waste material where possible through its use as secondary aggregate or material as part of the development.

Master plan policies should also ensure that details are submitted at the design stage of schemes, that explain how the waste generated following the completion of developments (which is the waste which will be generated through their use as residential, industrial or other uses) is dealt with. The emphasis here should be on the sustainable management of the waste generated, which will in certain cases will require the provision of a waste management facility to encourage re-use, recycling and composting of waste as part of the overall scheme.

Whilst the waste issues need to be considered in all types of developments it is likely that they will be more relevant in the assessment of medium to large scale developments. In this respect it is considered that planning authorities should establish their individual thresholds related to the scale of all types of developments (other than specific proposals for waste management facilities) for which more detailed information on waste issue is required or the provision of a waste facilities should form part of the overall development.

8.9.3 Best practice: policy guidance

The following information provides best practice guidance (based on the plans drawn from the experience of the developed world; other developing countries and the empirical research) for the local authorities reviewing their master plan. It also provides guidance for the waste industry and developers.

a) Specific allocation guidance:

1. Each of local authority has a duty to allocate within its local plan an integrated and adequate network of waste management facilities to deal with the forecast waste generated within their own area.

2. Where it is not possible/ practicable for a local authority to deal with all forecast waste arising within its area, then it's development plan shall identify how that particular element of waste be managed by reference to cross boundary arrangements.
3. The allocation of waste management facilities within the municipality shall have a cumulative capacity that deals with all of waste forecast to be generated in the area. Any additional capacity over and above the waste forecast to be generated in the area will need to be fully justified.

b) Guidance on siting of facilities:

1. As far as is practicable, small scale re-use, recycling and composting facilities shall be located as close as possible to local communities.
2. New major waste management facilities shall only be allocated within the designated sites of ecological importance or other sites of national or local importance within the area where this is demonstrated to be in the national interest and can be demonstrated to meet the tests specified in the planning policy framework.
3. Having regard to the environmental impacts of transporting waste, each local authority shall in their local plan encourage the siting of waste management facilities as close as practicable to the community and/or industrial activity where the waste is generated. The plan should also promote more sustainable transport methods for the movement of waste materials.
4. In order to ensure the most effective use of land within each local authority area and across the municipality as a whole, each local plan shall consider allocating additional land for waste management facilities at or adjacent to existing waste management sites. Where this is not possible/ practical then new sites shall be allocated on previously developed land, at existing industrial sites, or on land already allocated for industrial or employment purposes.

c) Guidance on methods for dealing with waste:

1. Recovering energy from waste facilities shall be considered as a method of dealing with waste not capable of being re-used recycled or composed for either economic or technical reason before disposal of that waste via landfill.
2. Each local authority shall promote the concept of the "Eco-Park", which is broadly defined as an industrial site or part therefore which includes waste

facilities and other industrial use located adjacent which utilize any recyclables. Each local authority shall allocate in their local plan a site which promotes the principles of an "Eco-Park" at or adjacent to existing industrial sites or employment areas or on previously developed land to encourage the sustainable management of waste generated within that local authority area.

d) Guidance relating to all types of development:

1. Each local authority shall ensure that all proposed developments have demonstrated, as part of the application how the development address waste minimization and recovery efforts at the design, construction and demolition stage. The degree of detail requires should reflect the type of development proposed.
2. Each local authority in the municipality shall ensure that all large scale developments particularly housing, provides as an integral part of the scheme on site composting and cycling waste management facilities, either at industrial buildings or at easily accessible locations within the development itself. These composting and recycling facilities shall conform to standards set by the local authority.

e) Guidance on general waste management issues:

1. Local authorities and the Environment Agency shall liaise closely on all waste management matters. It is considered good practice to seek to twin track applications for planning permissions and authorization required under pollution control legislation.
2. A local authority shall ensure through the planning process that waste management and disposal facilities provide regular relevant data regarding their waste operations, including the capacity of the waste management facility.
3. Each authority shall contribute to the economic growth and employment opportunities within their own area by addressing new waste management facilities as an essential component of local service infrastructure.
4. Each local authority in the municipality shall work in partnership with the private and community sectors to attract businesses using innovative technology to manage waste with an emphasis on re-use, recycling and composting.

f) Raising awareness:

One of the general aims of the 'plan' is to raise awareness about waste issue throughout the municipality.The implementation of the framework which has been set out for the municipal area will need the support, commitment and involvement of the general public, product manufactures, industrial and commercial waste producers, the construction industry, retailers, local authorities, the waste management industry community/voluntary sector, planning institutions, environment agencies, the state government and the federal government.

Raising awareness about waste issue can contribute to changing the way that we manage our waste and assist in the implementation of the framework for the municipality.In producing this joint MSWM 'plan' the intention would be to make the process as inclusive and transparent as possible.

8.10 Summary and conclusion of chapter eight

Chapter eight has provided a future possible system for Greater Jos MSWM by identifying the need for a joint 'plan' – where best practice in line with the experience of developed world, other developing countries and the empirical research in chapters two, three, four, six and seven (after the data analysis collected and models for urban waste management identified) have been done. From the analysis, inferences were drawn that gave some discernible results. This chapter has looked at the challenges facing the municipality and how planning for MSW comes first before SWM. It then gives a blue print and suggests areas that should be addressed in improving MSWM in Greater Jos. It finally brought out the key planning principles that shall guide the development of the new joint MSWM system in Greater Jos in line with global best practices. It is clear from the idealised 'plan' that the current system is far from this benchmark. Funding has not been discussed but clearly there are substantial resource implications not just a change in planning culture. This is translated into the concluding chapter (nine) that followed this one with recommendations for the research prescribed.

Chapter Nine

Summary, Conclusions and Recommendations

9.0 Introduction

The research is supporting the existing framework in chapter three section 3.2 and 3.11 which states the listed factors (see table below) that are responsible for the weak waste management situation in developing countries.

Practice	Developing Countries: Ghana, Kenya, South Africa, Nigeria
Policy, legislation and environmental regulation	Absence of systematic control and enforcement mechanisms, fragmentation of policies and laws, duplication of roles (Onibokun, 1990; UNCHS, 2000; Dauda and Osita, 2003; FEPA, 2008; Oyedele *et al*., 2008)
Financial instruments	Very low priority, limited funding, inadequate taxation (AfDB, 2002; Agumwamba, 2003; Ahmed and Ali, 2004; Sha' Ato *et al*., 2007)
Plan / strategy and implementation	Absence of systemic control and plans /strategy if any (Onibokun *et al*., 2000; Estevez, 2003; World Bank, 2004; Attah, 2005; Ndidi *et al*., 2009)
Institutional, administrative capacity	No clear definition of roles and lack of coordination, higher administration and institutional costs (World Bank, 2000; USEPA, 2010)
Planning and stakeholder participation	Lack of planning institution for waste management and formal stakeholder participation (UNEP, 1999; Zurbrugg, 2003; Fobil *et al.*, 2010)
Coverage, collection, recycle, reuse	No industry for waste issues, weak economic base for resource recovery and recycling. Informal sector scavengers used (Achankeng, 2003; UNO, 2007; Onwughara, 2010; Gasu and Gasu, 2011)
Environmental and economic gains	Conflict between economic development and environment protection, lack of socio-economic values and attitudes, lack of public awareness (Chua and Garces, 1992; Hoornweg and Bhada-Tata, 2012)

Table 9:1 :Factors responsible for weak solid waste management

This can help improve municipal solid waste issues in Greater Jos municipal area been guided by five objectives which were:

1. Examine the municipal solid waste challenges in developing countries.
2. Review international literature and identify best practice in urban planning in relationship to municipal solid waste management.
3. Investigate the municipal solid waste problems in developing countries using Greater Jos.
4. Examine the urban management system and evaluate its functions in municipal solid waste management.

5. Make recommendations and establish the future of urban planning to improve municipal solid waste management in a developing country.

The last three chapters (6, 7 and 8) have addressed the second and third objectives. This final chapter brings the study to a conclusion by summarising and discussing the key findings of the research. Based on the research findings, the chapter makes recommendations for addressing the worsening municipal solid waste problem in Nigerian municipalities, thereby addressing the last objective for undertaking the study. The chapter also reflects over the entire research process, pointing out its strengths and limitations. Finally, a number of areas requiring further research are identified.

9.1 Summary of the thesis process

The following summary and discussion of the research process are based on the five objectives (just stated above) that guided the study. The summary of chapters and their conclusions are stated below:

Chapter one is the general introduction of the entire chapters presenting the context of the research covering background information and justification of the research as: statement of problem and research question; aim and objectives; outline of research process and the thesis structure. This chapter concluded that there is an urgent need for solid waste management issues research in Greater Jos.

Chapter two reviewed in detail MSWM practices in the developed world. It generally pointed at the benefit of MSWM from the global and United Nations perspective, the European Union and United Kingdom from a historical perspective on how policy has evolved and set out a standard in line with global practices.

Chapter three reviewed in details MSWM practices in developing countries from a clear objectives, and set out a framework that pointed to a lot of short-comings at developing countries' level. This chapter identified major problems as: municipalities are undergoing deterioration of solid waste condition due factors listed in section 3.9 of this chapter. It therefore derived this problems to be applied as the framework for the experience of developing countries.

Chapter four looked at critical urban management issues incorporating the role of planning in Nigeria. It noted one weakness of urban waste management is as a result of the three tier system of government institutions having conflicting roles, responsibilities and functions in Nigeria. It look at the strengths and weaknesses of the planning systems in Nigeria. The chapter concludes that planning authorities were constrained in solid

waste management, and there was no effective urban management strategy to address the problem of MSWM in urban areas.

Chapter five identified suitable methodology used in conducting the qualitative and quantitative research. The approaches used in data collection were interviews, questionnaire survey, participant observation and analysis of documents. It presented how conducted interviews to 26 senior officials/industrial stakeholders and household survey of 288 residents after a pre-visit (preliminary survey) and fieldwork trip was done. The methods used were face-to-face and door-to-door nterviews The methodology reported the thread for the thesis, after using comparative review analysis in chapters two and three. The approaches came out with findings of this research in chapters six and seven and subsequently developed chapter eight before this last chapter.

Chapter six examines the finding using the framework identified through chapters two and three and analysed the experience in Greater Jos, using the results of the participation exercise, the interviews conducted on ket stakeholders and senior officials. In addition, household survey results from selected residents in Greater Jos was analysed using descriptive statistical methods. The chapter concluded that the local, state and federal governments are lacking in adequate planning to deal with the waste situation in Jos. In addition, relationship exists between planning and residential zoning in terms of MSWM.

Chapter seven discussed the findings and analysed the MSW situation in Greater Jos. It identified three interwoven key elements of government, politics and the public constituted the major framework for viewing MSWM. It concluded that planning for urban management is lacking, which is serving as the basis for lack of funding, inadequate personal/ training and motivation of personnel, lack of enforcement and waste legislation, and poor public education and involvement in the planning and organization of waste (see chapter three for more details).

Chapter eight is a linked from chapter six and seven. It proposed the establishment of a joint MSWM plan that can be viewed as a benchmark to address the worsening waste issues in developing countries. It draws its experience mainly from chapter three and presented a blue print that shall guide the development of a joint MSWM in developing countries.

Chapter nine is the concluding chapter of this research and mainly dwells on the research results from this empirical study of developing countries especially Nigeria.

9.2 The MSW situation in Greater Jos

In line with what other researchers have found about the solid waste situation in disadvantaged cities around the world, the current study found that Greater Jos has very poor MSW management. This is shown by solid waste accumulation and overflowing containers in many residential and commercial areas, heavy litter on the streets and open lands, garbage-choked gutters and streams clogged with wastes.

The analysis has shown that MSW generation in Greater Jos greatly beats the capacities of the authorities for solid waste collection and disposal. In Jos, PEPSA claims that 40 percent of the daily solid waste output is collected for disposal but the validity of these statistics cannot be ascertained. One thing that is clear to any casual observer is that enormous quantities of MSW remain uncollected each day and solid waste accumulation is a growing problem, making the municipal environment's condition and human life threatening. Apart from the low rates of solid waste collection, the research also found that the MSWM authorities concentrate their waste collection activities in the wealthy residential areas and official grounds of the municipality while many low-income communities and commercial areas receive little or no service for waste collection. The delivery of solid waste disposal services in the municipality is, therefore, skewed in favour of the rich and to the disadvantage of the poor, a situation which raises concerns of planning issues.

The final disposal of MSW in Greater Jos also leaves much to be desired. The research found that crude dumping is the norm and the loads of MSW collected by the waste authorities (PEPSA) dumped in poorly-managed landfills which create dire environmental conditions in the vicinities. The proximity of these poorly-managed disposal sites to residential areas gives rise to concerns about planning issues. The lack of adequate services and protection for the low-income areas in the organisation of MSWM also means that they are denied the opportunity to live in healthy environments. For some of the poor, this also has implications for livelihood and survival. Songsore *et al.* (2001) for instance have noted the high incidence of filth related diseases and the associated high disease burden in the low-income areas in Greater Jos due to unplanned circumstances. Such high incidence of diseases in the poor communities can prevent many people from working and earning income to meet their needs.

9.3 Causes of the MSWM problem in the study area

This research identified elements of MSWP from the framework for MSWM in developing countries to be responsible for the abysmal MSW situations in the study area.

These elements are (i) government: which has to do with planning for population change, institutional structures, funding and recovery; (ii) politics: political commitment, legislation and power, operational and technical factors; (iii) public: public education and awareness, socio-cultural factor and others on MSW disposal and general urban and regional management of the environment.

9.3.1 Poor planning for population change

In developing countries the production and consumption activities of both the residents and floating populations generate enormous quantities of municipal solid waste on a daily basis. A number of factors are contributing to the growing volumes of solid waste in this municipal area. Over the years, rapid urbanization has been accompanied by expansion of the urban economy, rising incomes among the population and increased production and consumption of products. One thing that is clear is that municipal solid waste generation is on the increase. There is a lack of data on the scale of MSW and to overcome this problem, there is the need to gather accurate data on such topics as the quantities and types of waste being generated, their characteristics, as well as the waste disposal practices among the population. Accurate data on solid waste generation and composition, for example, would be useful in determining appropriate strategies for MSWM.

9.3.2 Institutional constraints

The institutional structures for MSWM in developing countries (see chapter three section 3.3 and chapter seven figure 7.2) and Nigeria is seriously weak. The weak government institutions are not provided with clear mandates nor sufficient resources. The lack of clear roles among the relevant institutions and agencies often results in conflicts, duplication of efforts, the wasting of resources, and unsustainability of overall MSWM system. State ordinance or by-laws on MSWM are not also well developed. In the past, the need for private sector participation for waste services delivery has been recognized by government. Although the engagement in the past of the private companies was perceived to be negative mostly by the public, the researcher recommends SWM liberalization in developing countries. The greater involvement of the private sector is recommended. This will address barriers that are currently operational affecting the efficiency of the institutions.

9.3.3 Funding and cost recovery constraints

The research has shown that municipal authorities in the developing countries lack the necessary financial resources to organise waste management effectively. The limited funding of the municipal solid waste sector does not only make it impossible for the waste departments to employ enough professional staff to handle the technical aspects of MSWM (such as planning, operations and maintenance of equipment), but also hinders the recruitment of enough labourers to undertake regular cleaning of the street and market grounds. The same finance problem makes it difficult for the waste departments to pay their contractors promptly to encourage them to work with enthusiasm. Thus, the waste sector is characterised by a vicious cycle of debts that deals a debilitating blow to efforts to keep the municipalities clean and healthy. Linked to the problem of finance is that of logistics.

The study found that scarcity of funds greatly affects the ability of the municipal authorities to acquire the necessary equipment for the collection of MSW from the municipality and its transportation to final disposal sites. In the municipality investigated (see chapter six subsection 6.1.2), the available MSW equipment is obsolete and experiences frequent failure. The high rate of equipment failure greatly reduces the number of trips made by the waste trucks to the disposal sites and frequently leads to waste accumulation in the municipal area. Apart from the fact that available equipment is not adequate to handle the large volumes of waste generated by the residents of Greater Jos, most of the equipment is also unsuited to the housing culture in the numerous low-income communities where the poor layout of structures greatly obstructs the movement of the waste trucks used. The inability of waste trucks to manoeuvre through the chaotic housing developments promotes waste accumulations in many low-income communities.

The study also found the resource scarcity problem facing the waste sector in the country to include shortage of both skilled and unskilled personnel to carry out various functions. Nigeria's educational system lacks courses in SWM, a situation which has created a dearth of qualified SWM personnel. Besides, the waste sector (like other parts of the public sector) is characterised by low salaries and poor conditions of service which discourage graduates from taking up employment in it. Over the years, MSW departments in the country have therefore, not been able to undertake adequate planning and effective organisation of MSWM due to the shortage of qualified waste management personnel including planners, engineers, administrators, finance officers and accountants among others.

9.3.4 Low political commitment/neglect

The research found that both the federal, state and local governments in Greater Jos lack a sense of urgency of the MSW situation and so have not bothered to put in place the necessary measures to address the problem. The political neglect of the solid waste problem is shown in a number of ways including the lack of a policy to provide a framework for the organisation of waste management; inadequate resources for the planning and organisation of waste management activities and the non-enforcement of existing regulations for urban management in general and MSWM in particular. Further evidence of the low political interest in the municipal waste problem is the lack of public education on waste disposal and environmental awareness in general, a situation which promotes negative public attitude towards solid waste disposal and other aspects of environmental management in particular planning.

9.3.5 Lack of legislation and power

There is no clear legislation on MSWM in Greater Jos. This has been partially responsible for the undefined roles of different SWM institutions and agencies as well as lack of coordination among them. FEPA policy of waste management has SEPA laws at the state level, which is expected to be enforced by different institutions and agencies. In addition enforcement and penalties is absent.

9.3.6 Operational factors

Barriers in operations are main reasons for MSWM in Greater Jos. There is no waste handling vehicles. On many occasions even black bin bags and plastic receptacles are not available. Opportunities of training in MSWM methods are not available for staffs. The danger of this is that most of the MSWM sections especially in SEPA and related agencies/ministries are controlled by staff of lower cadres. The effects of this is such staff cannot be part of a decision making board, so waste issues are decided not based on sound judgment but rather by politics.

9.3.7 Poor environmental attitude of the public and government

The poor MSW handling attitude of Nigerians also emerged as one of the causes of the poor solid waste situation in the study area. The inability of municipal planning and management authorities to enforce existing by-laws on MSW results in a general lack of respect for the law and a ‘throw-it-where-you-like’ attitude towards SWM among the population. It is therefore common to see motorists, pedestrians and passengers littering the streets without any fear of the law. For the same reason of non-enforcement, many

householders, traders and other business operators resort to indiscriminately dumping solid waste in open spaces and into drains, streams and drainage channels.

Existing laws on land use and housing development also lack enforcement, a situation that promotes haphazard developments in many low-income areas of the municipality, thus blocking road access within the settlements. Such situations obstruct the movement of waste collection vehicles and promote waste accumulation in many low-income settlements in the municipality.

The third objective for conducting this research was to investigate the MSW problems in developing countries using Jos residents. The waste containers serving the numerous low-income communities is particularly worrying. They are never removed on schedule and are always overflowing with waste that exude smell and cause nuisances to the residents.

9.4 Recommendations for MSWM improvement

This research pursued to investigate the MSWM problem in developing countries using Greater Jos municipality. MSWM in developing countries is in an infancy stage (see chapter three). Among the objectives of the study was the identification of the reasons of the MSW problem. Grounded on the findings presented in chapters six and seven, the following strategies and policy advantages has been provided as recommendations for the improvement (efficiency and effectiveness) of MSWM in developing countries, and Nigeria in general.

9.4.1 Political commitment to municipal waste management

The study has shown that federal, state and local governments in Greater Jos have a low level of commitment to waste management and this proves to be the root cause of the waste problem in the most developing country's municipalities. To address the problem, the lackadaisical manner in which the national and municipal governments currently approach waste management must give way to a firm commitment. In this regard, a number of measures are necessary. A major part of the solution lies in the enactment of a national waste policy to guide the conduct of waste management. A realistic policy framework must be formulated to guide urban sector institutions as well as provide them adequate legal support to enforce their mandates. Furthermore, there is the need to strengthen the resource urban management agencies to enable them carry out their mandates of planning and managing municipalities. These institutions need to be

well-resourced with operational funds, logistics and qualified personnel to enable them to discharge their duties creditably.

To tackle the waste problem effectively, various tiers governments must also commit themselves to improving the conditions of service in the waste management sector to make jobs there attractive to both skilled and unskilled personnel. Besides, political commitment to waste management should also include active public education on environmental sanitation and waste disposal and the inclusion of environmental education in the country's schools' curriculum. Public education on environmental sanitation should be accompanied by adequate provision of facilities such as litter bins and well-maintained public toilets that encourage the public to handle waste responsibly.

9.4.2 Improved funding and equipment for waste management

In order to improve solid waste management in the municipalities, the perennial financial crisis that characterises the waste sector also needs to be addressed. In this regard, there is a need for the federal or national government to greatly improve its allocations to municipal governments and also make these allocations more regular to meet the operational costs of waste management. At the same time, the municipal authorities must be supported to improve revenue mobilisation from local sources. This can be done by attracting qualified finance and accounting staff that will help identify additional sources of funds such as taxes on properties and business, and also improve the financial management practices of the MSW planning and management authorities by plugging leakages and stemming corruption. Additional revenue can also be raised from waste disposal service clients. Analysis of the household survey data has shown that many residents of low-income communities, who currently dump their waste for free albeit in poorly maintained central containers, are willing to pay for improved service while many of those who currently have no waste disposal services are also willing to pay for a good service (see appendix 10.4). This provides hope for the waste management authorities but they must provide a good service to justify such charges. Enhancing the finances of local governments will enable them to maintain infrastructure and provide better waste collection, disposal and other services within their jurisdictions.

Adequate investment therefore has to be made in the logistics for waste management including collection trucks and containers, and also in equipment for the maintenance of disposal sites. At the same time, the private waste companies must be supported to acquire adequate equipment and other necessary resources to enable them to discharge their duties effectively. The waste management departments of the various

municipalities should also be supported to establish well-equipped garages with the necessary spare parts, and to recruit well-qualified engineers and supporting mechanics to maintain the equipment. The problem of poor vehicular access for waste removal in the unplanned communities can also be addressed by introducing simple technologies such as pull-carts, tricycles and even wheelbarrows for primary collection in the otherwise inaccessible locations. In order to deal with the problem of street litter, it is hereby recommended that more bins be provided and placed at close intervals in all busy commercial areas and along all major streets in the municipalities to encourage the floating population to dispose of waste properly and avoid littering the streets. Alongside this, existing waste management disposal by-laws should be strictly enforced to deter people from indiscriminate disposal.

9.4.3 Adopting Joint (MSWM) Plan

It recommended that Joint MSWM Plan (see chapter eight section 8.5 for details) be adopted as a guiding framework within which to conduct the business of municipal solid waste management in the country. This will ensure a varied and flexible (Hybrid option) approach than the integrated solid waste management (ISWM) approach (discussed in chapter eight). In this regard, municipal solid waste planning and management authorities in country should ensure a provision of a comprehensive, integrated and sustainable network in the various strategies of solid waste management in the order presented by the waste hierarchy (Figure 8.2).

All waste producers such as households, businesses and institutions should be enlightened by the authorities on the merits of, and encouraged to practice waste prevention, waste reduction and re-use while measures are instituted to promote recycling, composting and incineration for energy with waste disposal being the last options. In particular, since the bulk of solid waste generated in developing countries consists of compostable organic materials, a successful composting project can greatly reduce the amount of municipal solid waste going for land filling and reduce the need for landfill space. In fact, there is the need to move away from waste disposal in unmanaged dumps, and to the construction of modern landfills designed to control leachate flow and harvest landfill gas (methane) for energy production. These landfills can be supplemented with incineration for energy production, recycling and composting all of which can generate additional revenue to fund waste management operations.

To solve the problem of residents mixing organic waste with other waste types, waste producers can be encouraged or even mandated to separate ‘compostable’ waste

materials from recyclables to facilitate material collection for composting. The compost might also be better accepted if farmers are encouraged to use it on cereal crops that get processed before consumption instead of using it in the cultivation of vegetables. The price of compost manure could also be subsidised and kept low to make it affordable to farmers. Even if the sale of compost fails to yield adequate funds to sustain the operation of compost plants, municipal planning and management authorities have to accept the fact that the cost of solid waste management can only be minimised and it is highly unlikely that waste can ever yield a profit. After all, solid waste management remains an essential municipal service that aims to check climate change and protect public health and environment, and should therefore not be treated as a money-making venture.

9.4.4 Providing adequate land space for solid waste disposal

In addition to providing sufficient funds and logistics for municipal solid waste collection and transportation, there is also the need to provide adequate land space for the treatment and final disposal of waste collected from the municipal environments. In view of the difficult land tenure system in most countries, the task of acquiring land for waste disposal should not be left to the municipal governments alone since they usually lack the influence and negotiating power to engage with land owners. In this regard, the local communities, through such agencies as the related ministries and the surveyor generals of various governments, must play a leading role by identifying suitably located lands, negotiating with land owners and paying adequate compensation to acquire such lands for the purpose of solid waste treatment and disposal. In view of the growing Not-In-My-Back-Yard (NIMBY) attitudes towards the siting of solid waste disposal facilities and the health implications of people living close to these facilities, it would be helpful for the solid waste planning and management authorities to site future solid waste disposal facilities in uninhabited areas far from the municipalities. Boundaries should then be created around these sites and monitored to prevent people from settling near the facilities. Undoubtedly, siting solid waste disposal facilities at considerable distances from cities will increase haulage distances and hence the operation costs of solid waste management. The advantage in this, however, will be the prevention of community pollution and NIMBY protests. There will therefore be trade-offs that will have to be considered in order to solve the perennial land scarcity problem that confronts the municipal solid waste sector in developing countries.

9.4.5 Generating data for planning municipal waste

The lack of data on the municipal waste situations in developing cities is a limitation to the planning for MSWM operations. In order to overcome this problem, the federal or national governments should create a national database on solid waste and also support municipal planning and management authorities to undertake regular research to generate accurate data on the waste situations of municipalities to facilitate municipal solid waste planning and management. Accurate data on solid waste generation and composition, for example, would be useful in determining appropriate strategies for waste management. In situations where municipal government lack the capacity to undertake the necessary research to generate solid waste data, qualified researchers can be recruited from the universities and other research organisations to carry out the research and assist in the planning and implementation of solid waste management operations. There will also be the need to identify all stakeholders in the waste sector including waste producers, those who provide (formal and informal) waste collection services, waste pickers and recyclers. The contributions of these stakeholders must be recognised and their operations formalised and supported to improve waste management in the municipalities.

9.4.6 Public education on environmental sanitation

The poor waste disposal culture can be addressed through public education on environmental sanitation in general and municipal solid waste disposal in particular. This can be achieved through such avenues as schools, churches/mosques and the media. Environmental sanitation should be made an integral part of the basic education curriculum, while institutions of higher learning such as the universities and polytechnics should be encouraged to introduce programmes on environmental management, including courses on solid waste management, to train qualified personnel for the sector. The fact that some are either Christians or Muslims (see NPC, 2008) also makes religious organisations important avenues for environmental education. Federal local governments must, therefore, build partnerships with religious leaders and encourage them to educate their members on environmental sanitation and proper waste management practices such as reuse, recycling, waste prevention and proper waste collection with disposal. This would be a practical way of actualising the popular adage that ‘cleanliness is next to Godliness’. Besides, the media, including the numerous radio stations, television and newspapers should be used to raise awareness among the general public on the importance of maintaining a clean and healthy environment. The fact that many of the radio stations broadcast in local languages provides an opportunity to reach most of the

population. These measures would help address the worsening municipal solid waste situations..

9.4.7 Constant enforcement of regulations on solid waste issues

The study has shown that the public has a very poor waste handling culture which exacerbates the waste disposal problem in developing countries. To curtail this negative public attitude, the municipal authorities must strictly enforce existing by-laws on waste disposal including littering and fly-tipping. Once environmental education has been carried out and waste management services are extended to all communities including litter bins at all vantage point within the municipalities, there will be no excuse for persons who engage in improper waste disposal practices and the law should be made to take its course to bring any offenders to book. Prescribed penalties for waste disposal offences should include court fines, orders to clean up the streets and even imprisonment depending on the gravity of the offence committed. Such enforcement measures could change the rather poor waste disposal culture among peoples. To facilitate the enforcement of the solid waste management by-laws, however, municipalities will have to be supported to recruit enough environmental sanitation guards to monitor waste handling by the public. They will also need the support of the law enforcing agencies such as the police and the courts to help bring offenders to book. These measures will go a long way to improve the municipal waste management situation in developing cities.

9.4.8 Addressing the concerns for environmental planning

The study has confirmed that spatial disparities exist in environmental sanitation between low densities areas and high densities neighbourhoods in Greater Jos municipal area and this is because the municipal authorities overlook the concerns for planning in the organisation of waste management. Waste accumulation in the many low-income communities can be addressed by pursuing planning for the environment and ensuring that all communities in the urban areas receive fair and adequate service for solid waste disposal irrespective of the socio-economic situation of the residents. There is the need to give recognition to and incorporate all informal settlements to make them entitled to solid waste management and other environmental services. This is because people and the environment cannot be protected without extending basic environmental services to all localities in the municipalities.

Municipal authorities should confront the challenge of finding innovative ways to raise additional resources to upgrade and extend environmental services more equitably

across the entire jurisdictions of municipalities. This may include reform of the property tax system and expansion of the tax net as well as efforts to reduce corruption in the handling of public resources. Municipal waste disposal facilities should be sited at reasonable distances from settlements, away from ecologically sensitive areas and managed properly to avoid the pollution of communities and their resources. If actively implemented by the authorities, it is hoped that the above recommendations could go a long way to improve waste management and environmental sanitation in developing countries, thereby helping to achieve the primary objective of waste management which is to protect public health and the environment.

9.5 Reflections on the research process

Having completed the study, there is the need to reflect on the research process and to point out the strengths, contributions and limitations of the entire research. This will be done by discussing the strengths, contribution/wider implication and limitation of the approach that has been used to carry out this study as well as outlining a number of areas where further research is recommended to complement the current study.

9.5.1 Strengths of the research and contribution to knowledge/wider implications

Among other things, the strength of this investigation lies in the triangulation (see chapter five section 5.9) of methods (interviews, questionnaires, field observation and documentary analysis) in a single study which allowed for the use of different strategies to collect data from a range of sources. For example, the use of the direct field observation technique provided me with an opportunity to obtain first-hand information on the municipal solid waste situation in the municipality which kept a clear picture in my mind during the analysis while the interviewing technique allowed for dialogue with key stakeholders in the solid waste sector to generate rich qualitative data for the analysis of the research themes.

From the critical reviews of MSWM in developed and developing countries to analysis, there has never been any research to collect data on MSW from some developing countries to address the issue of urban solid waste planning. This research has done that and advanced a prototype guideline of joint MSWM plan to address the waste problems in developing countries. In addition, the detailed comparative analysis and triangulation of the research elements from a wider global (UN, EU, etc.) perspective, has breached the gap between the weakness of the research done to date and what has not been done now in urban waste management of developing countries. The governance factor parked in

financial sustainability MSWM framework has been overlooked in all the researches. This research has assessed the framework in terms of the key issue in controlling MSW and coherence in management institutions in developing countries. Once the financial aspect is addressed, the solid waste situation in the cities can be assessed, progress monitored, recorded and analysed over time for improved urban environmental management.

Furthermore, the use of questionnaires in the household survey enabled me to cover a reasonably large number of households in Greater Jos which would not have been possible with only interviews considering the limited time period and other constraints within which the fieldwork was conducted. The triangulation of methods also provided the opportunity to crosscheck the various sources of data, one from another, which greatly improved the validity of the data gathered for the study. The study was also able to explore the issues surrounding the topic from the perspectives of different stakeholders including municipal waste departments, private sector waste companies, some public sector institutions and householders in the different socio-economic groups. This multi-source approach provided an opportunity to get a more rounded perspective on the municipal solid waste management problem in the municipality.

Finally, my familiarity with the research environment gave a further boost to the field work conducted for the research. Apart from being familiar with Greater Jos which served as site for the field investigation, my knowledge of the Nigerian cultural context enabled me overcome many situations which would otherwise, pose constraints to the data collection process.

9.5.2 Limitation of the research

While the study has been successful in collecting and analysing data to address the research objectives, it is still limited in a number of ways. Generally, the factors that limited the research methodology include the limited time period for collecting the data due to the limited financial and logistical resources I had for the data collection exercise. As a result of this factor, the household survey was limited to a total of 288 households. A larger sample would have captured the views of more residents to increase the representation of householders in the study. Another situation that reduced the number of householders to include in the study was the lack of sample frames and street maps that would have facilitated the process of selecting householders for the study. This made the process of selecting the participating communities and households clumsy and time consuming. Even with the help of three field assistants, considerable time was spent in

selecting households for the survey. The interviews covered 26 senior officilas in both public and private institutions out of the 33 contacted.

Besides, the interviews were also limited to a few key staff of the institutions that participated in the study such as the municipal solid waste departments, public institutions and the private sector waste companies. Wider involvement of the staff of these institutions including lower level administrative staff would also have given me an opportunity to hear from a much larger and representative audience for the fieldwork which, no doubt, would yield richer and more elaborate data for the research. The language barrier was another factor which may have affected the quality of data gathered for the study. Even though English is the official language in Nigeria, some respondents in both the household questionnaire survey and the semi-structured interviews (e.g. informal waste collectors and business operators) could not express themselves well in English. Interviews with such respondents were, therefore, conducted in the relevant Nigerian languages and the responses recorded in English.

In spite of my good knowledge of the local languages involved (namely Hausa and Berom), the translation process could still lead to a loss of meaning of what the respondents actually said and thus affect the quality of information obtained.

9.6 Concluding observations

The current study has shown that the issue of municipal solid waste management has become an exampler for developing countries staring the authorities in the face while they look on rather helplessly. As noted earlier, the problem largely results from the lack of political commitment to address the issue of wastes management. This is reflected in government failure to resource municipal solid waste authorities to deal with the rather complex issue of municipal waste management. Apart from the acute lack of funds and logistics for the organisation of solid waste management, municipal waste departments in the country also lack well-qualified technical personnel such as planners, engineers, administrators, accountants and researchers to tackle important issues regarding municipal waste management. Besides, lack of the required legal strength to enforce existing by-laws on waste management, and to check the rather poor waste-handling attitude of the populace as well as the inability to enforce standards on land use and housing development within the municipality continue to frustrate the efforts of municipal governments in their attempts to keep the municipality clean and safe.

The frustrating waste problem, however, has also been caused by poor governance practices in the management of waste services. Municipal authorities have failed to

promote partnership with the waste-producing public and to involve them in the various aspects of waste management including needs assessment, financing, waste collection and final disposal. Besides, the authorities have failed to address the concerns for holistic planning in the provision of solid waste disposal services and the final disposal of solid waste. As a result, the needs and concerns of the poor and powerless segments of the urban population have been overlooked, a situation that creates discontent and fails to secure the co-operation of sections of the urban population and thus frustrate the efforts of the authorities.

In view of the above, the solution to the growing solid waste problem in developing countries will be for both the state and municipal government to committing themselves to the issue of waste management. This could be done by improving the capacities of municipal government in the areas of finance, logistics and personnel, as well as providing them with legal support to enforce regulations on waste disposal and other aspects of urban planning. The solution to the solid waste problem also lies in promoting good governance practices and addressing the concerns of planning in the organisation of waste management. The urban poor should neither be denied solid waste collection services nor be made to suffer unduly, the burdens of waste management. Besides, the current approach to solid waste management which regards the waste problem as a technical issue to be solved with funds and logistics alone must give way to a comprehensive, integrated and sustainable network approach which incorporates adequate participation, good governance and planning as key element of the municipal waste management process.

9.7 Recommendations for further research

The present research has examined the municipal solid waste problem in developing countries' municipalities, especially Nigeria, focusing on the solid waste situation in Greater Jos, the limits to waste management efforts in the country and issues of planning in the organisation of solid waste management. In the course of the research, however, a number of themes have been identified that critically affect the organisation of solid waste management but which remain underresearched. These areas include appropriate strategies and technologies for municipal solid waste management, waste management financing, the governance of waste management, urban land use and housing, waste stream studies for data generation, liquid waste disposal and medical waste disposal. These and other aspects of urban development critically impact the organisation of municipal solid waste management generally but are beyond the scope of

the present study. Full-scale investigation in these areas is therefore recommended to create greater understanding of urban development issues and pave the way for improved urban environmental management and sustainable urbanisation in developing countries.

In addition, as indicated in chapter one section 1.8 and chapter three table 3.3, the research context was not limited to Greater Jos municipality. It is entirely possible that there may not be significant differences in the findings if this research is replicated in other sub-Saharan municipalities. It will be interesting and useful for benchmarking purposes to find out if differences do exist. It is therefore recommended that this research is replicated in other municipalities of developing countries to give more room for comparative investigation. This research presented is an up to date representation of waste management problem in developing countries.

Appendices

10.0 Appendices

10.1 Letter of Introduction for interview(fieldwork)

Letter of introduction

Dear Sir/ Madam

REQUEST FOR INTERVIEW

I am a PhD student of Heriot-Watt University, Edinburgh UK conducting research on how town planning in Nigeria can help improve municipal solid waste management issues. Secondly, whether the planning system has the capacity to help in the management of municipal solid waste, particularly in Greater Jos used as a case study. My supervisors are Prof. Angela Hull (principal supervisor), Prof. Paul Jowitt and Dr. Adebayo Adeloye. In summary, the research will look at:

i. The relationship between town planning and municipal solid waste management in Jos
ii. The municipal solid waste problems in Jos.
iii. The current management system for solid waste in Jos.
iv. The town planning system and its functions in municipal solid waste management and
v. The project will establish parameters for assessment of improvements in performance by waste management authorities as well as prescribe strategies that will inform future policy and investment decisions.

As a stakeholder in the waste sector, your views are important in this study and I would be grateful if you could grant me an interview between 15th May and 30th June, 2013.

I would like to assure you that the information you provide in the interview will be treated confidentially and anonymously and will be used solely for the purpose of this research.

If you are able to honour this request, please indicate (on the appointment slip unclosed) your preferred date, time and venue for the interview. Kindly return the slip in the self-addressed and stamped envelope that is enclosed.

Thank you for your assistance.

Gwom Peter
Principal Investigator

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Appointment for interview

Name of officer: …….Institution/Organization…….....

Position/rank:…….……..……Contact Tel. No: …….…….....

Preferred date for interview:……Time:……Venue:…….....

10.2 Interview questionnaires

2a) QUESTIONNAIRE – QUALITATIVE (In-depth interview guide)

PART ONE: INTERVIEW WITH OFFICIALS OF MUNICIPAL SOLID WASTE DEPARTMENTS IN GREATER JOS

Name of Municipality:.....

Designation of officer granting interview:…….....

Professional background of officer:…….……

Job history:…… ……..……..

Section A: Stakeholders in waste management

1. Which institutions are involved in the organization of waste management in Jos and what are their respective roles?

Institutions	**Role in waste management**
……..…	…….
……..…	…….
……..…	…….

2. Do you find the institutional arrangement for waste management effective?
• Yes [ ]
• No [ ] Why ……..……
3. Is there adequate capacity for waste management in Jos?
• Yes [ ]
• No [ ]
Reason for answer:……..……..…
4. What is your own department's role in waste management?
a. .....
b.....
c.....

Section B: The waste situation in Jos

5. How would you describe the solid waste situation in this city?
……
……

6. Are you able to determine the following?
a. Per capita waste output in the city? ……..
b. Total daily waste output for the city? ……..
c. Rate of increase in waste output …….
7. Has the city's waste output been increasing in recent years?
• Yes [ ] what could be causing the increase? .....
• No [ ]
8. Can you provide the following information about the city's waste stream?

Major components of the waste stream	**Percentage of output**	**Main sources**
1…….....	.....	.....
2…….....	.....	.....
3…….....	.....	.....
4…….....	.....	.....
5…….....	.....	.....

9**.** Has the waste mix being changing?
• Yes [ ] what is changing in it? ……..
• No [ ]
10**.** Have you made any projections for waste output in the next few years (5 – 10years; 10-15years)?
• Yes [ ] what are your projections?.....
• No [ ]
11. Do you think you will be able to cope with the waste situation in the future?
• Yes [ ] how are you preparing for this? ……
• No [ ] why not? ……..……...
12. Can you briefly describe the arrangements for solid waste collection in this city?
……
……
13. Are you able to provide waste collection services in all areas of the city?
• Yes [ ] (proceed to Q.17)
• No [ ] why are you unable to do this? …. ……
……..

14. Please indicate:

Which areas are served?	Which areas are not service?
a.....	....
b.....	....
c.....	....

15. What considerations influence your decisions to serve or not to serve an area?
……
……
16. How do communities without waste collection service dispose of their waste?
……
17**.** What are the arrangements for waste collection in the following areas?

Area	**Method of collection**	**Frequency of collection**	**Service provider**
High-income areas	.....	.....	.....
Middle-income areas	.....	.....	.....
Low-income areas	.....	.....	.....
Commercial areas	.....	.....	.....
Institutional premises	.....	.....	.....

18. What considerations influence the level or quality of service to provide in an area?
……
……
19. Is littering a major problem in this city?
• Yes [ ] can you please elaborate? ……..
• No [ ] (proceed to Q.21)
20. What do you consider to be the reason for littering in the city?
……
21. Do you have any by-law against littering/indiscriminate disposal of waste?
• Yes [ ] what are its provisions?…….
• No [ ] (proceed to Q.23)
22. Are you able to enforce the by-law on waste disposal?
• Yes [ ] how is it enforced? ……
• No [ ] why are you unable to enforce it? …….
23**.** Are you able to provide enough litterbins in public places?
• Yes [ ]
• No [ ] why?.....……. (Proceed to Q. 26)
24. How regularly are the litterbins scheduled to be emptied? ……..…
25. Are you able to meet this schedule?
• Yes [ ]
• No [ ] why not? ……..
26. How will you describe public attitude towards waste disposal in this city?
……
……
27. Do you carry out public education on waste disposal?
• Yes [ ] How is it done? ……...…….

• No [ ]
28. Please indicate how the following public places are cleaned in terms of:
Place / **Schedule for cleaning** /**Who does the cleaning**? / **Are you able to meet schedule**? (yes/no)
a. Open-air markets
b. Lorry stations
c. Major streets
d. Drains and gutters
e. Other public places (explain)

29. Are you able to determine the quantity of solid waste collected for disposal in a day?
• Yes [ ] what quantity is collected daily? ……
• No [ ] why not? …….
30. What waste treatment/disposal facilities are operated in the city?

Type of disposal facility	**Location(s)**	**Number operated**
a.	.....	... .
b.	.....	....
c.	.....	.....

31. What considerations influence the siting of waste disposal facilities?
……
…… ……
32. Are all the waste disposal sites/facilities approved by the Environmental Protection Agency?
• Yes [ ]
• No [ ] how many are approved?. ……
33. Who maintain(s) the waste disposal facilities? ……..
34. Are you aware of any environmental problems associated with the disposal sites?
• Yes [ ] what are they? ……..……..
• No [ ]
35. Have communities around the disposal facilities complained of any nuisances?
• Yes [ ] what have they complained about?.....
• No [ ]

Section C: Resources, private sector participation and commitment for waste Management

Equipment

36. How do you acquire equipment for waste management/who provides them?
……
37. What equipment do you have for waste management operations?

Equipment type	No. required	No. available	No. in use
a.	.....	.....	....
b.....	....	.....	.....
c.....	.....	.....	....
d.	.....	.....	....

38. Are you able to adequately maintain equipment for waste management?
• Yes [ ]
• No [ ] Why?……..
39. Do you consider your equipment adequate for your operations?
• Yes [ ] (proceed to Q. 42)
• No [ ]
40. What is the nature of your equipment problem?/ what equipment do you lack?
……
41. In your view, how can the equipment problem of the waste sector be solved?
……
……

Finance

42. What are your sources of finance?
……
43. Are you able to acquire adequate funds for your operations?

• Yes [ ]
• No [ ]
44. What proportion of the required funds are you able to acquire?
…….....
45. Do your service clients pay waste disposal levies?

Who pay(s)?	Rate	Who do not pay and why?

46. Are there any potential sources where you could generate additional funds?
• Yes [ ]

Potential sources	**Why are these sources not being exploited at the moment?**

47. In your view, what could be the solution to the finance problem of the waste sector?
……
……
48. Have you received any donor support for waste management in recent years?

Name of donor/organization	Support received (type or amount)	Year

Personnel

49. What categories of staff are employed in the waste department?

Category of staff	No. employed	Are they enough?

50. Is it easy to attract staff to the waste sector?
• Yes [ ]
• No [ ] Why? ……. ……..……..
51. Do you have any programmes for staff training?
• Yes [ ] In what aspect of waste mgt?.....……
• No [ ] why? ……..…… (proceed to Q52)

Land

52. Are you able to secure enough suitable land for the siting of waste disposal facilities?
• Yes [ ] (proceed to Q. 54)
• No [ ] why?……..
53. How do you respond to the problem of land shortage for waste disposal?
……..…….
54. What do you consider to be the major constraints to waste management in your city?

Constraint	What causes the constraint?	How can it be addressed?

Private sector participation

55. Is the private sector involved in waste management in this city?
• Yes [ ]
• No [ ] But what role could they play?……(proceed to Q.65)
56. Can you elaborate?

Nature of private sector involvement (e.g. contracts, franchises etc)	Aspects of waste management handled by private sector (e.g. collection, recycling, site maintenance etc)

57. When did private sector involvement start in this city? ……..……
58. What prompted the involvement of the private sector in waste management?
……
59. How many private companies participate in waste management in this city? ……..…
60. Which sectors of the city are covered by private sector operations?
(e.g., whole city, residential sector, commercial sector, industrial sector)
……
61. How are contracts/franchises awarded to private sector participants?
……
62. What conditions do companies have to meet to qualify for a contract/franchise?
……
63. Do you have the need to engage more private companies?
• Yes [ ] how many more? ……Why haven't you done so? ……...
• No [ ]
64. How would you describe the performance of the private waste companies?
……...

Commitment for waste management

65. Would you say there is adequate commitment to waste management in Jos?
• Yes [ ] How is this shown?.....
• No [ ] Why? ……...
66. What do you consider to be the cause of the waste problem in Jos?
……
67. How can waste management be improved in Jos?
……..
……
68. Would you like to make any other comments or ask questions in relation to this discussion?
……
……
……
……

Thank you for your time and assistance

<u>PART TWO</u>: INTERVIEW WITH PRIVATE WASTE COMPANIES

Municipality:.....

Name of company ……

Designation of officer granting interview: …….

What has been your employment history?.....

1. When was your waste company started? ……..
2. Is the company a local or foreign one? Local [ ] Foreign [ ]
3. What motivated you into the waste business? ……..……

4. Do you have a standing contract with the city waste department?
• Yes [ ] what is the duration of this contract? ……..
• No [ ]
5. What is the procedure for getting a contract?
……
6. Would you say the contract procedure is transparent and fair?
• Yes [ ]
• No [ ] why? …….
7. Did you have to meet any conditions to get a contract? (E.g. possession of equipment etc)
……
…….
8. Which parts of the city fall within your contract area?
…….
9. What exactly do you do? (E.g. waste collection, management of disposal sites etc)
……
……
10. Would you be able to handle a larger contract than you currently do?
• Yes [ ]. How much more? (e.g. 2x or 3x more) ……
• No [ ]. Why not?..…….
11. What categories of staff work in your company? (e.g. engineers, health inspectors, Labourers etc)

Category of staff	**No. Employed**	**No. Required**

12. Do you find it easy to attract and retain staff?
• Yes [ ]
• No [ ] why not? ……..
13. What equipment do you have for your contract operations?

Equipment type	No. available	No. operational	No. Required

14. Do you consider your equipment adequate for your contract work?
• Yes [ ]
• No [ ]
15. How do you acquire your equipment?
……
16. What are your sources of finance?
……
17. Are you able to mobilize adequate finance to cover your operational costs?
Yes [ ]
No [ ]
18. Who are your service clients?
……
……
19. What type of service do you provide and how do you charge your clients?

Category of client	Type of service	Frequency of service	Service charges

20. How do you hope to improve your finances?
……
……
21. How much waste are you able to collect in a day? ……..kg/.tonnes.
22. Where do you dispose of the waste you collect? ……
23. Is the disposal site approved by the Environmental Protection Agency?
• Yes it is [ ]
• No it isn't [ ]

• Don't know [ ]
24. How is waste treated at the disposal site? (e.g. incinerated, land filled, recycled etc)
……
25. Who manages the disposal site? …..……
26. How would you describe environmental conditions at the disposal site?.....
27. Do you know of any environmental problems associated with the disposal site?
• Yes [ ] what are these problems? …….
• No [ ]
28. Are you charged for waste disposal at the site?
• Yes [ ] How are you charged? ……..…….
• No [ ]
29. Do you have any problems in the operation of your contract/franchise?
• Yes [ ] What are they? ……
• No [ ]
30. How do these constraints/problems affect your operations?
……
……
31. What is your own impression about the waste situation in Jos?
……
32. What are the reasons for the current waste crisis in Jos?
……
33. In your view, how can waste management be improved in Jos?
……
……
34. Would you like to make any further comments or ask any questions in relation to this discussion?
……
……

Thank you for your time and assistance.

<u>PART THREE</u>: INTERVIEW WITH OFFICIAL OF SOME PUBLIC INSTITUTIONS IN THE URBAN SECTOR

Municipality:.....

Designation of officer granting interview:……...…….… …….....

Professional background of officer……

Job history:…… ……..

1. When was your office/department established in Jos?
……..……..
2. What is the mandate of your office/department?
……
3. Are you adequately resourced to discharge your functions with regard to funds, logistics and personnel?
• Yes [ ]
• No [ ] what do you lack?
……..
4. How do your functions affect waste management in Jos?
……
……

Specific to Environmental Protection Agencies

5. Do you regulate the siting and maintenance of waste disposal facilities?
• Yes [ ]
• No [ ]
6. Are you able to enforce the regulations on waste disposal?
……

……
7. What considerations qualify a place as site for a waste disposal facility?
……
……
8. Have you approved the siting of any waste disposal facilities in this city?
• Yes [ ] which ones have you approved? …….
• No [ ] why: ……..
9. Are you satisfied with the maintenance of waste disposal facilities in this city?
• Yes [ ]
• No [ ] why?.....……

Specific to Lands, Survey and Town Planning Departments

10. Is your department involved in the siting of waste disposal facilities?
• Yes [ ] How are you involved? ……..
• No [ ] (stop interview)
11. What factors do you consider when siting a waste disposal facility?
……
……
12. Do the existing waste disposal facilities meet the siting requirement?
• Yes [ ]
• No [ ]
13. Which parts of the city do you consider to have?
• Good roads: …….....
• Bad roads: ……...
14. Why is the road quality poor in some parts of the city?
……
15. How does road quality affect the organization of waste management in the city?
……
16. What is the role of urban planning ministry/ environmental agency/ urban development board in waste management of Jos?
17. Do you see reason for planning to be the lead organization of waste management in Jos?
• Yes [ ] (go to Q. 18)
• No [ ] why?.....
18. What is their capacity to take on waste management in terms of:
a. Staff strength.....
b. Skills and training.....
c. Ability to access additional finance.....
d. What information is required in solid waste? .....
e. Who holds? / Sharing / Publicly available
- IT needs / data sharing protocols
- Levels of funding required
- Funding requirements
- Management – core / contract management
19. What is the rationale for town planning to be the lead organization?

All Institutions

16. What do you consider to be the cause of the poor solid waste situation in Jos?
……
……
17. Would you like to make any further comments or ask a question with regard to what we have just discussed?
……
……
……

<u>PART FOUR</u>: INTERVIEW WITH PRIVATE WASTE COLLECTORS

Municipality:.....

1. How long have you worked as a waste collector? ……... .....(years/months)

2. What equipment/tools do you work with?
……
3. Who are your clients and how do you charge for your service

Clients	How often do you collect their waste?	How do you charge?

4. Where do you dispose of the waste you collect from your clients?.....
5. Are you charged where you dispose of your collection?
• Yes [ ] How much do you pay? ……..How often do you pay? ……....
Who do you pay to?.....(proceed to Q. 7)
• No [ ]
6. Will you be willing to pay if asked to?
• Yes [ ] why will you? ……
• No [ ] why not? ……
7. About how much do you earn on a working day? …….....
8. Would you like to be employed by the city waste department to do this same work?
• Yes, I would [ ] why? ……..……
• No, I wouldn't [ ] why not? ……
9. Are you a native of this city?
• Yes [ ]
• No [ ] where do you originally come from?…….
10. What motivated you into this work? ……..……
11. Do you have anything else to say about your work or a question to ask with regard to this discussion?
……
……

Thank you for your time and assistance

<u>PART FIVE</u>: INTERVIEW WITH RESIDENTS OF COMMUNITIES AROUND WASTE DISPOSAL FACILITIES

Municipality:.....

Name of sub-urban area: …….....**.....**

1. How long have you lived in this community? **.....**
3. What do you consider to be the major problems affecting this community?
……
……
4. Do you have any concerns about the siting and maintenance of the waste disposal facility in your community?
• Yes [ ] what are your concerns? ……
• No [ ]
5. Does the waste disposal facility pose any nuisance to the residents of this community?
• Yes [ ] what nuisance(s) does it cause? ……
• No [ ] (go to 13)
7. How does the nuisance(s) affect the community?
……
……

8. As residents, have you collectively complained about conditions at the facility to the municipal authorities or the Environmental Protection Agencies?
• Yes [ ]
• No [ ] why?.....
10. What was the complaint about?
……
11. How did the authorities respond to your concerns?
……

……
12. What do you think should be done about the waste disposal facility?
……
13. Do you have any other comments or questions with regard to what we have discussed?
……
……

Thank you for your time and assistance

PART SIX: INTERVIEW WITH STAFF AT WASTE DISPOSAL FACILITIES

Municipality:.....

1. When did waste disposal start at this facility? ……
2. Which agency is responsible for maintenance of the disposal site?.....…….
3. Who bring waste here for disposal? ……..
4. About how much waste is brought here in a day? ……..
5. What types of waste are brought here? (e.g. household, commercial)
……
6. What do you do with the waste you receive? (e.g. composting, recycling, land filling)
……
7. What equipment do you have here for operations?

Equipment type	Number required	Number available	Number operational

8. Do you consider the equipment adequate for your operations?
• Yes [ ]
• No [ ]
9. How many people work at this facility?

Categories of staff	No. required at site	No. employed at site

10. Do you charge those who bring waste here for disposal?
• Yes [ ]
• No [ ] why not?…….(proceed to Q.14).
11. How do you charge them/ how do you determine the charge? (e.g. by weight or per trip etc)
……
12. Do you consider environmental conditions at the facility to be satisfactory?
• Yes [ ]
• No [ ] why not? ……
13. Do you know of any nuisances or environmental problems associated with this facility?
• Yes [ ] what are they? …….
• No [ ]
14. Have residents of the host communities ever complained of any nuisance from the facilities?
• Yes [ ] what about? ……
• No [ ]
15. How do you respond to their complaints?
……
……
16. Do you have any problems or difficulties in managing this facility?
• Yes [ ] what are they?.....
• No [ ]
17. Do you have any further comments or questions regarding this discussion?
……
……

Thank you for your time and assistance

2b) Household survey questionnaire 1

HERIOT WATT UNIVERSITY

QUESTIONNAIRE FOR HOUSEHOLD SURVEY

INTRODUCTION

Dear resident,

We are carrying out a study to assess the solid waste situation in Jos. The purpose of this questionnaire is to find out about your household waste disposal needs, the waste disposal services you receive, and how you perceive the solid waste situation in this city. The ultimate goal of the study is to find ways of improving solid waste management in the city.

As a resident of this city your views and ideas are considered very important for the success of this study and it would be very much appreciated if you could spend a little time to answer this questionnaire.

Thank you for your assistance

Section A: General Information

A1: Information about you

Name of respondent (Optional)_____

Contact address (Optional) _____

Tel. (Optional) _____

A2: Which area of Jos do you reside (Please tick option, e.g. √)

Jos South	☐	Bassa	☐
Jos North	☐	Riyom	☐
Barki - Ladi	☐	Jos East	☐

A3: Using the scale 1 – 6 (1=excellent, 6=poor), please identify your level of knowledge of the under listed waste management subjects (tick √ correct response)

	1	2	3	4	5	6	not sure
1. Waste minimization	☐	☐	☐	☐	☐	☐	☐
2. Recycling	☐	☐	☐	☐	☐	☐	☐
3. Composting	☐	☐	☐	☐	☐	☐	☐
4. Plateau Environmental protection and Sanitation Agency (PEPSA) waste Management	☐	☐	☐	☐	☐	☐	☐

A4: Using the scale 1 – 6 (excellent, 6=poor), could you point out how well you have done in carrying out (PEPSA) environmental regulations on (tick √correct response)

	1	2	3	4	5	6	not sure
Environmental Sanitation	☐	☐	☐	☐	☐	☐	☐
Recycling	☐	☐	☐	☐	☐	☐	☐
Composting	☐	☐	☐	☐	☐	☐	☐

Section B: Operations

B1: Waste generation and collection

Please respond to the following relating to waste generation (tick√ correct response)

5. Your household size (persons)	☐ 1	☐ 2 - 4	☐ 5 - 7	☐ 8 - 10	☐ > 10
6. Size of accommodation	☐ single room	☐ room & parlour	☐ flat	☐ semi-detached	☐ duplex/ detached
7. Income range (Naira)	☐	☐	☐ 30,000-	☐	☐ business
8. Residential classification	☐ wealthy achievers	☐ Urban prosperity	☐ Comfortably off	☐ Moderate means	☐ Hard pressed
9. Type of container used for waste collection	☐ standard bin (240L)	☐ other covered bins	☐ black bin bag	☐ communal bins	☐ open container
10. Who is responsible for collection and transfer of your waste	☐ PEPSA	☐ contractors	☐ informal agents/vendors	☐ yourself	☐ others
11. Estimate of weekly volume of Waste generated from your residence	☐ > standard bin	☐ <240 Lbin	☐ >1 bin bag	☐ < 1 bag	☐ varies
12. On the average how much do you spend on waste services per month (Naira)	☐ <500	☐ 500-1000	☐ 1000-5000	☐ >5000	☐ varies

B2: Recycling, composting and waste transfer

Please respond to the following statement as honestly as possible (tick √ correct response)

13. How much of your cooked food or food purchases end up being thrown into your waste bin	☐ < 10%	☐ 10-29%	☐ 30-49%	☐ above 50%
14. Estimate of recyclable items sometimes disposed off in your bin	☐ <10%	☐ 10-29%	☐ 30-49%	☐ above 50%
15. Estimate the proportion of your possible waste that you re-use	☐ 0%	☐ 1-10%	☐ 11-20	☐ above 20%
16. I do not recycle/compost but would like to if	☐ I am Trained	☐ I have a recycling bin	☐ if the law compels me	☐ if I have some incentives
17. Being paid for recyclables will increase recycling rate	☐ Yes	☐ No	☐ Not really	☐ don't know
18. Scavenging (informal sector recycling) is useful because/for	☐ It creates employment	☐ provision of raw materials	☐ cleaning the environment	☐ don't know

19. Please mention other reasons why you consider scavenging useful.....

.....

20. Please suggest ways to make Jos residents

1. Recycle more .....
2. Compost more .....

Section C: Waste policy and Strategy
C1: Barriers affecting management of municipal solid waste in Greater Jos

Please respond to the following statements as honestly as possible (tick √ correct response)

21. How would you index your Level Of satisfaction with services provided by the PEPSA ☐ very satisfactory ☐ good ☐ satisfactory ☐ fair ☐ poor ☐ very poor ☐ not sure

22. Please use the scale to indicate how the following barriers affect waste management in Jos.
A value of **1** will imply **minor barrier**while **6**implies factor is a **major barrier** to waste management in the city

	1	2	3	4	5	6	not sure
Waste policies lack clear strategies for action	☐	☐	☐	☐	☐	☐	☐
Laws regulating waste management are inadequate	☐	☐	☐	☐	☐	☐	☐
Waste management institution are weak	☐	☐	☐	☐	☐	☐	☐
Unplanned aspects of the city make waste collection difficult	☐	☐	☐	☐	☐	☐	☐
Density and high moisture content makes waste difficult to manage	☐	☐	☐	☐	☐	☐	☐
Availability of dumping grounds discourages expensive investment in alternative disposal methods	☐	☐	☐	☐	☐	☐	☐
Limited funds available are sometimes misused	☐	☐	☐	☐	☐	☐	☐
Public education on waste management is low	☐	☐	☐	☐	☐	☐	☐
Waste workers are poorly trained and poorly paid	☐	☐	☐	☐	☐	☐	☐
Operational equipment are absolute and insufficient	☐	☐	☐	☐	☐	☐	☐

Please list other factors that could constitute barriers to sustainable waste management in the city

1.....

2.....

3.....

C2: Waste management strategy (please tick √correct response)

23. How would you rate the effectiveness of current practice for managing municipal solid waste in Jos	☐ excellent	☐ good	☐ poor	☐ don't know
24. Please suggest an environmentally Friendly way to manage solid waste in Jos	☐ waste minimization	☐ recycling/ composting	☐ energy generation	☐ landfilling
25. In your opinion who is best equipped to manage the waste problem in the city	☐ government agencies	☐ private organizations	☐ joint government and private	☐ individuals
26. Waste facilities in the city are at times located without proper environmental consideration	☐ Yes	☐ No	☐ Don't know	

C3: Success factors affecting management of municipal solid waste in Jos

27. Please use the scale to indicate how the following factors will affect waste management in Jos
A value of **1** will imply factor **minimal effect** while **6** implies factors has major **effect**.

	1	2	3	4	5	6	not sure
A culture of informal sector recycling (scavenging) already exists in the city	☐	☐	☐	☐	☐	☐	☐
Waste stream is highly compostable	☐	☐	☐	☐	☐	☐	☐
Large city population is a potential market for recycled products and compost	☐	☐	☐	☐	☐	☐	☐
Recent emergence of small scale industries	☐	☐	☐	☐	☐	☐	☐

Section D: Waste disposal and environmental health

Please respond to the following statements as honestly as possible (√correct response/s)

28. Who is responsible for the disposal of waste generated from your home?	☐ PEPSA	☐ Private Contractors	☐ Scavengers	☐ Yourself
29. Some people dump waste in un-authorized places because	☐ no facilities	☐ Inadequate information	☐ No penalty	☐ To Save cost
30. The commonest method of waste disposal in my area is	☐ Sanitary landfills	☐ Open dumping	☐ Burning	☐ incinerators

31. Please mention some major health concerns associated with waste scavenging in your area

1. .....
2. .....
3. .....

ANY OTHER COMMENTS

.....

.....

.....

.....

.....

Will you be available for a brief follow-up confidential interview?

Yes ☐

No ☐

Thank you for completing the questionnaire.

2c) Household Survey Questionnaire 2

QUESTIONNAIRE FOR HOUSEHOLD SURVEY

Dear resident,
We are carrying out a study to assess the solid waste situation in Jos. The purpose of this questionnaire is to find out about your household waste disposal needs, the waste disposal services you receive, and how you perceive the solid waste situation in this city. The ultimate goal of the study is to find ways of improving solid waste management in the city.

As a resident of this city your views and ideas are considered very important for the success of this study and it would be very much appreciated if you could spend a little time to answer this questionnaire.

Thank you for your assistance.

A

i. City: Jos North [ ] Jos South [ ]

ii. Name of suburb ……

iii. How long have you lived in this neighborhood? Years ……. Months…….

iv. How many people live in your house? ……..

B

Household waste generation and disposal practices

1. Please indicate the items commonly found in your household waste and how often you generate them

Common household waste items (e.g. food waste, paper, plastic)	**How often do you generate this?** (e.g. daily, weekly, occasionally)

2. How do you store your waste before disposal?
   - In a closed container [ ]
   - In an open container [ ]
   - In a polythene bag or sac [ ]
   - Other [ ] **Please indicate**:……

3. In the table below, please indicate with a tick (√) the type of waste collection service available to your household.

Waste collection service	**(√)**	**Question to proceed**
Home collection		
Roadside collection		
Truck visit		
Communal container		Proceed to Q. 6
Waste dump		Proceed to Q. 10
Other (Please Indicate).....		Proceed to Q. 14

4. In the table below, please indicate your service provider and frequency of the service

Service provider	**Frequency of service**

5. Is your service provider able to keep to the agreed schedule for waste collection?
   - Yes [ ]
   - No [ ] What do you do with your waste then?
     .....

Proceed to Q.17

****

6. Is the waste container close to your home or other homes in the neighborhood?
   - Yes [ ] how close? .....(e.g. distance in meters)
   - No [ ]

7. Is the waste container emptied regularly?
   - Yes [ ] how regularly is it emptied?.....
   - No [ ] do you know why?
     - Yes [ ] state reason:.....
     - No [ ]

8. How will you describe the sanitation around the waste container?
   - Very satisfactory [ ]
   - Satisfactory [ ]
   - Poor [ ]
   - Very poor [ ]

9. Do you suffer any nuisance from the waste container site?
   - Yes [ ]
   - No [ ]

Proceed to Q.17

****

10. Is the waste dump close to your home or other homes?
    - Yes [ ] how close is to the nearest homes? ……..(e.g. distance in meters)
    - No [ ]

11. Is the waste dump maintained (e.g. is the waste regularly removed or burned)
    - Yes [ ] who do maintains it? ……
    - No [ ]

12. Do you suffer any nuisance associated with waste dump?
    - Yes [ ] what do you suffer from? ……
    - No [ ]

13. How will you describe the sanitation situation at the waste dump?
    - Very satisfactory
    - Satisfactory
    - Poor
    - Very poor

Proceed to Q.17

****

14. Please indicate how you dispose of your waste
    - Burning [ ]
    - In the bush/roadside/drain [ ] specify:……
    - Burying [ ]
    - Other method [ ] specify:……

15. Why do you dispose of your waste by this method?
    - I have no waste collection service [ ]
    - I cannot afford service fee [ ]
    - Other reason (please indicate) [ ] ……

16. Do you know of any environmental problems associated with your method of waste disposal?
    - Yes [ ] what are they?……
    - No [ ]

****

17. Do you find your waste disposal arrangement convenient?
    - Yes [ ]
    - No [ ]. Why is it not convenient?……

18. How will you describe the general waste situation in your neighborhood?
    - Very satisfactory [ ]
    - Satisfactory [ ]

2d) Semi-structured Questionnaire

Semi-structured questionnaire for business and institutions in Jos

INTRODUCTION

Dear sir/madam

We are carrying out a study to assess the solid waste situation in Jos. The purpose of this questionnaire is to find out about your business/institution waste disposal needs, the waste disposal services you receive, and how you perceive the solid waste situation in this city. The ultimate goal of the study is to find ways of improving solid waste management in the city.

Your views and ideas are considered very important for the success of this study and it would be very much appreciated if you could spend a little time to answer this questionnaire.

Thank you for your assistance

1. Name of business/institution: ..... Location:.....
2. About how much waste do you generate in a day? (in kg or other measure: .....)
3. What are the major items of waste you commonly generate?

   .....
4. Do you have a waste collection service?
   - Yes [ ]
   - No [ ] (proceed to Q.12)
5. Who is your waste collection service provider? .....
6. How often is your waste collected by your service provider?
7. Do you find your waste collection service satisfactory?
   - Yes [ ]
   - No [ ] Why not? .....
8. How do you store your waste before collection/disposal?.....
9. Do you pay for your waste collection service?
   - Yes [ ]
   - No [ ]
10. How much do you pay? ..... How often do you pay?.....
11. How do you dispose of your waste? .....
12. Do you need a waste collection service?
    - Yes [ ]
    - No [ ] why? .....(proceed to Q.21)
13. How regularly will you want such a service? .....
14. Will you be willing to pay for the waste collection service if it is provided?
    - Yes [ ]
    - No [ ] why not? .....(go to 20).

15. How much will you be willing to pay for the service?.....(refer Q.14)
16. Are you happy with the waste situation in your surroundings?
    - Yes [ ]
    - No [ ] Why not?.....
17. In your view, how can waste disposal be improved in this city?

    .....

    .....

18. Do you have any further comments or questions regarding this discussion?

    .....

    .....

    .....

Thank you for your time and assistance

10.3 Resource people interviewed(Face-to-Face)

Key stakeholders for the in-depth interviews conducted

Planners

i. Prof. John Y. Dung-Gwom – Professor of Urban and Regional Planning, University of Jos, Nigeria.
ii. Tpl. John Kefas – Director of Town Planning, Jos Metropolitan Development Board, Plateau State, Nigeria.
iii. Tpl. (Barr.) Gamde – Director of Town Planning, Ministry for Housing and Urban Development, Plateau State, Nigeria.
iv. Tpl. Dr. Steve Hirse – Planning consultant and practitioner, STEE Consult Jos, Plateau State, Nigeria.
v. Tpl. S. T. Killi – Planning consultant, Jos and former Director of Town Planning, Ministry of Lands, Survey and Town Planning, Jos, Plateau State, Nigeria.
vi. Tpl. John Gopar - Director of Town Planning, Ministry of Lands, Survey and Town Planning, Jos, Plateau State, Nigeria.
vii. Tpl. (Barr.) Lohor - Senior Lecturer in Urban and Regional Planning, University of Jos, Nigeria.
viii. Tpl. (Dr.) Ijeoma Ayuba - Senior Lecturer in Urban and Regional Planning, University of Jos, Nigeria.
ix. Tpl. Stella Achenu - Lecturer in Urban and Regional Planning, University of Jos, Nigeria.
x. Tpl. Makama Makeri – Director of Town Planning, Federal Ministry of Lands, Housing and Urban development.
xi. Tpl. Monday – Director of Lands, Ministry of Local Government and Chieftaincy Affairs, Jos, Plateau State, Nigeria.
xii. Tpl. Oguniyi – Private Waste Operator and Planner, Lafia, Nassarawa State, Nigeria.
xiii. Mr. Osiyi – Waste Management consultant, Abuja, Nigeria.
xiv. Tpl. (Dr) Sam Wapwera – Senior Lecturer in Urban and Regional Planning, University of Jos, Nigeria.
xv. Dr. Maren Mallo – Senior Lecturer in Estate Management, University of Jos, Nigeria.
xvi. Tpl. (Alh) Fola – Development Planning consultant for Greater Jos Master Plan. Managing Director, Fola Konsult, Nigeria.

Policy makers/political authorities

i. Mr. Francis Bot - Chief of Staff, Governor's office, Jos, Plateau State, Nigeria.
ii. Senator Gyang Pwajok – Member (elected), National Assembly, Abuja, Nigeria.
iii. Dr. Prince MwadKwon – Member (elected), House of Representatives, Abuja, Nigeria.
iv. Hon. Christopher Mancha – Member (elected), Plateau State House of Assembly, Jos, Nigeria.
v. Engr. Sam Gyang – Chairman, Riyom Local Government Council, Plateau State, Nigeria.

Municipal solid waste management agencies/ authorities

i. Mr. Thomas Chollom – Director of Public Relations and Enforcement, Plateau Environmental Protection and Sanitation Agency (PEPSA), Jos, Plateau State, Nigeria.
ii. Mr. Beka – Director, National Environmental Standard and Regulation Enforcement Agency (NESREA), Jos zonal office, Plateau State, Nigeria.
iii. Mr Solomon Gomwalk - General Manager, Plateau State Millennium Development Goals (MDG) Office, Jos, Plateau State, Nigeria.
iv. Mr. Selemod Dakwak - Plateau State Community and Social Development Agency (World Bank Assisted), Jos, Nigeria.
v. Mrs Vou Dido – Director of Waste Management, Ministry of Tourism, Culture and Environment, Jos, Plateau state, Nigeria.

10.4 Bivariate Analysis: Relationship between variables

1 Residential zones and frequency of household waste generation

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Frequency of Household Waste Generation	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Frequency of Household Waste Generation Crosstabulation

			Frequency of Household Waste Generation			Total
			Daily	Weekly	Occasionally	
Residential Zones	Low Density Areas	Count	110	0	22	132
		% within Residential Zones	83.3%	0.0%	16.7%	100.0%
		% within Frequency of Household Waste Generation	80.9%	0.0%	22.0%	45.8%
		% of Total	38.2%	0.0%	7.6%	45.8%
	Medium Density Area	Count	15	37	0	52
		% within Residential Zones	28.8%	71.2%	0.0%	100.0%
		% within Frequency of Household Waste Generation	11.0%	71.2%	0.0%	18.1%
		% of Total	5.2%	12.8%	0.0%	18.1%
	High Density Area	Count	11	15	78	104
		% within Residential Zones	10.6%	14.4%	75.0%	100.0%
		% within Frequency of Household Waste Generation	8.1%	28.8%	78.0%	36.1%
		% of Total	3.8%	5.2%	27.1%	36.1%
Total		Count	136	52	100	288
		% within Residential Zones	47.2%	18.1%	34.7%	100.0%

	% within Frequency of Household Waste Generation	100.0%	100.0%	100.0%	100.0%
	% of Total	47.2%	18.1%	34.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	254.577[a]	4	.000
Likelihood Ratio	259.840	4	.000
Linear-by-Linear Association	121.978	1	.000
N of Valid Cases	288		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.39.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.940	.000
	Cramer's V	.665	.000
N of Valid Cases		288	

2 Residential zones and household waste disposal

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Household Waste Disposal Type	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Household Waste Disposal Type Crosstabulation

			Household Waste Disposal Type					Total
			Closed container	Open container	Polythene bag/sack	Others	No Indication	
Residential Zones	Low Density Areas	Count	98	0	14	4	16	132
		% within Residential Zones	74.2%	0.0%	10.6%	3.0%	12.1%	100.0%
		% within Household Waste Disposal Type	70.5%	0.0%	25.0%	30.8%	100.0%	45.8%
		% of Total	34.0%	0.0%	4.9%	1.4%	5.6%	45.8%
	Medium Density Area	Count	18	34	0	0	0	52
		% within Residential Zones	34.6%	65.4%	0.0%	0.0%	0.0%	100.0%
		% within Household Waste Disposal Type	12.9%	53.1%	0.0%	0.0%	0.0%	18.1%
		% of Total	6.3%	11.8%	0.0%	0.0%	0.0%	18.1%
	High Density Area	Count	23	30	42	9	0	104
		% within Residential Zones	22.1%	28.8%	40.4%	8.7%	0.0%	100.0%
		% within Household Waste Disposal Type	16.5%	46.9%	75.0%	69.2%	0.0%	36.1%
		% of Total	8.0%	10.4%	14.6%	3.1%	0.0%	36.1%
Total		Count	139	64	56	13	16	288
		% within Residential Zones	48.3%	22.2%	19.4%	4.5%	5.6%	100.0%
		% within Household Waste Disposal Type	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	48.3%	22.2%	19.4%	4.5%	5.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	174.895[a]	8	.000
Likelihood Ratio	203.496	8	.000
Linear-by-Linear Association	12.948	1	.000
N of Valid Cases	288		

a. 3 cells (20.0%) have expected count less than 5. The minimum expected count is 2.35.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.779	.000
	Cramer's V	.551	.000
N of Valid Cases		288	

3 Residential zones and household waste collection

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Household Waste Collection Type	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Household Waste Collection Type Crosstabulation

			Household Waste Collection Type				Total
			Home collection	Collection at road side	Communal container	Waste Dump	
Residential Zones	Low Density Areas	Count	86	24	0	22	132
		% within Residential Zones	65.2%	18.2%	0.0%	16.7%	100.0%
		% within Household Waste Collection Type	86.0%	42.9%	0.0%	26.2%	45.8%
		% of Total	29.9%	8.3%	0.0%	7.6%	45.8%
	Medium Density Area	Count	13	17	22	0	52
		% within Residential Zones	25.0%	32.7%	42.3%	0.0%	100.0%
		% within Household Waste Collection Type	13.0%	30.4%	45.8%	0.0%	18.1%
		% of Total	4.5%	5.9%	7.6%	0.0%	18.1%
	High Density Area	Count	1	15	26	62	104
		% within Residential Zones	1.0%	14.4%	25.0%	59.6%	100.0%

Total	% within Household Waste Collection Type	1.0%	26.8%	54.2%	73.8%	36.1%
	% of Total	0.3%	5.2%	9.0%	21.5%	36.1%
	Count	100	56	48	84	288
	% within Residential Zones	34.7%	19.4%	16.7%	29.2%	100.0%
	% within Household Waste Collection Type	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	34.7%	19.4%	16.7%	29.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	179.048[a]	6	.000
Likelihood Ratio	224.108	6	.000
Linear-by-Linear Association	116.511	1	.000
N of Valid Cases	288		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.67.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.788	.000
	Cramer's V	.558	.000
N of Valid Cases		288	

4 Residential zones and household waste service provider

Case Processing Summary

	Cases

	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Household Waste Service Provider	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Household Waste Service Provider Crosstabulation

			Household Waste Service Provider					Total
			Agency (PEPSA)	Ministry of Environment	Scavengers	Private Waste Organisation	No Indication	
Residential Zones	Low Density Areas	Count	110	0	0	1	21	132
		% within Residential Zones	83.3%	0.0%	0.0%	0.8%	15.9%	100.0%
		% within Household Waste Service Provider	62.5%	0.0%	0.0%	6.3%	26.3%	45.8%
		% of Total	38.2%	0.0%	0.0%	0.3%	7.3%	45.8%
	Medium Density Area	Count	45	3	4	0	0	52
		% within Residential Zones	86.5%	5.8%	7.7%	0.0%	0.0%	100.0%
		% within Household Waste Service Provider	25.6%	75.0%	33.3%	0.0%	0.0%	18.1%
		% of Total	15.6%	1.0%	1.4%	0.0%	0.0%	18.1%
	High Density Area	Count	21	1	8	15	59	104
		% within Residential Zones	20.2%	1.0%	7.7%	14.4%	56.7%	100.0%
		% within Household Waste Service Provider	11.9%	25.0%	66.7%	93.8%	73.8%	36.1%
		% of Total	7.3%	0.3%	2.8%	5.2%	20.5%	36.1%
Total		Count	176	4	12	16	80	288
		% within Residential Zones	61.1%	1.4%	4.2%	5.6%	27.8%	100.0%
		% within Household Waste Service Provider	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	61.1%	1.4%	4.2%	5.6%	27.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)

Pearson Chi-Square	139.572[a]	8	.000
Likelihood Ratio	161.047	8	.000
Linear-by-Linear Association	84.779	1	.000
N of Valid Cases	288		

a. 6 cells (40.0%) have expected count less than 5. The minimum expected count is .72.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.696	.000
	Cramer's V	.492	.000
N of Valid Cases		288	

5 Residential zones and household waste service provider

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Efficiency of Waste Provider	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Efficiency of Waste Provider Crosstabulation

			Efficiency of Waste Provider			Total
			Yes	No	No Indication	
Residential Zones	Low Density Areas	Count	110	0	22	132
		% within Residential Zones	83.3%	0.0%	16.7%	100.0%
		% within Efficiency of Waste Provider	80.9%	0.0%	18.3%	45.8%
		% of Total	38.2%	0.0%	7.6%	45.8%
	Medium Density Area	Count	15	24	13	52

		% within Residential Zones	28.8%	46.2%	25.0%	100.0%
		% within Efficiency of Waste Provider	11.0%	75.0%	10.8%	18.1%
		% of Total	5.2%	8.3%	4.5%	18.1%
	High Density Area	Count	11	8	85	104
		% within Residential Zones	10.6%	7.7%	81.7%	100.0%
		% within Efficiency of Waste Provider	8.1%	25.0%	70.8%	36.1%
		% of Total	3.8%	2.8%	29.5%	36.1%
		Count	136	32	120	288
Total		% within Residential Zones	47.2%	11.1%	41.7%	100.0%
		% within Efficiency of Waste Provider	100.0%	100.0%	100.0%	100.0%
		% of Total	47.2%	11.1%	41.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	206.306[a]	4	.000
Likelihood Ratio	200.659	4	.000
Linear-by-Linear Association	124.145	1	.000
N of Valid Cases	288		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.78.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.846	.000
	Cramer's V	.598	.000
N of Valid Cases		288	

6 Residential zones and household waste service provider

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Distance of Collection Point from Home	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Distance of Collection Point from Home Crosstabulation

			Distance of Collection Point from Home				Total
			Less than 10 meters	10-12 meters	More than 20 meters	No Indication	
Residential Zones	Low Density Areas	Count	33	11	12	76	132
		% within Residential Zones	25.0%	8.3%	9.1%	57.6%	100.0%
		% within Distance of Collection Point from Home	84.6%	91.7%	75.0%	34.4%	45.8%
		% of Total	11.5%	3.8%	4.2%	26.4%	45.8%
	Medium Density Area	Count	0	1	4	47	52
		% within Residential Zones	0.0%	1.9%	7.7%	90.4%	100.0%
		% within Distance of Collection Point from Home	0.0%	8.3%	25.0%	21.3%	18.1%

		% of Total	0.0%	0.3%	1.4%	16.3%	18.1%
		Count	6	0	0	98	104
		% within Residential Zones	5.8%	0.0%	0.0%	94.2%	100.0%
	High Density Area	% within Distance of Collection Point from Home	15.4%	0.0%	0.0%	44.3%	36.1%
		% of Total	2.1%	0.0%	0.0%	34.0%	36.1%
		Count	39	12	16	221	288
		% within Residential Zones	13.5%	4.2%	5.6%	76.7%	100.0%
Total		% within Distance of Collection Point from Home	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	13.5%	4.2%	5.6%	76.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55.841[a]	6	.000
Likelihood Ratio	70.328	6	.000
Linear-by-Linear Association	37.151	1	.000
N of Valid Cases	288		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 2.17.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.440	.000
	Cramer's V	.311	.000
N of Valid Cases		288	

7 Residential zones and sanitary condition around waste containers

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent

Residential Zones * Sanitary Condition around Waste Container	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Sanitary Condition around Waste Container Crosstabulation

			Sanitary Condition around Waste Container				Total
			Very Satisfactory	Satisfactory	Poor	Very Poor	
Residential Zones	Low Density Areas	Count	12	56	24	40	132
		% within Residential Zones	9.1%	42.4%	18.2%	30.3%	100.0%
		% within Sanitary Condition around Waste Container	100.0%	87.5%	75.0%	22.2%	45.8%
		% of Total	4.2%	19.4%	8.3%	13.9%	45.8%
	Medium Density Area	Count	0	8	5	39	52
		% within Residential Zones	0.0%	15.4%	9.6%	75.0%	100.0%
		% within Sanitary Condition around Waste Container	0.0%	12.5%	15.6%	21.7%	18.1%
		% of Total	0.0%	2.8%	1.7%	13.5%	18.1%
	High Density Area	Count	0	0	3	101	104
		% within Residential Zones	0.0%	0.0%	2.9%	97.1%	100.0%
		% within Sanitary Condition around Waste Container	0.0%	0.0%	9.4%	56.1%	36.1%
		% of Total	0.0%	0.0%	1.0%	35.1%	36.1%
Total		Count	12	64	32	180	288
		% within Residential Zones	4.2%	22.2%	11.1%	62.5%	100.0%
		% within Sanitary Condition around Waste Container	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	4.2%	22.2%	11.1%	62.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	118.140[a]	6	.000
Likelihood Ratio	144.700	6	.000
Linear-by-Linear Association	105.331	1	.000

N of Valid Cases	288		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 2.17.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.640	.000
	Cramer's V	.453	.000
N of Valid Cases		288	

8 Residential zones and nuisance from waste

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Nuisance from Waste	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Nuisance from Waste Crosstabulation

			Nuisance from Waste			Total
			Yes	No	No Indication	
Residential Zones	Low Density Areas	Count	12	63	57	132
		% within Residential Zones	9.1%	47.7%	43.2%	100.0%
		% within Nuisance from Waste	100.0%	82.9%	28.5%	45.8%

		% of Total	4.2%	21.9%	19.8%	45.8%
	Medium Density Area	Count	0	13	39	52
		% within Residential Zones	0.0%	25.0%	75.0%	100.0%
		% within Nuisance from Waste	0.0%	17.1%	19.5%	18.1%
		% of Total	0.0%	4.5%	13.5%	18.1%
	High Density Area	Count	0	0	104	104
		% within Residential Zones	0.0%	0.0%	100.0%	100.0%
		% within Nuisance from Waste	0.0%	0.0%	52.0%	36.1%
		% of Total	0.0%	0.0%	36.1%	36.1%
Total		Count	12	76	200	288
		% within Residential Zones	4.2%	26.4%	69.4%	100.0%
		% within Nuisance from Waste	100.0%	100.0%	100.0%	100.0%
		% of Total	4.2%	26.4%	69.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	91.764[a]	4	.000
Likelihood Ratio	119.667	4	.000
Linear-by-Linear Association	82.295	1	.000
N of Valid Cases	288		

a. 2 cells (22.2%) have expected count less than 5. The minimum expected count is 2.17.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.564	.000
	Cramer's V	.399	.000
N of Valid Cases		288	

9 Residential zones and neighbourhood sanitary situation

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Neighbourhood Sanitary Situation	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Neighbourhood Sanitary Situation Crosstabulation

			Neighbourhood Sanitary Situation					Total
			Very Satisfactory	Satisfactory	Poor	Very Poor	No Indication	
Residential Zones	Low Density Areas	Count	20	90	2	4	16	132
		% within Residential Zones	15.2%	68.2%	1.5%	3.0%	12.1%	100.0%
		% within Neighbourhood Sanitary Situation	100.0%	59.2%	5.0%	25.0%	26.7%	45.8%
		% of Total	6.9%	31.3%	0.7%	1.4%	5.6%	45.8%
	Medium Density Area	Count	0	42	10	0	0	52
		% within Residential Zones	0.0%	80.8%	19.2%	0.0%	0.0%	100.0%
		% within Neighbourhood Sanitary Situation	0.0%	27.6%	25.0%	0.0%	0.0%	18.1%
		% of Total	0.0%	14.6%	3.5%	0.0%	0.0%	18.1%
	High Density Area	Count	0	20	28	12	44	104
		% within Residential Zones	0.0%	19.2%	26.9%	11.5%	42.3%	100.0%
		% within Neighbourhood Sanitary Situation	0.0%	13.2%	70.0%	75.0%	73.3%	36.1%
		% of Total	0.0%	6.9%	9.7%	4.2%	15.3%	36.1%
Total		Count	20	152	40	16	60	288

	% within Residential Zones	6.9%	52.8%	13.9%	5.6%	20.8%	100.0%
	% within Neighbourhood Sanitary Situation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	6.9%	52.8%	13.9%	5.6%	20.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	137.576[a]	8	.000
Likelihood Ratio	165.075	8	.000
Linear-by-Linear Association	73.261	1	.000
N of Valid Cases	288		

a. 2 cells (13.3%) have expected count less than 5. The minimum expected count is 2.89.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.691	.000
	Cramer's V	.489	.000
N of Valid Cases		288	

10 Residential zones and payment to waste service collectors

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Payment to Waste Service	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Payment to Waste Service Crosstabulation

			Payment to Waste Service			Total
			Yes	No	No Indication	
Residential Zones	Low Density Areas	Count	20	98	14	132
		% within Residential Zones	15.2%	74.2%	10.6%	100.0%
		% within Payment to Waste Service	100.0%	45.4%	26.9%	45.8%
		% of Total	6.9%	34.0%	4.9%	45.8%
	Medium Density Area	Count	0	52	0	52
		% within Residential Zones	0.0%	100.0%	0.0%	100.0%
		% within Payment to Waste Service	0.0%	24.1%	0.0%	18.1%
		% of Total	0.0%	18.1%	0.0%	18.1%
	High Density Area	Count	0	66	38	104
		% within Residential Zones	0.0%	63.5%	36.5%	100.0%
		% within Payment to Waste Service	0.0%	30.6%	73.1%	36.1%
		% of Total	0.0%	22.9%	13.2%	36.1%
Total		Count	20	216	52	288
		% within Residential Zones	6.9%	75.0%	18.1%	100.0%
		% within Payment to Waste Service	100.0%	100.0%	100.0%	100.0%
		% of Total	6.9%	75.0%	18.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	62.949[a]	4	.000
Likelihood Ratio	75.761	4	.000
Linear-by-Linear Association	39.895	1	.000
N of Valid Cases	288		

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 3.61.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.468	.000
	Cramer's V	.331	.000
N of Valid Cases		288	

11 Residential zones and quality of waste disposal service

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Quality of Waste Disposal Service	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Quality of Waste Disposal Service Crosstabulation

			Quality of Waste Disposal Service					Total
			Very Satisfactory	Satisfactory	Poor	Very Poor	No Indication	
Residential Zones	Low Density Areas	Count	16	82	9	3	22	132
		% within Residential Zones	12.1%	62.1%	6.8%	2.3%	16.7%	100.0%
		% within Quality of Waste Disposal Service	100.0%	51.3%	17.3%	25.0%	45.8%	45.8%
		% of Total	5.6%	28.5%	3.1%	1.0%	7.6%	45.8%
	Medium Density Area	Count	0	52	0	0	0	52
		% within Residential Zones	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%

		% within Quality of Waste Disposal Service	0.0%	32.5%	0.0%	0.0%	0.0%	18.1%
		% of Total	0.0%	18.1%	0.0%	0.0%	0.0%	18.1%
	High Density Area	Count	0	26	43	9	26	104
		% within Residential Zones	0.0%	25.0%	41.3%	8.7%	25.0%	100.0%
		% within Quality of Waste Disposal Service	0.0%	16.3%	82.7%	75.0%	54.2%	36.1%
		% of Total	0.0%	9.0%	14.9%	3.1%	9.0%	36.1%
Total		Count	16	160	52	12	48	288
		% within Residential Zones	5.6%	55.6%	18.1%	4.2%	16.7%	100.0%
		% within Quality of Waste Disposal Service	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	5.6%	55.6%	18.1%	4.2%	16.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	127.095[a]	8	.000
Likelihood Ratio	147.219	8	.000
Linear-by-Linear Association	26.846	1	.000
N of Valid Cases	288		

a. 3 cells (20.0%) have expected count less than 5. The minimum expected count is 2.17.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.664	.000
	Cramer's V	.470	.000
N of Valid Cases		288	

12 Residential zones and the preference and willing to pay for waste service

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Preference and Willingness to Pay for Waste Collection Service	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Preference and Willingness to Pay for Waste Collection Service Crosstabulation

			Preference and Willingness to Pay for Waste Collection Service				Total
			Home Collection	Road Site Collection	Communal Container	No Indication	
Residential Zones	Low Density Areas	Count	28	19	9	76	132
		% within Residential Zones	21.2%	14.4%	6.8%	57.6%	100.0%
		% within Preference and Willingness to Pay for Waste Collection Service	100.0%	95.0%	75.0%	33.3%	45.8%
		% of Total	9.7%	6.6%	3.1%	26.4%	45.8%
	Medium Density Area	Count	0	1	3	48	52
		% within Residential Zones	0.0%	1.9%	5.8%	92.3%	100.0%
		% within Preference and Willingness to Pay for Waste Collection Service	0.0%	5.0%	25.0%	21.1%	18.1%
		% of Total	0.0%	0.3%	1.0%	16.7%	18.1%
	High Density Area	Count	0	0	0	104	104
		% within Residential Zones	0.0%	0.0%	0.0%	100.0%	100.0%

	% within Preference and Willingness to Pay for Waste Collection Service	0.0%	0.0%	0.0%	45.6%	36.1%
	% of Total	0.0%	0.0%	0.0%	36.1%	36.1%
Total	Count	28	20	12	228	288
	% within Residential Zones	9.7%	6.9%	4.2%	79.2%	100.0%
	% within Preference and Willingness to Pay for Waste Collection Service	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	9.7%	6.9%	4.2%	79.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	74.240[a]	6	.000
Likelihood Ratio	94.565	6	.000
Linear-by-Linear Association	60.999	1	.000
N of Valid Cases	288		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 2.17.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.508	.000
	Cramer's V	.359	.000
N of Valid Cases		288	

13 Residential zones and neighbourhood meetings on waste situation

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Neighbourhood Meetings on Waste Situation	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Neighbourhood Meetings on Waste Situation Crosstabulation

			Neighbourhood Meetings on Waste Situation			Total
			Yes	No	No Indication	
Residential Zones	Low Density Areas	Count	110	11	11	132
		% within Residential Zones	83.3%	8.3%	8.3%	100.0%
		% within Neighbourhood Meetings on Waste Situation	78.6%	10.2%	27.5%	45.8%
		% of Total	38.2%	3.8%	3.8%	45.8%
	Medium Density Area	Count	18	34	0	52
		% within Residential Zones	34.6%	65.4%	0.0%	100.0%
		% within Neighbourhood Meetings on Waste Situation	12.9%	31.5%	0.0%	18.1%
		% of Total	6.3%	11.8%	0.0%	18.1%
	High Density Area	Count	12	63	29	104
		% within Residential Zones	11.5%	60.6%	27.9%	100.0%
		% within Neighbourhood Meetings on Waste Situation	8.6%	58.3%	72.5%	36.1%
		% of Total	4.2%	21.9%	10.1%	36.1%
Total		Count	140	108	40	288
		% within Residential Zones	48.6%	37.5%	13.9%	100.0%
		% within Neighbourhood Meetings on Waste Situation	100.0%	100.0%	100.0%	100.0%
		% of Total	48.6%	37.5%	13.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	144.556[a]	4	.000
Likelihood Ratio	166.167	4	.000
Linear-by-Linear Association	95.652	1	.000
N of Valid Cases	288		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.22.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.708	.000
	Cramer's V	.501	.000
N of Valid Cases		288	

14 Residential zones and Assessment of Neighbourhood Cleanliness

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residential Zones * Assessment of Cleanliness of Neighbourhood	288	100.0%	0	0.0%	288	100.0%

Residential Zones * Assessment of Cleanliness of Neighbourhood Crosstabulation

			Assessment of Cleanliness of Neighbourhood				Total
			Very Clean	Averagely Clean	Dirty	Very Dirty	
Residential Zones	Low Density Areas	Count	24	81	3	24	132
		% within Residential Zones	18.2%	61.4%	2.3%	18.2%	100.0%
		% within Assessment of Cleanliness of Neighbourhood	100.0%	38.9%	25.0%	54.5%	45.8%
		% of Total	8.3%	28.1%	1.0%	8.3%	45.8%
	Medium Density Area	Count	0	52	0	0	52
		% within Residential Zones	0.0%	100.0%	0.0%	0.0%	100.0%

		% within Assessment of Cleanliness of Neighbourhood	0.0%	25.0%	0.0%	0.0%	18.1%
		% of Total	0.0%	18.1%	0.0%	0.0%	18.1%
	High Density Area	Count	0	75	9	20	104
		% within Residential Zones	0.0%	72.1%	8.7%	19.2%	100.0%
		% within Assessment of Cleanliness of Neighbourhood	0.0%	36.1%	75.0%	45.5%	36.1%
		% of Total	0.0%	26.0%	3.1%	6.9%	36.1%
Total		Count	24	208	12	44	288
		% within Residential Zones	8.3%	72.2%	4.2%	15.3%	100.0%
		% within Assessment of Cleanliness of Neighbourhood	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	8.3%	72.2%	4.2%	15.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	54.140[a]	6	.000
Likelihood Ratio	71.752	6	.000
Linear-by-Linear Association	5.536	1	.019
N of Valid Cases	288		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 2.17.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.434	.000
	Cramer's V	.307	.000
N of Valid Cases		288	

10.5 Summary report of fieldwork

The fieldwork took place between May and July 2013. Having obtained some preliminary data on previous visits in 2011, I was now able to prepare some questions in advance to address the major themes that feature this study: roles and responsibility, legislation and powers, financial instruments information available on solid waste and rationale for urban planning participation. At this point, in-depth interviews consisting of open-ended questions in which respondents were asked about facts of a particular issue became more relevant. The added advantage was that this made it possible for respondents to talk freely about any issues they felt was relevant. There was thus the possibility of obtaining new information. This type of interview feature mainly with my key informants: government officials mostly planners and industry stakeholders.

In addressing the research question of how urban planning in Nigeria can help improve municipal solid waste management issues and whether the planning system has the capacity to help in the management of municipal solid waste, particularly in Greater Jos as a case study as presented in Major Report, the starting point was to examine the roles and responsibilities in the waste management process. The data used for this came mainly from secondary sources. However, I needed to go further to examine the way Greater Jos waste management plan is structured and the functions performed by the different state institutions. Secondary sources were also useful in this but supplementary and updated information was obtained through interviews with senior officials of the Ministries of Lands, Survey and Town Planning; Environment, Tourism and Culture; Housing and Urban Development; The Plateau Environmental Protection and Sanitation Agency (PEPSA); Plateau State Millennium Development Goals (MDGs); Federal Ministry of Lands, Housing and Urban Development and Jos North Local Government Council. The next task was to examine the nature of power relations between the different institutions. To address this, I had to extend the investigation to solid waste management and specifically, the Greater Jos master plan, launched in 2009, in which the three tiers of the state – the Federal Ministry of Lands, Housing and Urban Development; Plateau State Ministry of Housing and Urban Development and Jos North Local Government Council, representing the three tiers of the state – participated. During the master plan project, a Stakeholders Committee had been formed to encourage smooth implementation between the state institutions. The officials that represented the different institutions in the committee were interviewed to ascertain the nature of relations and level of collaboration.

Another major area of interest was state legislation and powers – the role of urban planning. Once again, the solid waste issue was a major entry point. The research questions that guided data collection revolved around the information available on solid waste; within the current government structures, who has the capacity to take on waste management in terms of staff number, skills and training and fund-raising membership; the current aspired role from planning in Jos and the rationale for town planning to be the lead organization, with emphasis on who dominated; and the extent to which the outcome is traceable to the political characteristics of Jos. Concerning the first part of the question, I made two basic but related assumptions: a partnership is not open to all and the political

characteristics of a place can shape membership. To address these, I needed data on power relations and the characteristics of Greater Jos and the councils in the area. In addition power relations were examined through interviews and household survey on the issues of solid waste management in the study area.

In order to address the relevance of planning, interviews were conducted with residents to identify the major social stratifications in the community. Two major bases of stratification have been used in the study: ethnicity and gender. In the former, interviews revealed the major ethnic groupings, but the latter is obvious. In examining the relevance of the political characteristics of Greater Jos, I focused on the state institutional and administrative framework as well as local politics. In the former, a major interest was the linkage of the residents with the state institutions. I conducted interviews with state officials and residents to obtain the relevant data that would enable me identity which institution has closer ties with the residents. In the case of local politics, the interest was on the heterogeneous nature of Greater Jos, the resultant politics and the effect on local council relations.

From state officials, information concerning the roles in shaping the participation of state government and local council were obtained. This was to draw attention to the role of planning, which is seen as crucial in determining how state and local levels behave and what tasks they perform. In the bid to highlight the role of planning through responsibilities, I decided to focus on state ministry of environment and its agencies. This choice was based on the fact that they form the major institution of waste management in Greater Jos, and the director in ministry of environment, whom I found to be a very valuable source of information on waste management issues in Jos, also belonged to the same agency used in waste management. In order to obtain the perspectives of local councils, interviews with officials of the local council were conducted.

Private participation in solid waste management was also examined. I needed data on the various factors shaping private participation and the extent to which it was an outcome of political conditions in the place. The complexity of the issue was reflected in the methods used. Apart from in-depth interviews, residents' views and secondary sources required a survey and personal observation. The purpose of the survey was to know the views of the people at the local level. The questions had multiple answers and respondents were expected to choose one answer per question apart from written answers. The questionnaire that was administered contained questions related to the extent of private participation in solid waste management. First were those that focused on waste handling practices, such as storage and disposal. It also included questions about the level of priority given to waste in relation to other services as well as about perceptions about who should be responsible for solid waste management. Another was to identify the level of participation in local area. For example, they were asked if they participate in management of waste. This exercise served two useful roles purposes. It gave me some general indications about specific issues and the selection of some areas for site observation. After going through the data, I identified some respondents I particularly wanted to interview further based on their responses to some issues. For example, most

had ranked waste very low on their priority list. As a result, I was particularly eager to include the very few who had ranked it high. From the survey, I also had information concerning the occupations of the people so I made sure I had different occupations represented. Gender was also considered. I did not want a situation where all the interviews belonged to the same sex.

Furthermore, the questions were grouped into the sector related, the social, the political and the environmental. I wanted to know how they ranked waste compared to other services and why. I also asked questions regarding who they thought should be responsible for the management of the sector. The nature of association life and local politics also featured. Additional information on private participation came from site visits with scavengers. To improve the validity of the data, I also interviewed state officials and a community leader to get their own views on the main points of discussion with households. Personal observation also proved useful in validating or disproving some of the data obtained from respondents. The high visibility of the sector is particularly relevant. By walking through Jos-Bukuru metropolis, I was able to observe major problems such as the illegal dumping of waste.

Sampling Techniques

Different sampling methods were used depending on the unit of analysis and type of information selection, was useful at various stages. This method was adopted mainly with state officials who were in a position to give information on specific areas of interest. Also, according to Mikkelsen, purposive sampling is used when you interview people or groups based on criteria such as class, gender, age, and ethnicity. For example, I used this method when, following the household survey, I decided to choose some specific respondents based on gender or on the information provided in the survey for further inquiry.

Systematic random sampling was used for the household survey in Greater Jos. The area is divided into six sections – A, B, C, D, E and F. Households were interviewed with the help of an assistants. In the case of Jishe settlement, it was more difficult to be systematic due to the fact that this area is unplanned and houses are not arranged in any particular order. I got my assistants to make a sketch of the area. I used the map to identify some clusters and then chose houses at random, while making sure that each cluster was represented.

Snowball or chain sampling came in useful when, during the course of an interview, a name or names of useful potential informants came up. This happened when an interview remembered someone who could give me some additional information. An added advantage was that it helped check the authenticity of some information already provided by others, with state officials, this led to interviewing people in other state institution or in different departments or branches within, at the level of the community, an interview with a community leader could lead to interviews with others whom he felt could give me additional the information.

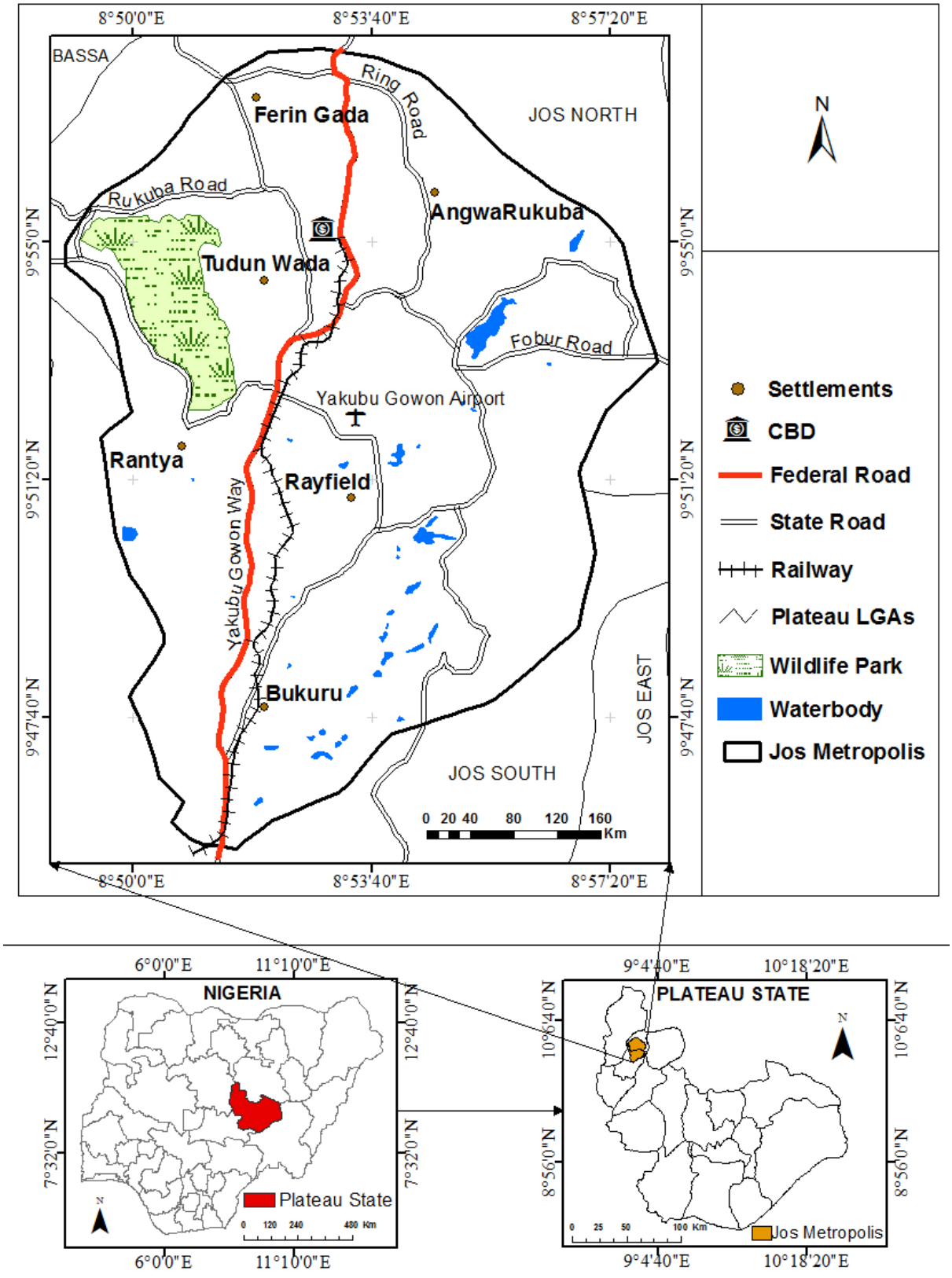
Limited Data

Some of the problems I faced have already been mentioned. This concluded the dearth of secondary sources and frequent change in government institution and policies. In the case of data this was manifested in two fronts. First is the lack of data on solid waste management in general both within and outside academic circles. In a poignant manner, some argue that "waste management is universally unpopular". For example, water supply projects are reported to have a longer history and thus a more extensive literature than solid waste projects. A related issue is the bias on the technical aspects. A cursory look at the available literature within the sector will reveal an obvious bias in favor of technical issue. At the sustainable waste management conference in 2003, "traditional topics such as landfill, Leachate and gas lining and capping, incinerator residues…remaining" and the greatest number of paper focused on the control of emission. These are important topics but may not be very relevant to developing countries at the moment. As has been noted, technologies have proven to be too expensive to acquire and maintain in the face of economic difficulties in developing countries and this makes the focus on the technical less appropriate. However, this problem is minimized in this study, since being a study on a current real-life problem; I have access to the relevant actors and was able to obtain date through interviews.

Validity of Data

In social research, there is often the problem of validity of data. This problem can however, be addressed at the data collection stage. A major way to increase the validity of data is to use multiple sources of data. On any crucial question, I tried to collect information from as many sources as possible to enable me establish the general pattern. Where opinions differed, I have also endeavored to point it out, an example of the relevance of using multiple sources concerned the question of illegal dumping of waste. Research on Greater Jos by others and interview with state officials and community leaders had pointed to illegal dumping of waste as a common feature in the settlement. However, I found out that in interviews with households, they were not willing to admit to the practice. At this point beside the evidence collected from the interviews with community leader and state officials, I also had to rely on personal observation which confirmed the problem of illegal dumping.

Another way of strengthening the validity of data is to have key informants review your report on prior interview. I was able to do this during my visits 2015. In addition, I used the opportunity to update the data by asking for any new development since my previous visit.



Map of Jos Metropolis
Source: Adzandeh et al., 2015 (Analysis of Urban Growth Agents in Jos Metropolis, Nigeria)

10.6 Conferences presented/paper/publications/research courses attended

a. 11-13 September 2013, UK-Ireland Planning Research Conference, University of the West of England, Bristol.
b. 11-14 September 2014, The North American Conference on Sustainability, Energy & the Environment, Providence Marriot Downtown, Rhode Island, United States.
c. 10-11 April 2015, The 7th International Conference on Climate Change: Impacts and Responses, UBC, Robson Square, Vancouver, Canada.
d. Conference Paper for (b): Municipal Solid Waste Management in Greater Jos, Nigeria.
e. Paper Publication : A Comparative Evaluation Analysis of Municipal Solid Waste Planning in Greater Jos, Nigeria; International Journal of Sciences and Energy Research, October 2014, Volume3(2) (see appendix 10.6 below for full paper).
f. University of Edinburgh, Institute for Academic Development: Edinburgh Local GRADschool Course on Joint Skills Statement of the UK Research Councils – for personal effectiveness, communication skills, networking, teamworking and career management for doctoral researchers : 18th to 20th May2016.
g. Associate Fellow, The Higher Education Academy, 2015 (UK Professional Standards Framework for Teaching and Learning Support in Higher Education): 1st April 2015.
h. Heriot-Watt University, Centre for Academic Leadership & Development: Attended Leadership Enhancement and Development Skills (LEADS) One; Two; and Three courses for 2 years.
i. Heriot-Watt University, Centre for Academic Leadership & Development: Attended RESEARCH FUTURES COURSES ON: Publishing Research; A Strategy for Publishing; Research Wring; Presenting Research; Word for your Thesis; Viva Preparation; Project Management; How to be an effective Researcher; From PhD to Publication; Preparing a Document for Publication, Proofreading and Referencing; Citation and Impact; How to Write a Great Research Paper and Get it Accepted by Good Journal; Understanding Peer- Review Both as an Author and Reviewer.
j. ENTERPRISING RESEARCHER SUMMER SCHOOL, June to July 2o14: Attended courses on: Great Mistakes in Technology Commercialisation; Intrapreneurship, Impact and Employability; Building and Developing Teams; Structuring Technology Projects; Financial Literacy for Beginners; Budgets and Venture Finance; Introduction to Intellectual Property; Innovation and Entrepreneurship;
k. University of Edinburgh, Applied Quantitative Methods Network (AQMEN): Attended workshop on: Introduction to Nvivo on the 12th October 2012.

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A COMPARATIVE EVALUATION ANALYSIS OF MUNICIPAL SOLID WASTE PLANNING IN GREATER JOS, NIGERIA

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Abstract

Greater Jos like other fast urbanizing towns and cities in Nigeria are faced with a multitude of problems ranging from poor state of roads, insufficient water and electrical power supply, inadequate municipal solid waste management and other related ones. Among this multitude of problems municipal solid waste management appears to be the most prominent in recent years. Municipal solid waste is seen in huge heaps on any piece of unused land, around buildings and in the open market places. Living with solid waste littered around appears to be an acceptable way of life among the people in the municipality in recent years. The work reported in this paper involves a study of planning constraint to residential municipal solid waste management in Greater Jos municipality in Nigeria. A site-specific study was carried out to estimate the quantity of residential municipal solid waste generated in the municipality through waste management agency–Plateau Environmental Protection and Sanitation Agency (PEPSA). Structured questionnaires were applied to collect primary information such as size of households, educational level, and monthly income from households. The results obtained indicated that of poor education, poor income of residence, insufficient funding, institutional structure, social disposition and cultural norms are the major planning constraints to municipal solid waste management in the municipality in which solid waste is in crisis stage. Feasible suggestion for improved municipal solid waste management based on the prevailing planning, educational and socio-economic state of the institutions and residents in the municipality has been presented.
Keywords: Municipal solid waste, Quantity generated, Planning constraints, Greater Jos, Nigeria.

Introduction

In last few decades municipal solid waste appears to be the most prominent among the multitude of problems existing in the fast urbanizing Greater Jos municipality. Municipal solid waste is seen in huge heaps on any piece of unused land, around buildings and in the open market places. Living with solid waste littered around appears to be an acceptable way of life among the people in the municipality in recent years. Municipal solid waste is commonly known as refuse or rubbish and is a waste type consisting of everyday items that are discarded by the public (Cointreau, 1982; Doan, 1998). It covers household waste and household-like commercial and industrial waste (e.g. from offices or hotels) (Van Beukering *et al.*, 1999). Municipal solid wastes are generated from residential, commercial and industrial activities in Nigeria (Igbinomwanhia, and Ohwovoriole, 2009). The work of this study revealed that residential solid waste stream constitutes the most problematic in Greater Jos municipality. Wastes generated from residential activities are seen thrown and disposed of indiscriminately (see figure 1). Investigation revealed that the most of the residents earn very low monthly income, their low income is not able to meet their daily financial need and they therefore avoid the services of the waste management agency, hence they dispose of their solid waste indiscriminately in the municipality.

The study further revealed that the agency responsible for waste management Plateau Environmental Protection and Sanitation Agency (PEPSA) is unable to develop a plan of managing the municipal solid waste generated in the municipal councils of Greater Jos namely: Jos North, Jos South, Jos East, Barkin-Ladi, Bassa and Riyom local government areas (LGAs). In fact they are faced with multitude of problems

ranging from underfunded government, inadequate waste data and tools and poor public attitude among others (Author's fieldwork, 2011). Municipal solid waste management has therefore become a nightmare to planners and decision makers in the municipality. The cultural practices of most Nigerians weigh more to consumption and waste generation than saving and investment (Audu, 2007). The sheer magnitude of the municipal solid waste problem in Nigeria is hard to comprehend. There are not enough public wastes receptacles, and municipal solid waste dumps are located on the side of the highway. When municipal solid waste accumulates, households and businesses piles up the waste in the median of major roads and set them on open fire without pollution control (Walling et al, 2004).

A large proportion of the municipal solid wastes are dumped indiscriminately around homes, market places, by the road side and on any piece of unused land. These waste dumped indiscriminately find their way into drainage system and waterways. And this has resulted to serious residential environmental crisis in the municipality. In addition waste data is almost non-existence in Nigeria and where it exists, it is only for few isolated cases in the country and they are not easily accessible and grossly inadequate for decision making (Njiribeako, 2003). Hence, the poor state of municipal solid waste management in urban areas of the country which is now not only an environmental problem, but also, a major economic and social handicap (Daskalopoulos *et al.*, 1998). This is also similar in other developing countries (Doan, 1998). However in the last few decades, the Plateau State government had made effort to solve the solid waste problem in the state particularly in the state capital- Jos city by recent improvements in the operations of the existing system through engagement of tasks force on environmental sanitation, but the effort had not yielded good results. Hence, we propagated that there are some salient problems bedeviling this solid waste management sector in the municipal area that when addressed have the capacity to improve its physical environmental condition and improve the well-being of the inhabitant of Greater Jos municipality and Nigeria at large. The work reported in this paper was therefore aimed at identifying the problems that are basically of planning constraints in the waste management sector in Nigeria using Greater Jos municipality as a case study.

Methodology

This study was broken down into three phases – A study of current municipal solid waste management activities in Greater Jos municipality, in-depth interviews and survey study of Residential (household) solid waste using Jos North and Jos South Local Government Areas (LGAs) as a case study. The first phase of the study involves the study of published and unpublished government agencies reports/records, private agency report, personal communication with private and government waste management agencies, literature review and a field work in Jos, Nigeria. The survey study involved the following steps – Determination of a representative sample, selection of sampling units and the use of structured questionnaires to collect primary information such as size of households and firms, income, educational level etc. from the selected sampling units (Omran and Read, 2008).

Figure 1: Municipal solid waste collection in part of Greater Jos

Source: Author's Fieldwork, 2013

Different sampling methods were used (Drew, 1980) depending on the unit of analysis and information selected. This method was adopted in the conduct of an in-depth interview with 16 senior government officials and industry stakeholders who were in a position to give information on specific areas of interest. This method was also used when administering the household survey. The density categorization method (JMDB, 2011; EPA, 1996) based on low, medium and high densities areas of Greater Jos municipality was applied for the sampling process and a total of 288 households (Fieldwork, 2013) were selected for the survey. A systematic random sampling technique was used and heads of households were interviewed using door-to-door stepping technique with the help of 11 trained field assistants. In the case of settlements, it was more difficult to be systematic due to the fact that these areas are unplanned and houses are not arranged in any particular order (informal settlement).

Results and Discussion

Table 1: Average component of household solid waste generated per person per day in Greater Jos

Component	Percentage (%)
Fabric	3.69
Plastic	3.33
Polythene	3.44
Organic	36.86
Metals/tin	2.59
Paper	6.85
Leather	2.07
Debris	31.49
Dead dry cells	1.29
Bottles/glasses	2.44

The data collected from the survey and site-specific studies (PEPSA, 2011) were analyzed and results from the analysis were collated and recorded as shown in Table 1. The results shown in Table 1 revealed the components of household solid waste generated as 36.9% of organic waste, 3.3% of plastic, 6.8% of paper, 2.6% of metal/tin, 2.4% of bottle/glass, 3.7% of fabric, 3.4 percent of polythene, 2.1% of leather, 31.5% of debris and 1.4% of dead dry debris of waste is generated in the municipality (PEPSA, 2011). The responses to some municipal solid waste management issues were collated from the questionnaire analyzed and results from the analysis were recorded in Table 2, 3, 4 and 5**.** The results obtained from the analysis shown in table 4 revealed that 22.2% spent 500 and 1000 – 5000 Naira (equal to about $6 and $12 to $60USD) for waste disposal per month. Considering the above responses it is clear that over 50% of the households live in a state of poverty, hence the households are not able to pay good user service charges that can help in the development of a sustainable solid waste management system. In addition, results in table 2 showed that 55.6% patronize government solid waste disposal agency - PEPSA, and 44.4 % dispose of their waste themselves.

Table 2: Method of disposal of municipal solid waste in Greater Jos

S/N	Method	Frequency	Percentage (%)
1	PEPSA	10	55.6
2	Contractors	0	0
3	Informal sector/vendor	0	0
4	Do-it-Yourself	8	44.4
5	Others	0	0
	Total	18	100

Table 3: Willingness to pay for disposal charges in Greater Jos

Willingness to pay	Frequency	Percentage (%)
Yes		74.7
No		25.3

Table 4: Amount spent on waste disposal in Greater Jos

S/N	Range (Naira per month)	Frequency	Percentage (%)
1	< 500	4	22.2
2	500 – 1000	1	5.6
3	1000 – 5000	4	22.2
4	> 5000	0	0
5	Varies	9	50.0
	Total	18	100

Table 5: Income range in Greater Jos

S/N	Range (Naira per month)	Frequency	Percentage (%)
1	18,000 – 20,000	4	22.2
2	20,000 – 30,000	1	5.6
3	30,000 – 60,000	5	27.8
4	60,000 above	3	16.7
5	Business	3	16.7
6	No indication	2	11.1
	Total	18	100

The results also revealed that 0.5kg per person per day of waste is being generated by an average resident of Greater Jos (PEPSA, 2011). Also from the results obtained from analysis shown in table 5 (see appendix), more than 50% earns monthly income which is less than or equal to about 60,000 Naira (equal to about $150USD. In addition the response on responsibility and payment for solid waste disposal in table 3, the survey revealed that 74.7% of the households are willing to pay any charge for their refuse to be collected while 23.3% are not satisfied with the idea.

Some planning constraints to municipal solid waste management in the municipality were identified as follows:

Constraints to municipal solid waste planning in Greater Jos

Economic constraint

By definition, developing countries have weak economic bases, hence, insufficient funds for development of sustainable municipal solid waste management systems (United Nations Commission on Sustainable Development, 1997). The survey revealed that an average of about 54.56% of the sampled households earn less than or equal to about $150, as monthly income. Considering the economic requirement of the family, a monthly income of less than or equal to $300cannot meet the economic demand of the family hence as they can do without the service of a solid waste disposal agent they engage in crude open dumping of solid waste in drainages, around the streets and open market places, any peace of unused land, Open air burning without air pollution control. In addition economic constraints also make them to patronize cart pushers who are not able to get to the approved designated dump sites where the municipal solid waste are expected to be managed properly.

Financial constraint

In general, municipal solid waste management is given a very low priority in developing countries, except perhaps in capital and large cities (United Nations Commission on Sustainable Development, 1997). This study showed that this is the case in Greater Jos metropolis. Municipal solid waste management is given

very low priority in the budget due to limited finances (PEPSA, 2011). As a result very limited funds are provided to the solid waste management sector by the governments, and the levels of services required for protection of public health and the environment are not attained. The user service charges collected by the disposal agents is too little to make any meaningful impact on solid waste management. However, users' ability to pay for the services is also limited by their income, and their willingness to pay for the services which are irregular and ineffective is not high either. More so the end point of the solid waste does provide financial reward to waste disposal agent hence the only source of finance to the disposal agent is the user service charges.

Technical constraint

In most developing countries, there is lack of human resources at both the national and local levels with technical expertise necessary for solid waste management planning and operation (Ogawa, 1996). Many officers in charge of solid waste management, particularly at the local level, have little or no technical background or training in engineering or management (United Nations Commission on Sustainable Development, 1997). This study revealed that there is lack of human resources at both the state and local government level and the private sector with technical expertise necessary for municipal solid waste management planning and implementation. Many officers in charge of solid waste management, particularly at the State Waste Management agency and ministries handling the issues of municipal waste, have little or no technical background or training in planning or management. In fact all the problems that the municipal solid waste management system is faced with are exacerbated by the lack of trained personnel. These include workers in all ranks, from the administrator to the refuse-men. There is no formal training program and communication is poor. Without adequately trained personnel sustainable solid waste management planning and implementation is not realizable (Zavodska, 2003).This study also revealed that there is ineffective municipal solid waste collection and unreliable solid waste collection service. In fact the study showed that the coverage of municipal solid waste collection service is very low, that municipal solid waste generated is dumped at many undesignated sites (e.g. open areas, water channels, streets etc.).

The lack of provision of sufficient public receptacles for solid waste storage is another technical problem worthy of note. Solid wastes were observed dumped in open areas in residential areas and market places. Aged vehicle fleet and poor road access were also observed. In addition a large proportion of the vehicle were observed to be open vans which results in waste littering on the way to the dump site. Open air burning of solid wastes was observed including medical waste in the dumpsite.

Institutional constraint

Several agencies have been created at the state level that is involved at least partially in solid waste management (Ogawa, 1996). Such agencies at the state level include – Plateau Environmental Protection and Sanitation Agency waste (PEPSA), special environmental task force etc. However, there are often no clear roles/functions of the various state and local government agencies defined in relation to municipal solid waste management and also no single agency or committee designated to coordinate their projects and activities. The local government environmental department has the responsibility of picking up and transportation of solid waste from public place to dumpsites (PEPSA, 2011). The PEPSA also has the mandate to pick up and transport solid waste to the dumpsite. However there is no body coordinating these activities. The lack of coordination among the relevant ministries and agencies often results in duplication of efforts, wastage of resources, and un-sustainability of overall municipal solid waste management programs. The lack of effective legislation for municipal solid waste management is partially responsible for the roles/functions of the relevant federal, state and local government agencies not being clearly defined and the lack of coordination among them.

Social Constraint

This study revealed that the social status of solid municipal waste management workers is generally low (Agunwamba, 1998). This is due to the negative perception of the society regarding the work which involves the handling of solid waste. Such societal perception leads to low regards for the work, low self-esteem for the workers especially the garbage men and in turn produces low working ethics and poor quality of their work (Ogawa, 1996). Where the society allows only a certain social class or group to deal with

solid waste, the availability of work force for solid waste collection and disposal becomes constrained by this rule.

Cultural Constraint

In the course of this study, materials such as dead animals, food items and used clothes were observed at the road junctions and by the road side. The practice of dumping material for sacrifices such as animal parts or full dead bodies of animal at road junctions and by the road side is a cultural norm acceptable some cultures. Such norms affect designs and implementation of sustainable municipal solid waste management systems.

Recommendations

Feasible Suggestions for improved municipal solid waste management in Greater Jos and municipality with similar characteristics include:

i. Public awareness on municipal solid waste management needs to be improved in the municipality. This can be achieved using a variety of factors such as the integration of environment education centered on municipal solid waste management and the environment into the school curriculum beginning with the elementary schools. Public awareness can also be improved through some low cost methods such as seminars, workshops, newsletters, speeches, church bulletin and messages, special seminars in the open market places, motor parks, and notice sand columns in newspapers.

ii. There should be improved litter control in the municipality. A very good way for promoting this is by providing more public receptacles throughout the municipality. If these bins are available, then at least people will have the option of using them. Without available bins, the only choice that people will have is to throw solid waste around in the environment as it is currently practiced. In addition, when the waste bins are old they should be replaced.

iii. It is obvious that funding is a major issue in municipal solid waste management; hence special attention should be paid to financial planning by the ministry of environment and the health department of the Local Government Areas in the municipality. The ministry should create special fee and charges that will be paid by residence and business in the municipality. And this fee and charges should be dedicated to research such as development and planning of solid waste management system and management of solid waste in general in the municipality.

iv. The results presented in Table 2 showed that 44.4% of residents dispose of their solid waste themselves and 55.6% patronize government solid waste disposal agents in the municipality. It therefore mean that a large proportion patronize private/individual independent waste disposal agents. However the study showed that none of the waste management agents has any training in planning or management. Apparently, they do not do anything with the waste. They neither sort the waste nor subject the waste to further treatment, hence, no financial return at the end point of the waste as what they do is simply solid waste relocation. They collect waste from the generators and relocate them from the point of generation to the 'approved' dumpsite where the waste is subjected to open air burning without pollution control. It is therefore instructive that when approvals are given to the waste management agents, it should be given to those that have plans that will bring financial return at the end point of the waste. This will ensure that the waste become assets instead of liability.

v. The practice of technology support has moved forward in recent years, especially in the 1990s (Zavodska, 2003; USEPA, 2006; Peter, 2008)). It is therefore imperative to develop new direction in concept and practice in accordance with the Nigerian environment to stimulate the growth of municipal solid waste management in the municipality. There is need for the government agencies and research institutions to run seminars and workshops on modern planning and industrial practice of municipal solid waste management to reorient the operators of solid waste management in Nigeria so as to increase their contribution to the gross domestic product (GDP).

vi. This study revealed that several policies have been developed in line with the international policies for waste management. It is crucial to develop new policies and strategies with reference to the immediate physical environment in addition to those already prompted by the international bodies to suit Nigeria's peculiar situation. New policies should be created for the management of municipal solid waste in the municipality and these new policies should be officially implemented by the responsible body. The new policies and strategies to be formulated should be targeted at implementation of government policies right from the planning stage for developing municipal solid waste management system in the municipality.

Conclusion

The result from the characterization of municipal solid waste in Greater Jos municipality showed that 0.5kg of municipal solid waste is generated per person per day (ppd) and over 20% of recyclable municipal solid waste is generated in Jos municipality. This study also revealed that enough attention is not given to management of municipal solid waste in Greater Jos municipality. The planning constraint to municipal solid waste management in Greater Jos has been identified. The major constraint is the lack of technical expertise especially in waste planning required for municipal solid waste management. However some feasible suggestions have been presented for improved municipal solid waste management in the municipality and Nigeria at large.

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