AN ASSESSMENT OF SOLID WASTE MANAGEMENT PRACTICES IN KADUNA METROPOLIS, NIGERIA

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M.Tech/SSSE/2007/1817

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

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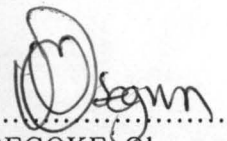
A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY (M.TECH) IN GEOGRAPHY (ENVIRONMENTAL MANAGEMENT).

DECEMBER, 2010

DECLARATION

This is to affirm that I, ADEGOKE, Olusegun Adeboye with registration number M.Tech/SSSE/2007/1817 carried out this project titled "An Assessment of the Waste Management Practices in Kaduna Metropolis, Nigeria" This thesis is a part of the requirements for the award of the degree of Master of Technology (M.Tech) in Environmental Management of the Department of Geography, School of Science and Science Education, Federal University of Technology, Minna. Within current knowledge, this same thesis has never been produced elsewhere by other researchers.



..... 6/8/2011 .....

ADEGOKE, Olusegun Adeboye Date

CERTIFICATION

This thesis titled: An Assessment of the Waste Management Practices in Kaduna Metropolis, Nigeria by: ADEGOKE, Olusegun Adeboye (M.Tech/SSSE/2007/1817) meets the regulations governing the award of the degree of Master of Technology (M.Tech) of the Federal University of Technology, Minna and is approved for its contribution to scientific knowledge and literary presentation.

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31/10/2011

DEDICATION

This work is dedicated to the Almighty God who sees me through it and to my family.

ACKNOWLEDGEMENTS

First and foremost, my profound gratitude goes to Almighty God for giving me the strength and will to complete my programme successfully. I am also using this opportunity to acknowledge the effort of those who have helped me during the course of this study. My profound gratitude goes to Dr. A.S. Abubakar who doubled as my project supervisor and the head of the department for his scholarly critiques and advice towards the success of this project. Also to my lovely family and colleagues who have in one way or the other help me to achieve my dream. To God be the glory and Honour.

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ABSTRACT

A persistent challenge in the modern city is the safe management of municipal solid waste. This has been a widespread global problem especially in developing countries where it has adversely affected the quality of life and the natural ecosystem. Solid waste has deep cause-consequence interdependency with the human environment – the causes can be attributed to issues as diverse as urbanization and massive backlog of neglects, while the consequences can be gleaned from the severe threats it poses to human lives and infrastructure. It is against this background that this thesis tends to assess the management practices evolved in abating municipal solid waste in Kaduna Metropolis- one of the most urbanized centres in Nigeria. The data for this research which are mainly primary in nature were obtained through intensive reconnaissance survey of authorized and unauthorized dumping sites so as to determine the types and magnitude of the waste generated and the adequacy of the dumping sites in the study area. This data were further augmented with structured questionnaire to determine among others the residents' perception of waste management in the city, factors responsible for indiscriminate waste dumping as well as management practices put in place by the Government to curb the menace of waste in Kaduna metropolis. Consequently, the results reveal that in spite the provision of additional dumping sites and landfills by Kaduna State Environmental Protection Agency, the menace of waste has remains unabated for over a decade in the area to the extent that the severity can be mirror from the drastic upsurge in waste generated in Kaduna metropolis, which rose from 11,243 cubic metric in 1996 to 42,349 cubic metric in 2008. Furthermore, evidence shows that high incidence of waste and indiscriminate dumping are associated with areas of high population density (For instance, Kawo area within the metropolis has the highest severity of waste, amounting to 17,046 cubic metric as at 2008). This research concludes that a pragmatic approach to waste management should suffice to integrate on one hand, active private and community involvement in municipal waste management as well as the 3R approach to waste minimization - Reuse, Reduce and Recycle - on the other hand.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The problem of waste management is one of the most serious environmental problem facing cities all over the world, but of serious concern is the dimension of the problem in the third world countries like Nigeria. One of the major problems facing Nigeria today is the need of handling and proper management of domestic solid waste, hazardous and non-hazardous ones (Sankey, 2007). Though there is no internationally accepted definition of solid waste, it has been described by many as "an unwanted material found in any environment"(American Public Works Association, 1976). According to this description, waste could be seen in relative terms, as what is taken to be unwanted by a person in a place may be useful to another person in another place and time. Despite the relativity of definition of waste, there are common items that are always referred to as unwanted waste to all social classes and state of the society. Social and cultural affiliation play a strong role in the definition and characterization of waste matter in Nigeria and Africa in general (Mabogunje, 1974).

Conceptually, solid waste or refuse is any solid material which is discarded by its owner or user (Savas, 1977). It consists therefore of discarded solid materials resulting from domestic and community activities and from industrial, commercial and agricultural operations. Urbanization as a factor of waste generation could be traced back to the transitional socio-cultural milieu and organizational context of most Nigerians from rural to relatively recent urban ways of living, and the fundamental differences between the characteristics of rural and urban environment,

significantly account for the quality of contemporary Nigerian urban environment (Okpala, 1986).

The problem of solid waste in our urban centres indicated that there is much to be desired in the process of making our cities clean. Factors that contribute to solid waste problem in our cities include refuse which continues to block road space, drainages and open spaces. A mark of uncontrolled urban development in any city is the proliferation of unauthorized waste disposal sites along drainages, frontage of residential and commercial buildings, shops and recreational centres. People hurriedly remove waste from their houses, shops and other living and working area and dump them in any available space without given consideration to the health hazard and other environmental impact of such practices. Most of these solid wastes are paper, nylon, kitchen garbages etc.

Because the environment and man operate a kind of symbiotic relationship, whatever man put into it whether good or bad comes back to him in either positive or negative manner. Okpala (1983) linked the increase in solid waste generation in our urban centres to the increase in population and Olawande (1974) classified the composition of waste in the layout of Ibadan and concluded that waste generation in layout vary according to the social status of the residents in the different layout. It was also revealed by Olowu and Akinola (1995) that out of over 400,000 tones of solid waste generated in Ibadan in 1975, only 140,000 tones were cleared; which implies that the disposal system was not commensurate with the amount of waste generated. Filani and Abumere (1986), in their study noted that open dumping is the most commonly used refuse disposal method in Nigerian urban centres.

Solid waste management is the combination of generation, collection and disposal of refuse from the source up to a final disposal site or ground. This may include the use of dustbin, transport and landfill respectively. The underdeveloped countries have not fully found a final solution to waste management because of their economic, political and social implications (Mabogunje, 1974, 1996). It has increase over the years due to change in consumption pattern, population increase and technological shortcomings to manage the problem (WHO, 1996). Research based on CNN, (2010) verbal communication have it that non-biodegradable solid waste have been made more than six times the size of the world.

1.2 Statement of Research Problem

The twin role of Kaduna as the commercial and administrative capital of Kaduna state have resulted in her rapid urbanization and increased industrialization which have in turn encourage the influx of people from all over the country and beyond at a rate that the Kaduna State Urban Development Board (KASUDA) could no longer cope with. One of the problem area of such uncontrolled urban development and also uncontrolled waste disposal sites that are scattered all over the town of Kaduna and the unsanitary condition in which the solid waste are disposed off contributed greatly to land degradation and environmental pollution.

The problem of solid waste in Kaduna town has become a matter of great concern. Many streets and residential backyards are littered with solid waste. One may simply say, we only need to come out of the house and the next thing we meet is refuse heaps all around the streets. This is actually the situation in Kaduna city which is evident in places like Nasarawa, Sabon Tasha, Angwan Gwari, Tudun wada just to mention a few places. Houses are built to provide shelter and

living comfort, but more often than not, these areas are being polluted by refuse which brings uncompromising heaps of waste that are menace and source of air and water borne diseases which could affect general health of the town dwellers. "Health they say is wealth" and if the metropolis of Kaduna is polluted by waste that pose a threat to dwellers in Kaduna metropolis, then a greater task lies ahead to correct the deteriorating health conditions.

This research is centered on enormous efforts being made to solve the problem of solid waste since the problem remained intractable. Why is this so? Is the methodology employed bad or is the institutional framework in place weak? The need to uncover the mystery behind this prompted this research.

The management of solid waste in Kaduna metropolis has passed through many agencies and teams which are mostly concern with the general sanitation of the city. Though these agencies have changed their names several times, their functions virtually remain the same. When this research was first conducted, the management of solid waste was saddled on Kaduna Environmental Protection Agency (KEPA), which was established by Edict No. 1 of 1994, but with the establishment of the State Ministry of Environment, there was a shift of waste collection responsibility which is out by the ministry and handled by Interproject Limited and individuals contractors under the supervision of the Ministry of Environment.

1.3 Aim and Objectives

The aim of this research is to examine the waste management practices in Kaduna metropolis. In order to achieve the stated aim the following specific objectives are proposed to

(i) Identify solid waste management practices in Kaduna metropolis

(ii) Investigate the manner of refuse dumping in the metropolis

(iii) Evaluate the effectiveness of the practices

(iv) Assess the role of agencies responsible for solid waste management in Kaduna metropolis

(v) Examine the institutional bottleneck in waste management in Kaduna metropolis

(vi) Proffer necessary solution to solid waste management in Kaduna metropolis

1.4 Scope of the Study

One feature of most urban centre including Kaduna in the past decades is the gradual conversion of any available open space, drainage and even uncompleted buildings to refuse dump sites. These sites not only obstruct human activities, it has also become a convenient ground for flies, mosquitoes and other rodents that constitute harmful health hazard to human being. Against this backdrop the research intend to examine the activities of man that generate waste, the method employed to dispose waste, the causes of indiscriminate dumping, the socio-cultural aspect of solid waste generation, perception of residents about filthy and dirty environment, the responsible agent/agencies saddled with responsibility of waste collection and disposals, the role of scavengers in solid waste management, the activities of recycle agencies in conversion of waste and the area of solid waste dump sites in Kaduna. The research lean itself on proposing sustainable way of managing solid waste in Kaduna in particular and framework for solid waste management in Nigeria in general.

1.5 Justification of the Study

Waste is the by-product of lack of proper disposal system in the management of waste. Infrastructure must be provided either by the government, NGO's, CBO's, or other forms of self help programmes to control indiscriminate dumping of waste. As such, since the use of ad hoc practices for waste management would not work, the understanding of the present practices in place and the consequent development of a holistic approach toward managing waste in Kaduna Metropolis will better equip the Government as well Kaduna Environmental Protection Agency in terms of capacity building regarding ways of managing such municipal wastes on a sustainable basis.

Again this study would be beneficial to the private sector investors who are willing to actively collaborate with the public sector in issues involving waste management by providing them with clear-cut directions with respect to the challenges of managing waste in the study area.

1.6 Study Area

1.6.1 Historical Development of Kaduna Metropolis

The history of Kaduna as a modern town dated back to 1912, when Lord Fredrick Lagged selected the area as the most strategic for his administrative and military headquarters for the Northern Protectorate. The choice of Kaduna according to Maxlock (1967) was said to have been influenced by four major attributes- availability of abundant water from river Kaduna, the centrality of the area in relation to other provinces that made up the Northern Nigeria and the availability of large expanse of land for development, the arrival of railway which made the town an important station point in the northern part of the country and finally the relative

isolation of the town made it free from local/ traditional and political complications, thus allowing for a well-planned modern settlement for the roles it was chosen to perform.

1.6.2 Location

Geographically, Kaduna town is located on the central part of the Northern Nigeria highland. It is located on latitude 10^0 20' North and longitude 7^0 45' E. It extends from upper river Mariga to the foot slope of the Jos Plateau. The spatial location of the study area that is Kaduna metropolis in relation to Nigeria; Kaduna State and the study area are shown in fig 1.1, 1.2 and 1.3.

1.6.3 Population Structure and Distribution

The provisional Census result of 2006 put the population of Kaduna metropolis about 2.2 million people. Majority of the people in the metropolis live and work in the metropolis. Despite the provisional nature of the Census result, observations of movement of young, strong male laborers in large numbers from rural communities and small towns to Kaduna metropolis are noted especially during the dry season and back to their rural communities during the wet season suggests a sizeable seasonal labour force in the city. However, the seasonal labour migration has no effect on the agricultural labour demands in the rural traditional setting . Indeed some of these seasonal migrants come to town to learn specific jobs and eventually go back to establish the same in rural area as skilled workers, for example, technicians, masons, drivers, carpentry workers, auto mechanics etc.

One of the demographic features of the population of Kaduna metropolis is the ratio of male and female. According to Census figure, there is equal proportion of male and female in the

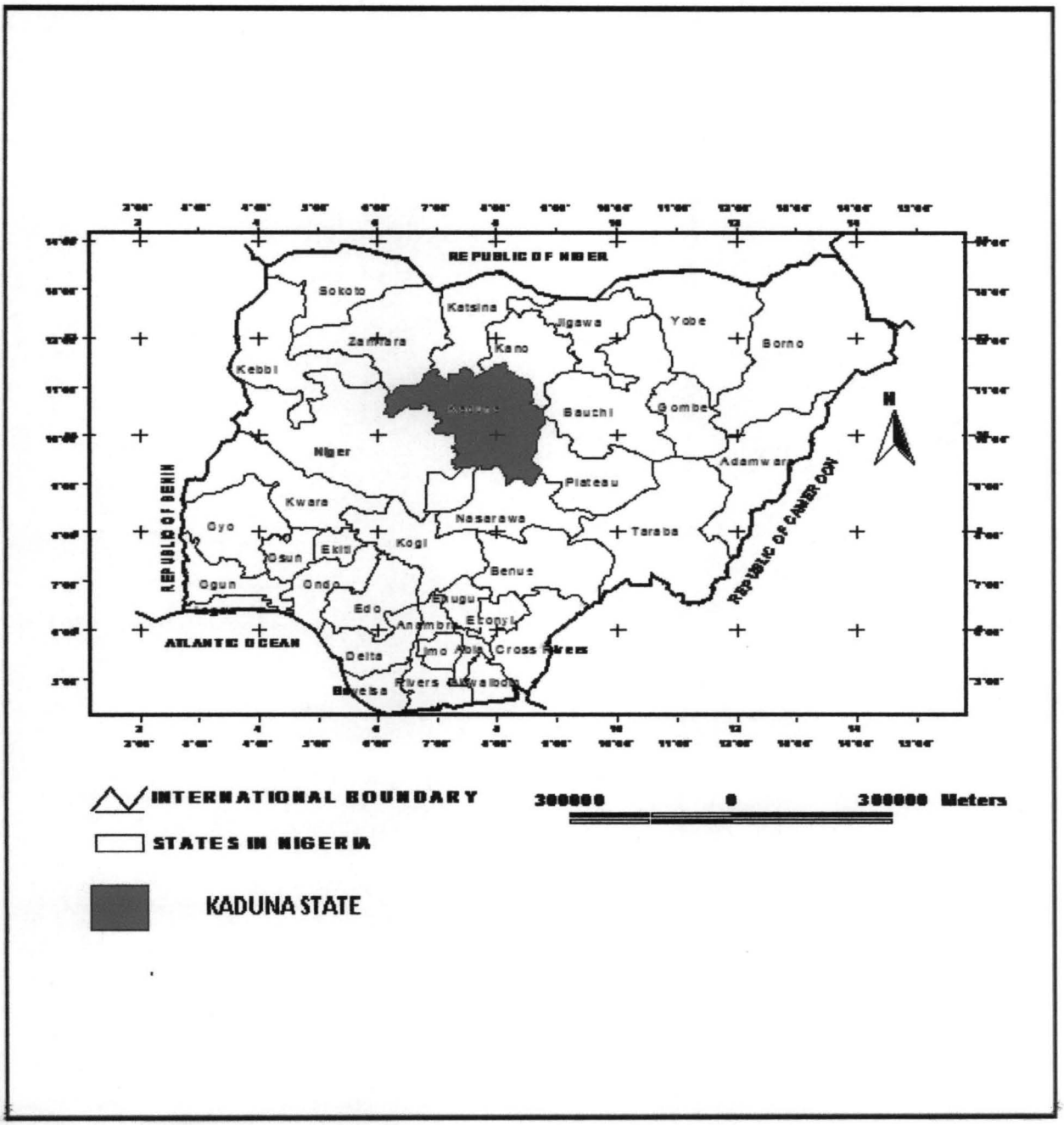

Fig 1.1: Nigeria showing Kaduna State.
Source: Federal Republic of Nigeria Population and Housing Census (2006)

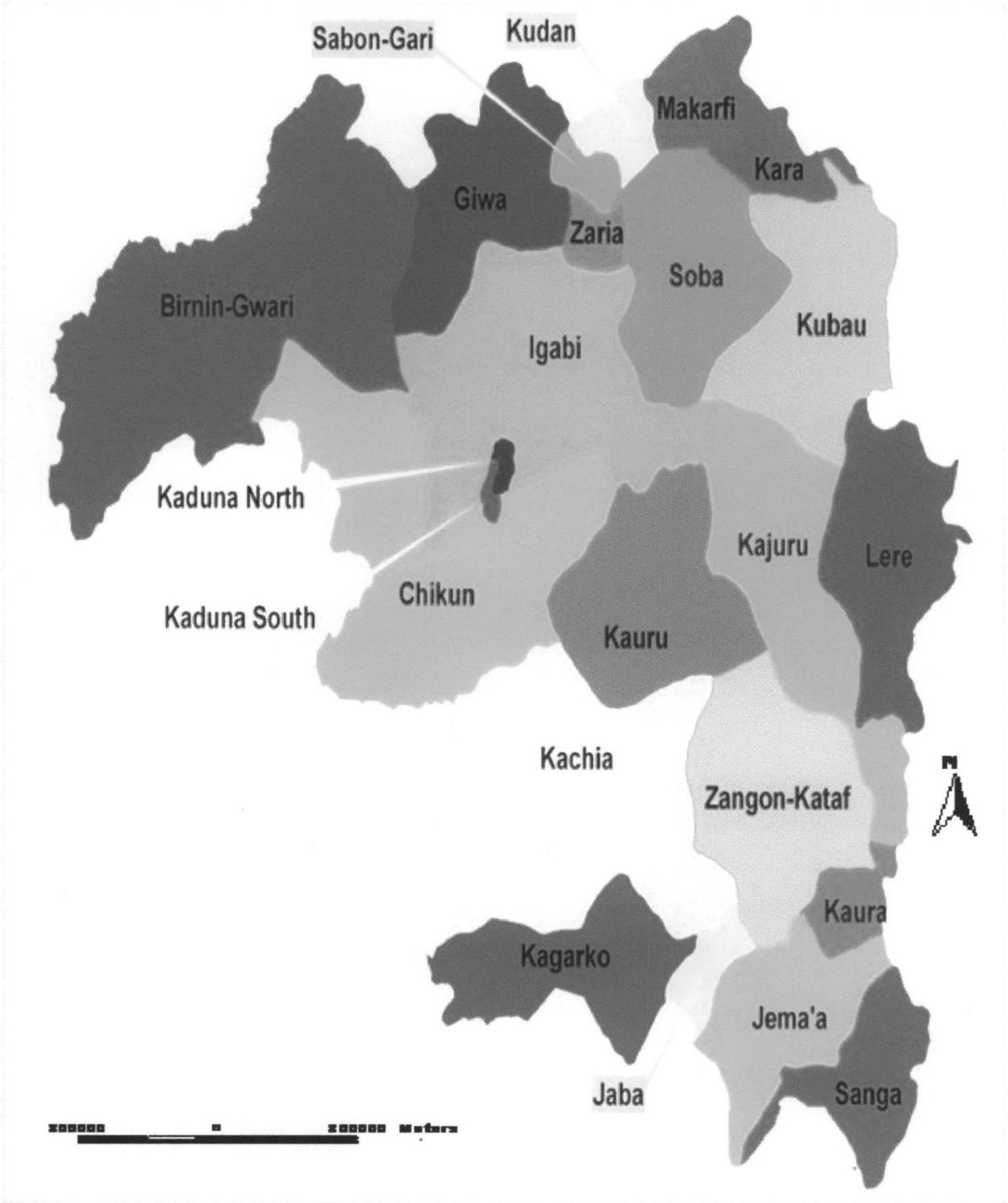

Fig 1.2: Kaduna State showing the Local Government Areas (Kaduna North and South)
Source: Federal Republic of Nigeria Population and Housing Census (2006)

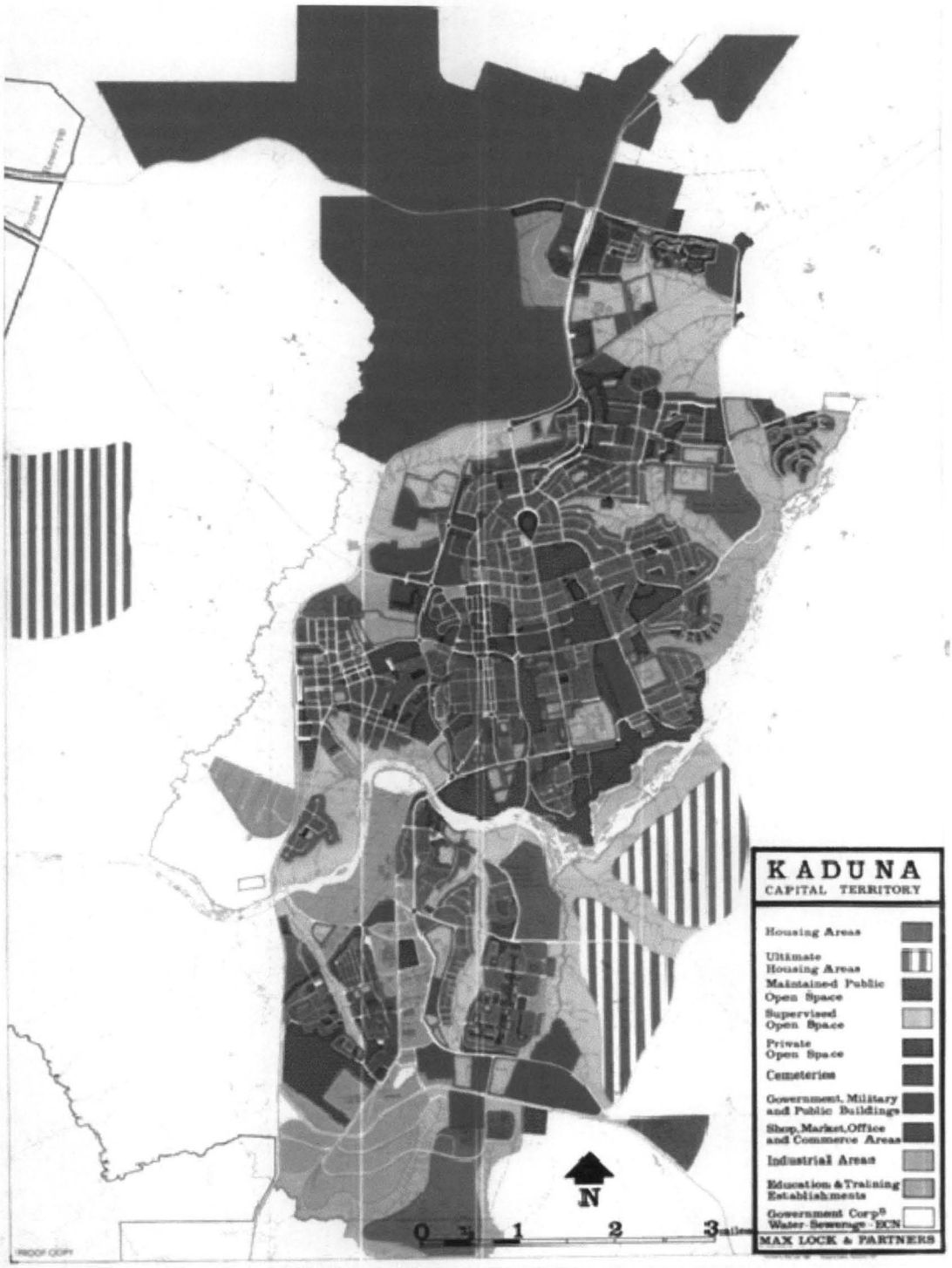

Fig 1.3: Kaduna Metropolis Land Use Distribution.

Source: Max Lock and Partners.

netropolis. The effect of this may be helpful to the future social and economic developments in he city.

.6.4 Administrative Settings

Kaduna metropolis has been a regional capital of the country and has not relented to its effort as apital in many ways. Kaduna metropolis was the capital of Northern Nigeria as far back as 917. It is also the capital North Central State from 1967 and the capital of Kaduna state from 976 till date. It is also serving as Local Government Headquarters for four different Local overnment- Kaduna North, South, Igabi and Chukun. The metropolis has grown to become smopolitan in nature and an important and integral part of the Country.

6.5 The People

e original settlers of Kaduna metropolis are people from different backgrounds - Gwaris, kuns and Hausas. Today the city has grown to accommodate all the tribes in the country and ny foreigners. The number of tribes that could be found in Kaduna today is countless because its importance as one of the commercial nerve centres in the country. It has peaceful vironment that attracts both non- indigenes and foreigners.

6.6 Economic Climate

ne 1999 political recognition and the successful take off of Local Government Councils and the tate civilian administration had serve as an indication of good economic climate for well-neaning entrepreneurs wishing to invest in Kaduna metropolis. Also, both newly created state nd national policies aimed at pursing vigorously diversification of Nigeria economy has been

yielding results in the States. There have been establishment of many industries both local and foreign.

The Government has instituted agencies to carter for the interest of Local, National and Foreign entrepreneurs/industrialists. Majorly, the ministry of commerce and industry arm of the state Government is charged specifically with the responsibility of maintaining good economic climate in the metropolis in particular and the state in general.

In other to promote industrial and commercial enterprises, the Government has put in place several infrastructures in place for better business climate in the state. For example, in Kaduna metropolis and Zaria town, Government has established seven and four industrial estates respectively. These estates have been laid out, provided with access roads, water and power supply and other incentives including pioneer status schemes for newly established industries in order to survive the initial capital outlay and related problems.

Approved user scheme provides for transfer of profits and dividends arising from investment in accordance with exchange control regulations after payment of tax. Also, the Federal Government has given approval for a Debt Conversion Programme (DCP) which aims at assisting industries that are viable but run into some financial predicament to bounce back.

1.6.7. Transport and Communications

Kaduna metropolis is served with 67 kilometre stretch of trunk "A", well surfaced roads stretching out from the Central Business District(Gari kasuwa) in five cardinal directios – westward to Tegina (Niger State), northward to Kano, Eastward to Jos and South- Westward to Abuja. The Government has constructed good- tarred surface road compactable to the trunk "A" total lane 12km and several developmental projects are still going on.

Apart from motor ways, rail ways converge on Kaduna metropolis from Lagos in the South West and Port Harcourt in the South- South political zones and extending to Zaria which is another railway Nodal settlement with railway lines branches to Kaura Namoda and Kano. These transportation networks are assets for movements of goods and people and services.

Recent developments in the air travel within Nigeria have linked the metropolis with many cities in Nigeria. Kaduna metropolis has now has a standard international airport. This is a welcome development bringing the metropolis closer to foreign investors. Indeed, business in any part of the metropolis and from any state of federation can been reached within an hour or two.

Modern telecommunication system connect Kaduna metropolis with all part of the world as telecommunication fast made the world global village. There is presence the entire communication outfit in Kaduna metropolis with some of them sitting their regional headquarters in Kaduna metropolis. Kaduna metropolis today is strategic in the country.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Framework

The system theory is explored in this research to explain waste management as a system. It is imperative however to first examine the definition of a system and then relate it to water management. Chorley and Kennedy (1971) defined a system as a structured set of objects and/or attributes. Harvey (1969) also explained system as:

(a) a set of elements identified with some viable attributes or objects;

(b) a set of relationship between the attributes of objects;

(c) a set of relationships between the attributes and/or objects and the environment;

From the above definitions, these objects and attributes consists of components or variables and exhibit discernible relationship with one another and operate together as a complex whole according to some observed pattern. Also, from the foregoing, waste management can be explained through the spectrum of the characteristics of a system as can be seen below.

A system has component parts: waste management consists of different parts (sub-systems) like the waste generation procedures, waste collection, transportation, disposal, cost recovery, maintenance and administration.

A system operates in a special environment and consists of well defined subsystem so that when one of them is altered, it could influence the entire system. Also, the system could be an open, isolated or closed system depending on the exchange of mass and energy with the wider

environment. Waste management is actually an open system since it allows for the exchange of mass and energy with the wider environment (Mabogunje, 1974, 1996). For example, if the maintenance component is improved, there could be a positive impact on the performance of the management system. The dominance of unskilled manpower in the management system could spell doom for the entire system.

A system has a goal to achieve. The ultimate goal of waste management is the provision of safe and clean environment devoid of filth in a sustainable fashion for aesthetic and beautiful environment. The slogan now is make the city clean and green to encourage good living habit an less cost of medical health

A system has a boundary. It has an area of operation that is distinct from another system. Its parts can be identified along with its relationships and its area of influence. For example, Kaduna State Ministry of Environment is quite distinct from the Power Holding Company of Nigeria.

A system has inputs and outputs. These inputs and outputs are part of the system. They sustain the system and are in the form of mass and energy. The domestic, commercial, industrial wastes form the input in waste management. These include paper, broken glasses, polythene bags, food wastage, fruits and vegetables which are indiscriminately discarded.

Finally, a system has a feedback. The presence of feedback process ensures adjustments and readjustments in the system. Any subsystem within the water management system that is faulty can be traced through the mechanism of management feedback.

All the subsystem within the waste management system can be controlled. Input and output can be regulated by the management. How effective these subsystems are controlled depends on the capacity and effectiveness of the management system.

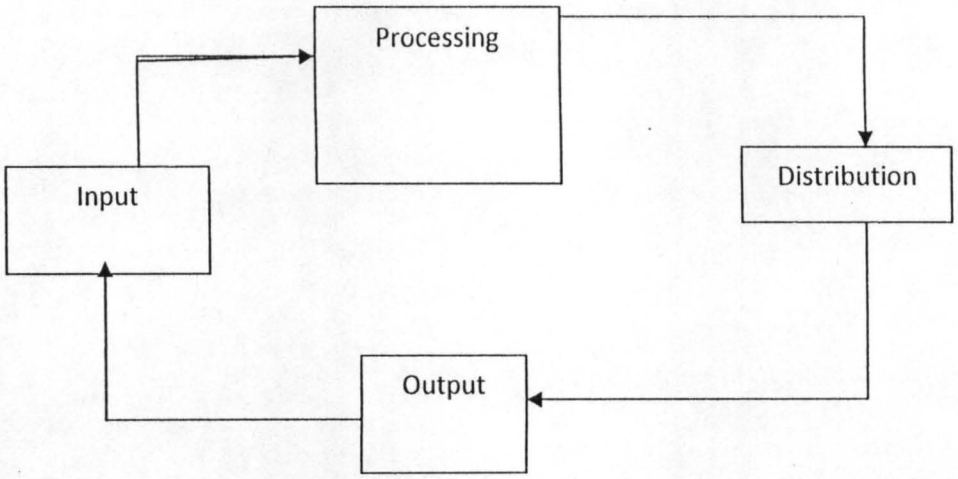

Figure 2.1: System Theory adapted from Harvey, (1969)

.2 Solid Waste Management

The state of the environment in Nigerian urban centres and cities, have become a cause for great concern for individuals, corporate bodies and various government at different tiers. This is supported by the fact that several works have been carried out on the problem of solid waste, including its generation, collection and disposal in Nigeria, and the world over. Solid waste has defied all solutions in its management process, as it remains intractable. These include paper, broken glasses, polythene bags, food wastage, fruits and vegetables which are indiscriminately discarded. Though there is no internationally accepted definition of solid waste, it has been

described by many as "an unwanted material found in any environment". According to this description, waste could be seen in relative terms, as what is taken to be unwanted by a person in a place may be useful to another person in another place and time.

According to Tsai and Chou (2006) Municipal Solid Waste Management (MSWM) are classified into two-general wastes and industrial wastes. They define general waste as those wastes including garbage, excrement and urine, animal corpses in solid or liquid forms, wastes generated by households or other non-industries, which have the capacity to pollute the environment. This definition is obviously in line with the universal accepted constituents of Municipal Solid Waste Management which is normally assumed to include all non-industrial community wastes such as residential wastes, commercial wastes and municipal service wastes (excluding treatment facilities).

Cities generate tremendous amount of solid waste. The generation of these wastes continues to increase worldwide both in absolute and per capita terms. Urbanization and urban development brings lots of people together at a given urban place. Urbanization brings about the concentration of population, and these people generate wastes. Several studies have put waste generation in Nigeria at about 0.5kg per person per day (See, Adeniyi *et al.* 1983; Filani and Abumere, 1986; Audu, 1994). The nature of refuse waste changes in urban context. In contrast to the largely vegetable waste in rural area, urban refuse consists of large proportion of non-bio-degradable matter such as metals, and other cans, synthetic materials, bottles and glasses etc. which cannot or are hard to decompose. As rightly observed by Jacoby and Pennance (1992), advancing technology has expanded the variety of products available for consumption, made products more

complex, raise rate of obsolescence and thereby added to the problem of waste disposal. It has also added immensely to the per capita consumption of physical materials and energy, with consequent increment of waste and pollution.

Several studies now substantiate the income theory. A Columbia (USA) study finds that each 1% increase in income generates 0.7% more waste (United State Environmental Protection Agency, 1991). Population growth, increase urbanization and rising standard of living due to technological innovation have contributed to an increase in both the quality and variety of solid wastes generated by domestic, agricultural, and industrial activities. Globally, the estimated quantity of waste generation was 12 billion tones in the year 2002 and about 19 billion tones of solid wastes are expected to be generated annually by the year 2025 (Yoshizawa et al, 2004).

World Health Organization (WHO, 1997) reported that estimated waste production per capita increase with rising average income. According to World Resources (1996), in cities of developing countries, an estimate 20 to 50 percent of the solid wastes generated remains uncollected, even though up to one half of local operational expenditures often goes towards waste collection. In Nigeria for instance, even if the waste are collected, municipal waste remain a problem in many cities. Municipal Solid Waste Management disposal sites, where they exist, often handle both domestic and industrial wastes, including hazardous wastes. Instead, it must be undertaken by individuals or local communities (WHO, 1997). In most cases, collected waste are disposed of in an uncontrolled ditch, dumped on the streets, in backyards or drainage ditches or most often burned in open fires. Without proper disposal or treatment, microbiological and or

chemical pollutants from these wastes may affect land and air, or enter surface and ground waters (Illelah, 2006).

Municipal Solid Waste Management encompasses the functions of collection, transfer, resource recovery, recycling and treatment. The primary target of Municipal Solid Waste Management is to protect the health of the population, promote environmental quality, develop sustainability, and provide support to economic productivity (Yongsheng et al, 2006). To meet these goals, sustainable solid waste management systems must be embraced fully by local authorities in collaboration with both the public and private sector (See, Ashby, 1977 for need to embrace partnership in solid waste management). Although in developing countries, the quantity of solid waste generated in urban centres is low compared to industrialized countries, the Municipal Solid Waste Management still remains inadequate.

As mentioned by Sankey (2007), Maclaran International was given the responsibility to study solid waste problems in Kaduna. The firm prepared master plan for solid waste disposal and drainage in Kaduna. The report on solid waste management gives detail account of existing waste disposal system and its attending problems. Factors involved in the design of future methods, analysis of alternative methods determination of the least cost solutions and the organization structure, legal and financial steps to take in implementing the programme. The report recommended three methods of waste disposal that is, sanitary landfill and incineration and proposed the establishment of a solid waste disposal board, public enlightenment programme and the purchase of appropriate equipment.

In their study, Filani and Abumere (1986), argued on the need for data on the present and future magnitude of solid waste for effective disposal in Nigerian cities. Fifteen towns are selected for the study based on the main ecological zone in Nigeria-Forests and Savannah, Kaduna and Kano topped the list of the towns selected in the savannah for the stud. From the study, they concluded that there was no significant difference in waste generating rate between towns in the southern and northern parts of the country.

As state by Okonkwo (2006), the United State of America in 1988, generated an estimated 180 million tones of municipal solid waste about 1.8 kilogram per person per day. But while the total amount of waste continued to grow since 1960, the rate of growth is slowing down due to the fact that the percentage of waste in Landfills is declining and USA recycling of solid wastes has increased from 9 percent in 1985 to 13percent in 1988.

The world generates some 10,000 tonnes of trash each day left a giant pile (Cunningham 2005). He stated that Mexico city is one of the largest cities that generate solid waste which is exposed to wind and rain as well as rats, flies and other vermin. He further argued that Manila in Philippines generate similar amount of waste that goes to a giant dump called "Smokey Mountain" over 20,000 people are said to live and work on this mountain of refuse scavenging for recyclable items or edible food scraps In his review, he mentioned that in July 2000, a torrential rain spawned by Typhoon caused the mountain to collapse, burying at least 215 people. The cause of this is open dumps because for many people, the way to dispose of waste is simply drop it someplace. Open, unregulated dumps are still the predominant method of waste disposal in most developing countries.

Phoenix, the capital city of Southwestern state of Arizona USA has a long standing reputation for being innovative and progressively managed. The reputation is the result of managers and employers who are both empowered and willing to experiment. This philosophy led Phoenix to develop a model for the privatization of solid waste services.

In the late 1970s Phoenix has a sanitation workforce of about 480 personnels serving a city of 700,000 people. The budget of this operation, inflated to today's dollar would be about US$ 43.3 million. Those results were achieved by developing a competitive privatization process. People have been at least as important as process in this success story. Council and top management gave line managers and labour the opportunity to compete for doing the job. "Competitive privatization" has served Phoenix well; it has created productivity, improvement, driven the implement action leading edge waste technology, empowered line managers to embrace change, create a labour-management team and proven a winner fir the rate payer (Jalam, 2006).

The collection and disposal of sewage and solid waste are major public health issues and a vital role factor affecting the quality of environment (Lukas, 1998). The problem of solid waste disposal, especially in our cities in Nigeria, has become one of the most serious environmental problems facing us today (World Bank 2007). There is a phenomenal increase in the volume and range of solid waste generated daily in the country; this is due largely, to the increase rate of population growth, urbanization, industrialization and general economic growth and poverty.

In many Nigerian cities, the volume of solid waste overwhelmed the urban administrators' capacity to plan for their collection and disposal. In many of the urban and rural centres throughout Nigeria, the arrangements for waste disposal have been ineffective or insufficient. Hence, these wastes are often indiscriminately dump on open plots of land and, particularly, along and on the street. Some of these affected streets may be rendered impassable for several weeks or months as a consequence. The unsanitary condition in which the solid wastes are collected, processed and disposed off, contribute greatly to environmental degradation in Nigeria. There is therefore, the need for environmentalist to continue the search for a more successful ways of handling the waste we generate.

Okpala (1983) linked the increase in solid wastes to generated in urban area to the increase in population and Oluwande (1974) classified the composition of waste in the layout of Ibadan and concluded that waste generation in layout vary according to the social status of the residents in the different layouts. It was also revealed by Akintola (1978) that out of over 400,000 tonnes of solid waste generated in Ibadan in 1975, only 140,000 tones were cleared; which implies that the disposal system does not commensurate with the amount generated. Umuakuka and Mba (1999), in their research noted that open dumping is the most commonly use refuse disposal method in Nigerian urban centres.

The factors to be considered in the selection of disposal methods of solid waste include the characteristics of refuse, economy, availability of disposal site, and cost of labour. Okoye (1989) observed that, attempts and efforts by different governments in Anambra State to improve the environmental condition of the state have not been effective in Onitsha. The open pilling of

refuse breeds such household pests like mosquitoes, and cockroaches, which in turn contaminate food in homes and bring about diseases. World Health Organization (WHO, 1971) stressed that, dumping solid waste on land without prior treatment or planned operation can lead to the degradation of land and surrounding area thereby subjecting it to nuisance from insects, rodents and dust and smoke. The increase in production of waste is causing storage, collection and transportation difficult as well as problem f treatment and final disposal. Different solid waste disposal methods in the world include; incineration, open dumping, sanctuary landfill, trench technique and composting (WHO, 1996; Cointreau, 1982).

Due to increase in population and demand for urban land, the space for waste tipping will become scarce and expensive and also the increase domestic and industrial waste disposal facilities. Okereke (1988) opined that the situation where solid waste management is left entirely in the hand of the environment mediocre and public health officials is the most singular cause of solid waste management crises in Onitsha. He attributed lack of data compilation and purposeful studies on solid waste tom insufficient management. To make solid waste management sustainable, local authorities must embrace collaboration with other public and private sectors as their waste management system still remain inadequate.

2.3 State of Solid Waste Management in Kaduna City

Before now solid waste management in Kaduna was the traditional responsibility of the municipal authority. When the government noticed that the authority lack the capacity to evacuate waste on open spaces and along the streets, it then launched the task force on environmental sanitation in 1985 during Gen. Mohammadu Buhari regime thereafter, an

environmental sanitation edict was also passed for every last Saturday of every month (7 am- 10 am) declared as environmental sanitation day, which the people responded to fairly. However, when the task force lost its grip over the sanitation programme, people went back to their old and unhealthy sanitation lifestyle. When the weakness of the task force was noticed by the government it was scrapped and replaced by Kaduna Environmental Protection Agency (KEPA) by the state government as a World Bank assisted programme.

Kaduna State Ministry of Environment was established to replace the Kaduna Environmental Protection Agency in 1999 so as to carry out solid waste management as one of its operational obligations in urban development in the state. Kaduna Environmental Protection Agency who was formally responsible for solid waste management was then moved to the new ministry. In June 2001, the ministry therefore put in place some measures and regulations to enhance solid waste management in the metropolis, in which they specified the type of containers to be used for solid waste, storage places not to be used for dumping and other activities that may pose health hazards to human lives, animals and the environment within the metropolis. There was contracting of waste management to a company known as Interproject for proper management. Despite all these regulations, indiscriminate deposition of wastes still continues unabated in Kaduna metropolis.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Research Methodology

This section deals with the method(s) used in gathering and use of information in this research. It discusses issues like data types and sources, sample technique, sample size, sampling procedure, questionnaire administration, data analysis and hypothesis of the study.

Most of the information used in this study were obtained from reconnaissance survey, administration of structured questionnaires in the study areas and consultation of available secondary data relevant to this study.

3.2 Data Types and Sources

Basically there are two different types of data. They include primary and the secondary data. These two types of data were used in this study. The instruments used and the types of information collected under each are as considered below.

3.2.1 Primary Data

This primary data was sourced through; reconnaissance survey, questionnaire and oral interview. In the course of this study, the reconnaissance survey entails observing the state of dirtiness in the metropolis and the availability and adequacy of existing dump sites so that they can be well comprehended and described accordingly. This also involves an inventory of both authorized and unauthorized dump sites as well as their spatial locations in the study area.

Also, two sets of structured questionnaires were used. The first was divided into two parts; one was to augment the inventory of the both authorized and unauthorized dump sites in Kaduna based on the reconnaissance survey.

The second part obtained information on perception of people about waste management in the city, their ways of disposing solid waste, factors responsible for dumping indiscriminately, distance of dump site to their residents, types of waste being generated and the managerial style employed in their disposal, social attitude to waste management, social status in waste disposal, impact of government in waste collection and disposal etc. The second set of questionnaire focused on the socio-economic benefits of clean environment, the effect of dirty environment on their livelihood and other social and cultural constraint to clean environment.

3.2.2 Secondary Data

Secondary data collection involving existing literature on the topic globally, in relation to the study were sought from journals, text books, pamphlets, World Bank reports and gazettes from Kaduna State Ministry of Environment. These were complimented with reports on the type and qualities of the programmes carried out by the ministry, the media both print and electronic, and the internet.

3.3 Sample Frame and Size

The samples for this study were drawn from all the wards in both Kaduna North and South Local Government. These communities are in the two local government areas (LGAs) that constitute the study area and for convenience are grouped into 5 zones . The first zones is Doka and

include: Kakuri, Mami market, Ungwan Rimi and Kabala Constain, The second zone is Kawo and consists of: Ungwan Gwari, Ungwan Kanawa, Hayi Banki, Malali, Badarawa, Abakpa, and Mando. The third zone is Gabasawa includes: Sabon Tasha, Ungwan Sunday, Barnawa and Narayi. Tudun Wada is the fourth zone and comprises: Rigasa, Kabala West, Ungwan Sanusi, Ungwan, Muazu, and Badiko. The last zone is Makera and is made up of: Kurmin Gwari, Gonin Gora, Nasarawa and Kudenda Industrial Site. The population of the wards is not uniform but a sample size was drawn from the total population of the communities that make up each of the study areas in such a way that all the communities were adequately represented.

With this vital information, 1% of the population was sampled for questionnaire administration in each of the LGAs. A total of 1200 questionnaires were administered in the study areas, out of these 1,146 questionnaires each were administered in both LGAs.

3.4 Sampling Procedure

A purposive sampling technique was used in selecting respondents in each of the communities studied. One of the first five (5) houses was randomly picked to determine the starting point. Thereafter, a systematic sample of four (4) houses was used to determine other samples. Questionnaires were administered to both male and female household heads. Due to the fact that the houses are scattered in arrangement, questionnaires were administered haphazardly in interval of four houses as the researcher proceeds in the sampling exercise.

3.5 Data Analysis

A total of 1,200 questionnaires were administered to about 117,357 households in the study area, and about 500 out of 554 were valid when subjected to statistical analysis. The remaining 54 questionnaire consist of those that were either not returned or have missing data. The data collected from field were subjected to statistical analysis. This was possible after the questionnaire had been coded. For preliminary descriptive analysis, frequency of all variable contained in the questionnaires were carried out using Statistical Package for Social Scientist (SPSS). This enabled a further identification of variables to be recorded/ recomputed for subsequence analysis. The analysis of the relationship between the quality of life of inhabitants and the environment is regressed and necessary deduction arrived at.

3.6 Methods of Data Presentation

The data for this research was analyzed using descriptive statistics. The following methods of data presentation were used, namely: tables, percentages maps, graphs and photographs.

CHAPTER FOUR

RESULTS

4.1 Overview

This chapter presents and analyses the data on the solid waste management practices in Kaduna metropolis. In this study, the results of the analysis on the management practices in the study area are presented using tables, charts, percentages among others. The extent of this assessment is analysed with emphasis on the areas prone to solid wastes, causes and effects of indiscriminate waste dumping, methods of waste disposal in the study area, residents' perception of the problem as well as private sector involvement in waste management.

4.1.1 Identification of Areas with Solid Waste problem in Kaduna Metropolis

The analysis of spatial outlook of Kaduna metropolis indicated that while some areas are clean in terms of environmental sanitation, some areas are opposite to such ideal environment as seen in Table 4.1.

Table 4.1: Areas associated with Municipal Solid Waste Problem in Kaduna Metropolis

Area associated with Clean Environment	Area associated with Unclean Environment
G.R.A, Ahmadu Bello way, Catholic Dioceses, stadium road	Kakuri, Mami market, ungwan Rimi and Kabala,Costain/Doki, Ungwan Gwari, Ungwan Kanawa, Hayi Banki, Malali, Abakpa, Kawon Mashi, Mando, Badarawa, Ungwan Sarki, Sabon Tasha, Ungwan Sunday, Barnawa, Narayi, Ragasa, Kabala West, Ungwan Sanusi, Ungwan Muazu, Tudun Nupawa, Badiko, Kurmi Gwari, Nasaiwa, Gonn Gora, Trikaniya, and Kudenda Industrial Site.

The results presented in Table 4.1 shows that majority of the areas within the metropolis are facing problem of municipal solid waste management- people dump their refuse indiscriminately to the open spaces, drains and other undesignated points. A lot of areas in the metropolis are known to be environmentally unkempt as this is shown in plate I, II and III below.

Plate I: Indiscriminate Dumping of Municipal Solid Waste in Kakuri Area of Kaduna Metropolis.

Plate II: Polythene Bags becoming a menace in Kawo Area of Kaduna Metropolis.

Plate III: Illegal Dumpsites close to household premises in Barnawa Area in Kaduna

4.2 Causes of Indiscriminate Dumping of Refuse in Kaduna

The analysis of the causes of indiscriminate dumping of solid waste on Kaduna Metropolis was considered and the responses of the respondents are shown as follows in Table 4.2.

Table 4.2: Reasons for Indiscriminate Dumping of Refuse.

Reasons	Frequency	Percentage
No designated dump site	110	22.0
Cultural Attitude	106	21.2
Non-Challant Attitude	84	16.8
Bandwagon Effect	123	24.6
No Response	77	15.4
Total	500	100.0

As reported in Table 4.2 the analysis of the reasons put forward by the inhabitants for indiscriminate dumping of refuse indicated that there are several factors responsible, ranging from cultural attitude to bandwagon effect and lawlessness of the society.

4.3 Effects of Indiscriminate Dumping of Refuse

Residents 'opinion of the effects of indiscriminate refuse dump was obtained in the study area. The results of which is seen in Table 4.3.

Table 4.3: Residents Opinion of the Effects of Indiscriminate Dumping of Refuse on the Environment.

Effect	Frequency	Percentage
Yes, it has	138	27.6
No, it does not	293	58.6
No response	69	13.8
Total	500	100.0

As indicated in Table 4.3 analysis of the effect of indiscriminate dumping of solid waste to the environment shows that there is little or no awareness on the parts of respondents on environmental management.

4.4 Solid Waste Generated in Kaduna Metropolis.

The results of sources, types, frequency of disposal, distance to dump sites and disposal method of solid waste in the study area among others are presented as follow.

4.4.1 Sources of Solid Waste Generated in Kaduna Metropolis.

To start with the analysis of the sources of solid waste been generated in Kaduna indicated that there are three sources as shown in table 4.4 below.

Table 4.4.: Sources of Solid Waste generated in Kaduna Metropolis.

Reasons	Frequency	Percentage
Domestic	304	60.8
Commercial	157	31.4
Industrial	39	7.8
Total	500	100

The analysis in Table 4.4 shows that the sources of solid waste generated in the study area are domestic, industrial and commercial in nature.

4.4.2 Types of Solid Waste Generated in Kaduna Metropolis

As shown in Table 4.5 the solid waste which are domestic, industrial and commercial in nature are generated from diverse types such as paper, polythene, plastics, roughages, food remnants, metals and cans, chemicals, vegetative matters among others.

Table 4.5: Types of Solid Waste Generated in Kaduna from different sources.

Sources	Types	Management style
Domestic	• Plastics	• Non-bio degradable
	• Paper	• Bio- degradable
	• Food remnants	• Bio degradable
	• Vegetative matters	• Non-bio-degradable
	• Ash and Dust	• Bio-degradable
	• Polythene bags	• Bio-degradable
	• Packaging	• Non-bio-degradable
	• Metal and cans	• Non-bio-degradable
Commercial	• Plastics	• Non-bio-degradable
	• Paper	• Non-bio-degradable
	• Polythene Bags	• Non-bio-degradable
	• Packaging	• Non-bio-degradable
	• Roughages	• Non-bio-degradable
Industrial	• Chemicals	• Non-bio-degradable
	• Oils	• Non-bio-degradable
	• Metals	• Non-bio-degradable
	• Cans	• Non-bio-degradable
	• Plastics	• Non-bio-degradable

4.4.3 Distance to Dump Site or Collection Point

The attitude of the respondents to solid waste management was also further tested and result tabulated in table 4.6 below.

Table 4.6: Distance of Dumpsite to Households.

Distance (m)	Frequency	Percentage
0-50	32	6.4
51-100	56	11.2
101-150	58	11.6
151-200	77	15.4
201-250	110	22
Above 250	167	33
Total	500	100

Table 4.6 indicates the nearest distance of the site or collection point relative to the number households.

4.4.4 Disposal Methods

Table 4.7 shows the disposal method been employed by the households in Kaduna.

Table 4.7: Disposal Methods

Methods	Frequency	Percentage
Burning	32	6.4
Open Dump	56	11.2
Composting	58	11.6
Channel Dumping	77	15.4
Waste Collection Point	110	22
No Response	167	33
Total	500	100

The table also indicates that there is different method, though not conventional, being used as means of waste disposal in the study area.

4.4.5 Frequency of Solid Waste Disposal per Households

Table 4.8 shows the frequency of solid waste disposal in Kaduna metropolis.

Table 4.8: Frequency of Solid Waste Disposal per Households

Disposal	Frequency	Percentage
Daily	313	62.6
Weekly	104	20.8
Fortnightly	53	10.6
Monthly	30	6.0
Total	500	100.0

Again, based on Table 4.8 the frequency of disposal is reported on daily, weekly, fortnightly and monthly basis.

4.4.6 Storage of Solid Waste

Table 4.9 presents the results of respondents responses to ways of storage indicated that those that dispose their solid waste on weekly, fortnightly and monthly basis.

Table 4.9: Storage of Solid Waste in Kaduna Metropolis

Storage	Frequency	Percentage
Dustbins with Cover	36	7.2
Drums	63	12.6
Others	401	80.2
Total	500	100.0

In addition the table also indicates the means of storing this waste at the household level.

4.4.7 Satisfaction with Solid Waste Disposal Methods

The results of the satisfaction by households on the methods of solid waste disposal are sought and the dichotomous responses are tabulated in table 4.10 below.

Table 4.10: Satisfaction of Disposal Methods.

Storage	Frequency	Percentage
Yes	252	50.4
No	138	27.6
No Response	110	22.0
Total	500	100.0

4.4.8 Alternative Disposal Methods

Table 4.11 presents the opinion of the respondents as to how effective would be the proposed alternative disposal methods if introduced.

Table 4.11: Provision of Alternative Method for Disposal

Storage	Frequency	Percentage
Yes	463	92.6
No	25	5.0
No Response	12	2.4
Total	500	100.0

As evident from Table 4.11 the results are presented using dichotomous responses.

4.5 Introduction of Private Solid Waste Management Methods.

The results of the efficacy of the private solid waste management process in Kaduna metropolis in other to make the study area clean and remove the bureaucracy in the public sector management of solid waste are presented in this section.

4.5.1 Private Solid Waste Collectors

Table 4.12 reports the result of the activities of private solid waste operators introduced for solid waste management by government agencies in the management of the waste in Kaduna metropolis.

Table 4.12: Response to Private Solid Waste Collectors.

Satisfaction	Frequency	Percentage
Yes	206	41.2
No	281	56.2
No Response	13	2.6
Total	500	100.0

The table depicts the satisfaction of the respondents with the activities of the private waste collectors and the frequency of their responses.

4.5.2 Amount Charged by Private Solid Waste Collectors.

Table 4.13 presents the amount charged by private solid waste collectors based on the type of storage bins.

Table 4.13: Charges by Private Waste Collector Companies

Charges (N)	Types of Storage Bins
0-100	Polythene Bags
101-200	Dustbins with Cover
201-500	Drums
501-1000	Industrial Bins

The table further depicts that the various amount been charge varies according to storage facility used.

4.6 Agencies Responsible for Solid Waste Management in Kaduna Metropolis.

The breakdown of succession of who is responsible for solid waste management in Kaduna metropolis over a given time dimension of more than three (3) decades is shown in Table 4.14.

Table 4.14: Solid Waste Management in Kaduna Metropolis over time.

Agencies	Years
Kaduna Capital Development Board	1970s
The Kaduna Urban Planning and Development Authority	1980s
The Kaduna North, South, Igabi and Chukun LGAs	1990s
Kaduna State Environmental Protection Agency	1994
Ministry of Environment, Kaduna	2002

This table shows apparent change and modification in agencies responsible for waste management in Kaduna.

4.6.1 Activities of Ministry of Environment on Solid Waste Management.

Table 4.15 below indicated progression of the activities of the Ministry of Environment over time in respect of waste management in Kaduna.

Table 4.15: Number of Designated dump sites in Kaduna between 1980 and 2010.

Agencies	Year	Number of Dumpsite	Number of Landfill
KEPA	1980-1996	56	1
Ministry of Environment	2002-2010	20 major and 60 minor	2

In addition, it is also evident from the results in table 4.15 the number of dump sites produced by the Ministry of Environment as compared to KEPA, its predecessor.

4.6.2 Volume of Solid Waste Generation in Kaduna

Table 4.16 below shows the amount of solid waste generated in Kaduna metropolis from officially recognized solid waste collection centres.

Table 4.16: Solid Waste Generated in the Five Zones of Kaduna Metropolis in 2008

Zone	Quantity (M^3)	No. of Collection Points
Doka	7,878	10
Kawo	17,064	15
Gabasawa	3,472	8
Tundu-Wada	10,893	12
Makera	8,132	15
Total	42439	60

The table further depicts that the amount of solid waste generated in Kaduna metropolis has been on the increase in the mid 1990s.

4.6.3 Average Composition of Solid Waste been Generated in Kaduna Metropolis

The analysis of the composition of the solid waste been generated in Kaduna metropolis indicated thus as shown in table 4.17 below.

Table 4.17: Average Composition of Solid Waste in Kaduna Metropolis

Material	Percentage Composition
Decomposable Materials	60.0
Polyvinyl Product/Ceramics	25.0
Glasses and Ceramics	7.0
Iron/Metal/Cans	5.0
Others	3.0
Total	100.0

4.6.4 Ministry of Environment Capacity to manage Municipal Solid Waste

Table 4.18 shows the equipment available to the Ministry through KEPA for the waste management compared to the standard required based on population.

Table 4.18: Facilities Available for Solid Waste Management in Kaduna Metropolis.

Facility	Number Available	Number required	Remark
Crusher Truck	5	8	-3
Fork Truck	10	10	-
Ro-Ro Metal Bin	250	1200	-950
Tipper Truck	10	20	-10
Container Vehicle	12	24	-12
Lifter Truck	3	8	-5
Compacting Vehicle	4	10	-6
Loaders	3	10	-7
Plastic Dustbin	500	1250	-750
Bulldozers	2	8	-6
Public Conveniences	10	70	-60
Transfer Station	10	25	-15
Tractors	7	32	-25
Supervising Vehicles	3	12	-9
Standard Landfill	20	40	-20

4.7 Institutional Constraints to Ministry of Environment on Solid Waste Management.

One of the major constraints of the Ministry of Environment to the effective municipal solid waste management in Kaduna metropolis is the issue of manpower and equipment to execute the services of municipal solid waste management.

4.7.1 Manpower Constraint

Table 4.19 shows the staff strength of Kaduna State Environment Protection Agency (KEPA) vis-à-vis their hierarchy.

Table 4.19: Staff Strength Situation of Waste Management Department of KEPA.

Categories of Staff	Number	Percentage	Qualification
Labourers	106	57.9	Nil
Health Assistants	39	1.3	Diploma
Community Health Workers	16	8.7	Certificate
Community Health Assistants	7	3.8	Certificate
Health Officers	15	8.2	Diploma
Total	183	100.0	

4.7.2 Breakdown of Equipment

Table 4.20 depicts the type and quantity of equipment used for municipal solid waste management in the metropolis

Table 4.20: Breakdown of Equipment.

Breakdown	Number of Available	Percentage
Crusher Truck	4	7.7
Fork Truck	6	11.5
Tipper Truck	5	9.6
Container Vehicle	7	13.5
Lifter Truck	2	3.8
Compacting Vehicle	2	3.8
Loaders	2	3.8
Bulldozers	6	11.5
Tractors	10	19.2
Supervising Vehicles	10	19.2
Total	52	100.0

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Areas Associated with Municipal Solid Waste Problem in Kaduna Metropolis

The analysis of the identified areas with municipal solid waste problem in Kaduna metropolis shows as evident in the results presented in Table 4.1 that many areas of the metropolis such as Kakuri, Mami market, Ungwan Rimi and Kabala, Costain/Doki, Ungwan Gwari, Ungwan Kanawa, Hayi Banki, Malali, Abakpa, Kawon Mashi, Mando, Badarawa, Ungwan Sarki, Sabon Tasha, Ungwan Sunday, Barnawa, Narayi, Rigasa, Kabala West, Ungwan Sanusi, Ungwan Muazu, Tudun Nupawa, Badiko, Kurmi Gwari, Nasaiawa, Gonin Gora, Trikanya, and Kudenda Industrial site are dirty while areas such as GRA, Stadium road and Ahmadu Bello way are clean.

By extension, this implies that majority of the high density areas of Kaduna metropolis are not clean, as solid waste litters the streets to make them unclean and it is only in the Government Reservation Area and places of low densities such as Stadium road that have clean environment. The implication of dirty environment is that it can lead to poor sanitary condition and environmental health related problems. The poor environment causes environmental health problem and can also lead to huge resources outlay on health of the people to stop epidemics if it occurs. This can arise due to unhealthy environment caused by indiscriminate dumping of municipal solid waste as seen in Plates I, II and III.

1.2 Causes and Effect of Indiscriminate Dumping of Refuse in Kaduna.

s indicated in Table 4.2 about 22.0% of respondents dump their solid waste indiscriminately cause of absence of designated dump site or collection points. For instance, most respondents veal that after cleaning their premises they make use of any available space for dumping, not

minding the environment consequences of their actions. Furthermore, 21.2% of respondents dump their solid waste indiscriminately due to their cultural antecedents. In this regards,it is hypothesized that it is part of our culture to stay in contact with solid waste especially in the poverty ridden environment. 16.8% of respondents dump their solid waste indiscriminately due to non-challant attitude to the surroundings as no importance attached to environmental sanitation. 24.6% of respondents do so because of bandwagon effect, that is, if you cannot beat them, join them. About 15.4% do not respond to the question.

The foregoing shows that the respondents have little or no ideas of the importance of clean environment as panacea for healthy living.

Turning to Table 4.3 on the residents' opinion of the effect of indiscriminate dumping of solid waste to the environment, it is garnered that there is little or no awareness on the parts of respondents on environmental management. This is because approximately 59% of the respondents are of the opinion that they are not aware of the grievous consequences - poor quality of the environment and effect on health well-being of the people- of indiscriminate waste dump on the environment.

The effect of this act is that there is untidy environment that can lead to unhealthy living habit which will put burden on health services in the metropolis. The implication of poor sanitary condition is so enormous that if necessary check is not put in place, it can lead to epidemic. To this one can conjecture that poor environmental condition is synonymous with poverty to the extent that there is need to incorporate in poverty eradication programme issue of better sanitation and clean environment through proper disposal of municipal solid waste.

5.1.3 Sources of Solid Waste generated in Kaduna Metropolis

In Kaduna Metropolis the solid waste generated are mainly from domestic sources. As seen in Table 4.4 this accounts for about 60.8% of the total solid waste. While 31.4% of solid waste is generated from commercial premises, 7.8% of solid waste is generated from industrial sources. This indicated that the majority challenges of solid waste management in Kaduna are about the domestic waste management.

As domestic waste have the largest turn out of the municipal solid waste compared to others, a reason which might be put forward is that of population explosion in the metropolis and the lifestyle of depending much on polythenes for packaging, wrapping of food items especially the package water called pure water. This lifestyle has prevails and produces more municipal solid waste, this has general consequence on the environment. Furthermore, the types of solid waste been generated from these sources are evident in Table 4.5.

5.1.4 Types of Municipal Solid Waste in Kaduna Metropolis.

As seen in Table 4.5 nearly all the commercial and industrial solid waste in Kaduna metropolis are non-decomposable and non-bio-degradable, whereas, majority of the household solid waste are bio-degradable except for few which are not. The recent phenomenon of the use of polythene bags, instead of vegetative materials for packaging, especially the sachet water popularly known as pure water, to wrapping of food items has caused menace in the study area in particular and the country in general.

A cursory look at Table 4.5 also reveals the types of municipal solid waste generated in Kaduna metropolis and include food remnants, plastics, paper, vegetative matters, ash and dust, polythene bags, packaging, metals and cans, oil, chemicals, e.t.c. Though many of these municipal solid wastes are not hazardous but constitute menace to the environment. They reduce the quality of the environment and cause unhealthy environment. The polythene bags have become so enormous, causing menace found every part of the metropolis. The effect of this is that the process of recycling has to be implemented so that polythene will not take over our streets. According to one report in CNN (2010), the volume of polythene manufactured in the world is six times the size of the earth.

5.1.5 Distance to Dump Sites or Collection Points.

The analysis of the distance of the household premises to nearest municipal solid waste is a factor indicating that many of the household premises are far from the dumpsites or collection points and presents a leeway for indiscriminate dumping of waste.

As obvious from Table 4.6 about 35.0% of respondents are of the opinion that the distance of dump site or collection point is over 250 metres from their residences, which therefore encourage them to dump their solid waste indiscriminately around the city- to avoid moving long distance to dispose off their waste. About 22.0% of the respondents indicated that the dump site is between 201 and 250 metres from their premises; about 15.4% indicated that the distance to dump site is between 151 and 200 metres; 11.6% indicated that the distance is about 101 and 150 metres while those with distance of less than 100 metres that is recommended for solid waste collection is about 17.6%.

The international standard of between 100 and 150 metres of household premises to municipal solid waste dump sites shows that only 29.2% enjoys such opportunity. This buttress the reason for the indiscriminate dumping. The implication of this is on the quality of the environment and health status of the residents of Kaduna metropolis.

Therefore distance to dump site is a factor on its own for indiscriminate dumping of solid waste round the city. This acts as an indicator for the indiscriminate dumping of municipal solid waste in and around neighbourhoods in Kaduna.

5.1.6 Disposal Methods.

As seen from Table 4.7 majority of the of respondents (26.6%) dump their solid waste either in the open space or along river channels and drainages thereby blocking the movement of water and causes flooding within the metropolis; 22% of the respondents dump their solid waste at the waste collection point which is left unattended to and overflow to the ground for several days. 10.4% did not indicate where their solid waste are been care off. The other factor is burning which have greater effect on the environment, it accounts for about 5.0% of the total solid waste generated in the study area that is Kaduna metropolis.

The implication of these disposal methods used by the inhabitants of Kaduna metropolis is that open space dumping of waste (whether legal or illegal), and channels of rivers, streams and drainages, cause blockage of the streams and causes flooding in and around the metropolis. The consequential effect of flooding is the loss of lives and properties. It also leads to the pollution of land and water bodies in the metropolis. The major pollution in the metropolis is the water bodies and this consequently affect livelihood of the people. The water table is going deeper and

deeper because of the polythene bags that did not allow rain water to percolate down the ground and make them as run-offs.

Again, burning of the municipal solid waste at the open dumpsite will result in air pollution and many toxic substances being sent to the atmosphere, notably suspended particulate matter (SPM), Carbon Monoxide (CO), Volatile Organic Compounds (VOC), Sulphur dioxides (SO_2), Oxides of Nitrate (NOx), and Lead (pb). The effect is short life expectancy in the metropolis in particular and the country in general.

5.1.7 Frequency of Solid Waste Disposal

Results from Table 4.8 reveal that 62.6% of respondents dump their solid waste indiscriminately on daily basis- this implies that a lot of waste are been thrown to the streets with the implication of generating such large volume of municipal solid waste. Again 20.8% dump their solid waste indiscriminately on weekly basis; 10.8% on fortnightly basis and 6.0% on monthly.

The foregoing implies that the frequency of disposal will pose some challenges to the solid waste management authority saddled with responsibility of managing the waste in the metropolis. As the frequency of disposal is a function of population growth and level of urbanization, this would affect the livelihood and quality of life of the inhabitants of the metropolis. There will be increase in the solid waste being generated which requires the collection, transportation and dumping to the designated landfills.

5.1.8 Satisfaction with Solid Waste Disposal Methods.

Turning to Table 4.10, residents expressed their satisfaction with the methods of municipal solid waste, as majority of the respondents want the disposal methods to remain the same and to continue the way it is. For instance, 50.4% of the respondents are satisfied with the method of indiscriminate dumping while 27.6% are not satisfied. 22.0% are undecided on whether they are satisfied or not. The reason which can be adduced for this high level of satisfaction is because they are not ready to pay for the services of municipal solid waste management.

The implication of this is high degree of indiscriminate disposal of solid waste resulting from poverty and inability to pay for municipal waste generated; they want to continue to litter the environment.

5.1.9 Alternative Disposal Methods

A consideration of the effectiveness of alternative means of disposal as shown in Table 4.11 reveals that 92.6% of respondents agree to the effectiveness of would be alternative solid waste disposal method aside the present crude indiscriminate dumping method at hand; 5.0% do not want any change and want the status quo to remain, while 2.4% are undecided.

This implies that the provision of alternative solid waste management requires a lot of sensitization so that people will understand the importance of clean built environment as the adage goes that cleanliness is next to Godliness. This is due to the fact that those that don't have storage facilities, want to continue to dump their municipal solid waste indiscriminately around. They are not interested in the consequences of their actions.

5.1.10 Private Municipal Solid Waste Collectors

Against the background that private sector involvement is fundamental to municipal waste management, a critical issue militating against effective waste management in the study area is the payment of fees in respect of waste management to waste collectors. This seemingly is not a welcome development among the people because of charges by the private entrepreneurs. The people want everything free and are not ready to path with their money at all not minding the consequences of their actions.

As seen from Table 4.12, the perception of the residents show that 41.2% of them want the services of the private solid waste managers; 56.2% do not want the services rendered by these private solid waste managers while 2.6% are undecided about the whole issue. This has been an issue limiting the effectiveness of these private solid waste collectors in Kaduna. The respondents are of the opinion that they are not supposed to pay fee for solid waste dump either indiscriminately or otherwise.

As such they are not interested in whether if waste generated is disposed properly or not, rather they are interested in the consumption of basic household need without minding the damage it can cause to the environment. This negates the spirit of free enterprise and upheld that of free riders principle.

5.1.11 Amount Charged by Private Solid Waste Collectors

As a corollary to the above, it is evident in Table 4.13 that the charges demanded by the private sector in the municipal solid waste management range between N100 and N1,000 for polythenes and industrial bins. Considering the fact that the collection of waste should be a social services

coupled with the perceived high poverty level in the metropolis, the people are not ready to pay any money. All they want is to dump their municipal solid waste indiscriminately and that it is the function of the government to dispose the municipal solid waste. They view municipal solid waste as public goods and need not to be privatized.

5.1.12 Agencies Responsible for Solid Waste Management in Kaduna Metropolis.

As evident in Table 4.14 the responsible agencies for solid waste management in Kaduna has been changing over a given time dimension. At inception was Kaduna Capital Development Board in the 1970s, that are charged with the responsibility; under its management of waste was the four local government that make the metropolis in the 1980s (Kaduna North, South, Iabi and Chuku LGAs);

It was Kaduna State Urban Planning and Development Authority in the 1990. However, the Kaduna State Urban Planning and Development Authority, was found to be inefficient leading to a takeover by the State Government and subsequent contracting of this responsilbility to a Canadian firm, Maclaran International, to manage solid waste in Kaduna.

The cost of executing the task became unbearable and the result was the termination of the contract. This coincides with the establishment of Kaduna State Environmental Protection Agency (KEPA) in 1994. Henceforth, the cost for solid waste management was to be borne by four Local Government that is Kaduna North, Kaduna South, Igabi and Chukun. The local government Administrators decided that they would on their own handle the management of solid waste independently. As soon as the state allowed them the authority to do so, heaps of solid waste remained for months without being evacuated.

The task was then in 1998 returned to KEPA only to be taken over by Ministry of Environment in 2002, which now equally use private contractors to effect efficiency in solid waste management. With these frequent changes, it becomes very difficult to get comprehensive data in regard to solid waste management in Kaduna metropolis. The chronological antecedents of solid waste management in Kaduna metropolis is tabulated in Table 4.14.

5.1.13 Activities of Ministry of Environment on Solid Waste Management

The management of solid waste by the Ministry of Environment is through the use of contractors or the private solid waste collectors. This start with the street sweeping, solid waste collection from dump sites which are mostly wall structure with an opening and atimes open ground. KEPA between 1980 and 1996 operates 56 dump sites and one landfill at kilometer 6, along Kaduna-Abuja road (Table 4.15). Within this period illegal refuse dumps are found all over the metropolis. Table 4.15,shows also the progression of the activities of the Ministry of Environment over time. The Ministry at present operates over 20 mega dump sites within the metropolis with over 60 minor dump sites (This is still inadequate but represents a departure from what was obtained between 1980 and 1996).

At strategic points in the city, solid waste are collected by contractors who use tipper lorries, pay loaders and open truck (mostly pick-up vans) to transport these solid waste to nearest landfill disposal site either at Gora along Abuja road, Lagos road or behind the trade fair complex at Kawo. The vehicles visit each dump site on daily basis so as ensure relatively cleanness of the metropolis in recent time.

In addition, it is also evident from Table 4.15 that though the Ministry of Environment has provided more dump sites within a span of 8 years (2002-2010) compared to KEPA, its predecessor, the dump sites provided are inadequate. Observation revealed that while Central Business District is getting better, the story in the suburbs is a pathetic one as the number and distribution of the wall dump sites are inadequate with the few available often overfilled and are not evacuated in good time. This indicated that the rate of solid waste generated especially in high density areas and periphery of the city is not as at equilibrium with the frequency of evacuation.

One of the challenges militating against effective waste management in the study area is the strategy adopted for household waste collection by the contractors involved in waste management. The contractors did not provide any customized form of solid waste storage facilities, rather they encourage open dumping. Residents in the core area of the city in the alterative make use of various sub-standard refuse containers ranging from iron buckets, polythene bags and illegal dumps to store waste. The total number of machinery use by contractors is put as less than 20 which is grossly inadequate considering the population of about 1.6 million people (NPC, 2010), as such inefficient, judging from the data collected and also in view of the teeming population of the metropolis.

Aside the fact that solid waste are dumped at compound or undeveloped land or left at various illegal dump site, for instance, at Tundu-Wada, Ungwan Muazu and Kawo (which are areas of high residential density) in which the people create illegal dumps for themselves where mountains of solid waste heaps pose a severe problem (See also, Uyanga), in Kaduna city, solid wastes are brought to the disposal sites without sorting, segregation or any form of processing.

Also, the use of the straight jacket approach by the supervisory unit of the Ministry of environment in Kaduna, by hiring robust security guards and detailed them to prevent people from dumping garbage heap at Kauwan Barci in Tundu-Wada, is but a temporary approach which would not work over time (See, Cunningham, 2005).

5.1.14 Volume of Solid Waste Generation in Kaduna

The amount of solid waste generated in Kaduna metropolis has been on the increase in the mid 1990s. For instance, (KEPA Handbook, Ministry of Environment, 2008) mention that the solid waste been generated daily in Kaduna metropolis increased from 11,246m³ in 1996 to about 42439m³ in 2008. This is about 389% increase over the space of 12 years.

Areas such as Kawo and Tudun Wada with high population have the highest turn out of municipal solid waste. For example, Kawo has 17,064m³ of waste. This is aptly followed by Doka and Makera which produce waste of between 7,000 m³ and 8,500m³ respectively on daily basis. While Gabasawa has the lowest of 3,472m³.

As evident in Table 4.16, about 42439m³ of solid waste is generated daily on the average as at 2010 in Kaduna Metropolis. Shehu (2006) attributed this increase in solid waste generation to mainly urbanization and population increase. The implication is that areas with high concentration of population and high level of poverty generate more waste than low density areas despite the consumption pattern.

5.1.15 Average Composition of Solid Waste been Generated in Kaduna Metropolis.

A cursory look at Table 4.17 reveals the components of average municipal solid waste generated in Kaduna metropolis. It is garnered that decomposition waste is 60% of the total waste

generated; polythene and its allied generates 25% waste daily; Glass and Ceramic generates 7%; iron and metal generates 5%, while other waste generates 3%.

As such the problem of the municipal solid waste been generated in Kaduna metropolis is that the wastes are not sorted out thereby reducing the rate of decomposition and problem of its management.

5.1.16 Ministry of Environment Capacity to manage Municipal Solid Waste.

Ministry of Environment through its parastatal, KEPA is the only central municipal waste collector and manager in Kaduna. Delays in the discharge of their services due to waiting for decisions to be approved by the senior management are common. Though there are several legislations concerning solid waste management in Kaduna, Ministry of Environment alone lacks the capacity to implement them. As evident from Table 4.18 the Ministry of Environment lacks the capacity to manage waste in Kaduna. This is because the facilities available are inadequate and obsolete.

The complexity of lack of building capacity by the Ministry has increased the generation of copious quantities of wastes. These Municipal solid waste poses significant problems for health and environment. For example, Air, water and food are seen as the principal exposure routes of of the problems posed by solid waste (WHO, 1997). Also heavily implicated are the manners in which the municipal solid waste in kaduna are handled, and the environmental conditions in which people live and work (See also,Yongsheng et al, 2006). Again,the extend of ground water pollution in and around the dump sites in the metropolis hitherto unknown because adequate pollution assessment studies have not been carried out on ground water and water table.

5.1.17 Institutional Constraints to Ministry of Environment on Solid Waste Management.

The Ministry of environment is facing a lot of institutional problem that are mandate and administrative bottlenecks. The constraints have major adverse effect on the effectiveness of the operation of the Ministry from discharging their roles well. This has led to indiscriminate dumping around the metropolis. The need for proper municipal solid waste management techniques is required in the metropolis.

For instance, one of the major institutional constraints is the unavailability of required and qualified manpower to handle day to day activities in the establishment. The staff strength of the parastatal (KEPA) in the ministry of environment can be garnered from Table 4.19. The Table shows that 57.9% of the staff are labourers who have no qualifications at all ; Community Health Workers and Community Health Assistants account for 12.5% and hold Certificate qualifications, Health Officers and Health Assistants are about 16.9% and have Diploma certificates.

This implies that the manpower at the parastatal are low level staff who cannot take decisions in the time of emergency before any action can take place. This is hindrance to effective and smooth operation of municipal solid waste management.

5.1.18 Breakdown of Equipment

One of the problems of the agency is the inadequate and often breakdown of tools for the smooth and effective operation of municipal solid waste management. The equipment are obsolete and outdated to carter for the need of today municipal solid waste management.

this wise Table 4.20 shows that about 45% of the equipment to tackle today municipal solid aste management is available and about 50% of them are in deplorable conditions. The plication is that the agency is working at about 25% level of its functions. This is a great ntributory factor to indiscriminate dumping of municipal solid waste.

Summary of Findings

e analysis shown in the preceding section indicated that there are several factors that cause the liscriminate dumping of municipal solid waste in the metropolis. The results show that area of h population density such as Kawo, Kakuri, Mammy market, Ungwan rimi,and Kabala, stain/Doki, Ungwan gwari, Ungwan kanawa, Hayi banki, Malali,Abakpa, Kawonmasha, ndo,Barwnawa, Ungwan sarki, Sabo tasha, Ungwan Sunday, Barwnawa,Narayi, Rigasa, bala west, Ungwan sanusi, Ungwan muazu, Tundu Nupawa, Badiko, Kurmi vari,Nasaiawa,Goni Gora, Trikaniya and Kudenda industrial sites are synonymous with iscriminate municipal solid waste, while areas such as GHRA, low density area show some el of clean environment.

re are several reasons for the indiscriminate dumping of municipal solid waste in the ropolis ranging from cultural attitudes to bandwagon effects. Also there three sources of nicipal solid waste generation in the metropolis which is the domestic, commercial and ustrial wastes. The types of been generated include the following food remnants, plastics, er, vegetative matters, ashes and dust, polythene bags, packaging, metals and cans, oil, nicals etc.

e analysis of distance indicated that majority of the respondents have their premises more than)m away from the dumpsites thereby causing indiscriminate dumping. About 71.4% falls into categories while 28.6% have their premises to dumpsites.

major form of disposal method in the metropolis is the open dumping followed by dumping he water bodies, drainage and rivers thereby causing pollution to the water bodies and ckage of the water channels. The effect is flooding and pollution of water thereby placing e problems on health and environmental quality.

frequency of disposal shows that people dump their wastes indiscriminately on daily basis only few storing their wastes. The wastes stored are disposed off on weekly, fortnightly and thly basis through the private sector. The activities of private waste disposal are prominent mmercial and industrial with few households having disposal bins in their premises.

wastes are been stored in the dustbins, drums and other form of designated waste bins. The ysis shows that majority of the people in the metropolis are satisfied with the present in criminate dumping of wastes rather than embracing the private sector in waste management. few are in support of the alternate methods of disposing the wastes through the private rs.

ntly, there are about seven different private sector waste collectors in Kaduna metropolis gh without their own disposal landfills. The amount charged by these private waste ctors varies between N 100 and N1000 depending on the area and the type of container for aste collection.

municipal solid waste collection have passed through many agencies in the metropolis
ng with Kaduna Capital Development Board in the 1990s, It then follows the four local
rnment that made up the metropolis in the 1980s, It was the turnoff Kaduna State Urban
ing and Development authorities in the 1990s, the Kaduna Environmental Protection
cy (KEPA) in 1996 and Ministry of Environment in 2002 till date. There was only one land
1996 but are now two in 2008. There were additional four dumpsites to make it to be 60 in
There is also construction of 20minor dumpsites. The landfills are in Kawo and Gonin

ation explosions possess a lot of challenges to the agency. There are also illegal dumpsites
d the high density area of Tundun- wada, Ungwan Muazu, and Kawo. There is no sorting
waste generated which makes management difficult. There are about five administrative
for muncipal solid waste management in the metropolis which are Kawo, Duka,
awa, Tundun-wada and Makera. These zones have their catchment area for waste
ement.

tal waste generated in Kaduna metropolis in 1996 was about 11,243m^3 and had increased
dously to about 42,349m^3 in 2008. High density areas around Kawo have largest waste
ion of about 17,046m^3 while Gabasawa produces lowest of about 3,47m^3 in 2008.

inistry of Environment have KEPA as its parastatal for municipal waste management in
metropolis, the equipment in the ministry is inadequate and are obsolete. The analysis of
te generated shows that decomposable waste was about 60% but the problems of sorting

vastes have make it not to decomposed on time. There are low level man power in the KEPA large chunk been laborers. There is also breakdown of equipment that is not adequate. At nt the ministry is working at 25% optimal level.

Conclusion

study have revealed the majority of the high density area of Kaduna metropolis are not clean are due to indiscriminate dumping of municipal solid waste. The management practices loyed is not adequate to cater for the proper management of the waste. For example only few e waste generated by households and individuals are evacuated by private waste collectors at quent intervals to dumpsites and landfills. This practices do not allow for sorting and mization and hence reuse or recycling of municipal waste.

agency responsible for the municipal solid waste management is ineptitude due to factors as manpower, breaking down of equipment and inadequate funding. The introduction of ate sector participation has not been accepted by the people. Community involvement ugh the mobilization of individuals and groups into clean community-based efforts ivating into them that sense of clean environment through clean community awareness grammes will also help.

io-economic characteristics may determine attitude such as the ability or willingness to ycle municipal solid waste. These attitudes however, may positively be influenced by reness campaigns and educative programmes. Lastly, the public will have to change itively their attitude towards the limited facilities provided by KEPA and the Ministry of ironment for the management of solid waste by dumping their wastes appropriately into the al and plastic bins instead of littering them around the space and bins.

e income is too low. Then municipal solid waste management in the middle and upper ne areas can be privatized and the local authorities divert some of the service and resources or areas where private service may not be affordable.

Proper orientation of the populace on the importance of clean environment and its nce in quality life enhancing ability made known to people so that they will be key in to vironment and stop the indiscriminate dumping.

Prompt and timely evacuation of municipal solid waste from the collection points to the t landfill and sorting of the waste to reduce the time of decomposing. The equipment that ailable be overhauled and new ones provided where necessary to reduce burden of health elivery in the state.

Adequate funding and training of staff in the ministry to be able to cope with the new in municipal solid waste management. The era of business as usual need to be forgotten w course taking to control the menace of indiscriminate dumping.

More dumpsites and collection points open up to meet the standard of not more than 150 for collection point be met to reduce the indiscriminate dumping.

Decentralization of the zones to accommodate the illegal dumpsites and make it legal for ve municipal solid waste management. Site referred to as illegal should be incorporated e scheme of things to facilitate quick response to municipal solid waste management.

Source reduction and re-use should be undertaken by the Ministry through KEPA as ement reform to bring an end to the visually displaced areas of uncollected or illegally d municipal solid waste. This would have to involve minimization of waste reaching the ites. The 3Rs approach of waste should be preached- Reuse, Reduce and Recycle.

Recycling is a way of reducing cost of raw materials for our local manufacturing ustries. This has given value to the otherwise worthless municipal solid waste and has ourages a second look at it before making decisions to dispose.

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