

**MUNICIPAL SOLID WASTE MANAGEMENT TECHNIQUES IN KADUNA NORTH
LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA**

BY

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DEDICATION

The research dissertation is dedicated to Almighty Allah who gave me the strength and wisdom to continue where I almost give up. His mercy, love and grace endure forever. This dissertation work is also dedicated to late my mother and father, my wife and children.

DECLARATION

I hereby declare that the work in this dissertation “Municipal Solid Waste Management Techniques in Kaduna North Local Government Area in Kaduna State, Nigeria, was carried out by YUSUF, AbdullahiAbdulkadir in the department of Geography, Ahmadu Bello University, Zaria under the supervision of **Professor E. O. Igusi and Doctor R. O. Yusuf**. The information derived from the literature has been duly acknowledged in the text and a list of references provided.

Name of Students

Signature

Date

CERTIFICATION

This dissertation titled ‘MUNICIPAL SOLID WASTE MANAGEMENT THCHNIQUES IN KADUNA NORTH LOCAL GOVERNMENT AREA, KADUNA STATE’’ by YUSUF, AbdullahiAbdulkadir meets the regulations governing the award of a degree of Masters oo Science (Environmental Management), at Ahmadu Bello University and in approval and for its contribution to knowledge literacy presentation.

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ABSTRACT

Urban centers in developing countries are still battling with waste management problems owing to insufficient collection and improper disposal of waste. In Kaduna North Local Government area, various techniques are still employed in waste management, such as the burning, burying, open dumping and others, but an empirical understanding is needed for the prominent ones. The objectives of the study are to :- examine the characteristics and volume of waste, characteristics of waste management techniques, capacities of waste management agencies, and examine the challenges of management techniques in the study area. For administration of questionnaires 327 respondents using random sampling techniques. Data collected were analyzed using percentages, histogram, pie charts. The major results are that less than 8% of the respondents were below the age of twenty, while 92% were between 20-40 years of age and were able to provide necessary information on behalf of the family. Another finding was that 13% were farmers, and 87% were either business people or civil servants. Solid waste generated in the study area 72% of organic waste papers and plastics 23%, 3% metals, 1% others. Another finding is that solid waste management techniques in the study area includes burning at 21.71%, burying at 15.90%, open dumping and secondary dumping locations has 61.77% and others at 0.61%. In terms of management capacities 134% of solid waste were managed by private, individuals and companies while 196% is managed by the State and the local authority. This explains reasons why government could not cope with the growing of waste streams. About 53.8% were not satisfied with the management techniques and 46.2% were of the opinion that the government is trying. Management and disposal of waste is commonly done in the study area by dumping on any relative available space or uncompleted buildings, local incinerators, burning, dumping on designated bins by the major road sides and important streets in the study area. The bulk by percentage of the solid waste generated are biodegradables, papers, plastic and other organic waste such as garbage. The Local government should in an effort find a way of converting the organic waste to re-useable manure or materials in farms and gardens by mere adoption of the local technology abundant in the study area.

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CHAPTER ONE

INTRODUCTION

Generally wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provision of national law (Akos, 2009). Waste are materials that are not prime products produced for the markets for which their initial use has no further use in terms of purpose production, transformation or consumption but ready for disposal (Adedibu, 1983). Waste are generated during extraction, processing of materials into final products and other human activities which can later be recycled ,reused or reduced at the point of generation or elsewhere (Aniko, 2009).

Okecha,(2000) defined waste as matter discarded as worthless, defective or of no further value and is most often derived from places of human or animal habitation, or through a manufacturing process. It is an acknowledged undesirable by product of human settlements and economic, industrial and social development, which has traditionally been collected as domestic or industrial wastes for incineration or disposal in land, water or air (Babatunde, 2009).

Waste was an early problem of mankind and a growing one that is of major concern to every caring nation. Waste disposed on the ground turns to compost in order to improve soil fertility.Solid waste management(SWM)is now a major environmental issue that can be likened “to monster” staring the authorities on the face.Solid waste can be classified on the basis of their sources, environmental risks factors, utility and physical properties, it could be municipal waste or agricultural waste. Kaduna north is no exception as it also grapples with heap of waste waiting for evacuation in most streets,Okecha, 2000,Solid

waste could be non-liquid or non-gaseous and consist of organic (biodegradables) and non- organic (non biodegradables) such as metals, plastics, bottles, and broken glasses. Municipal Solid Waste (MSW) are generally waste from household, businesses and institutions, demolition and industrial waste. Agricultural waste are always from the agriculture sector. It has been found out that in most Nigerian cities and villages, chickens, goats, sheep, pigs, and other non-pet domesticated animals are usually sighted in high populated and commercial areas. With rising urbanization and change in lifestyles and food, the amount of solid waste generated has been increasing rapidly and composition also changing. Industrialization, human activities and economic level of different sectors are relative to the type of waste generated. (Adeyemi, 2001). The composition of municipal solid waste may be broadly categorized into recyclables, inert waste, composite waste, domestic and hazardous waste and household waste produced from daily consumption.

Recognizing its importance, a number of developing countries have requested collaboration of external supporting agencies, both bilateral and multilateral, at improving solid waste management in their cities. Although some projects have succeeded in providing lasting positive impacts on the management of solid wastes in some of these developing countries and cities, many failed to continue activities after external supporting agencies ceased their support. This unsustainability of collaborative projects is due to various technical, financial, institutional, economic, and social constraints faced by both the recipient countries/cities and external support agencies (Agbede and Ajagbe 2004).

Municipal solid waste are generally sourced from households, commercial outlets, industrial and manufacturing activities. Other wastes are made up of residual wastes and bulky wastes resulting from biodegradable households, (Doan, 1998). Secondary materials from separate collection such as papers, glass, hazardous waste, street sweepings and litter collections, cardboard, metals, textiles materials, organics (food and garden wastes) wood, where the largest fraction consisting of paper and cardboard at 35% of the waste stream, where printing production prevails, organic wastes at 25% municipal waste represents approximately 14% of all waste generated (Ali, 2008).

Waste management strategies includes landfilling, burning, composting of biodegradables as full recyclables for further use, re-use and reduce the quantity to manageable level and burying. Others are incineration (increasing with recovery of energy for further use. (Bolaane, 2004), This unsustainability of collaborative projects is due to various technical, financial, institutional, economic, and social constraints faced by both the recipient countries/cities and external support agencies (Agbede and Ajagbe, 2004). Geoffrey, (2005) These constraints can be categorized as technical, financial, institutional, economic, and social and are discussed, in relation to the sustainability of solid waste collaborative projects.

Most developing and least developed nations are currently and recently on the increase of municipal solid waste generation which is about 0.5- 0.9% per capita/per head/kg. Similarly Blight and Mbande, (1996) observed that high density, large amount of organic content, small sized particles and large amount of dust and dirt characterizes waste generated in developing countries. Municipal centre produces great variety of solid waste often a mix of potentially useable and recyclable and may consequently be put to re-use,

and largely non-recyclable materials wastes such as the plastics, leather and rubber, though may be re-use when recycle, but requires a certain level of technological process.

Urbanization is on the rise in Africa, and this trend of 3.5% annual growth might increase in future. Of concern is the inability of infrastructure and land use planning methods (including for waste management) to cope with this urban growth, this is particularly urgent in slum which constitute a big part of many of the cities and towns in Africa.

A typical solid waste management system in a developing country displays an array of problems including low collection coverage and irregular collection services, crude dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and control of informal waste picking or scavenging activities. These public health, environmental, and management problems are caused by various factors which constrain the development of effective solid waste management systems (Geoffrey, 2005). These constrains can be categorized as technical, financial, institutional, economic, and social and are discussed, in relation to the sustainability of solid waste collaborative projects.

Although, refuse disposal and waste management are the constitutional responsibilities of local government councils it has become obvious that they are clearly incapacitated because they do not possess the financial capacity nor do they have the required human resources and organized to effectively tackle the problem. The matter is made worse for the metropolitan cities that have more than one local government are or council jointly tackle waste management sustainable. Alongside this environment problem has emerged health hazard posed by the mounting waste heaps, at the same time poverty is ravaging in Nigeria and in most cities in Africa.

1.2 STATEMENT OF THE RESEARCH PROBLEM

The high rate of urbanization, industrialization and population explosion in most Nigerian cities has led to a high rate of solid waste generation and hence, pose a great challenge to solid waste management (Nwocha, Mbanjo, and Dike 2011). Some of the existing studies on solid waste management are evaluative in nature. For example, Jonathan and Yusufu,(2011) assessed the factors influencing the generation and disposal of urban household solid waste in Nigerian cities .This study established that there is positive relationship among the significant assessment variables (such as type of residential area, employment status, income) and volume of waste generated and disposed.

Adeyemi, Olorunfemi and Adewoye, (2001) examined the role of waste scavengers in the waste recycling process in Ilorin, Nigeria. The research employed questionnaire survey and Plastic waste as an example, it was demonstrated that plastic recycling was economically viable. The findings indicated that, scavengers who operates in the informal sector have contributed significantly towards the separation of recyclables for the recycling industries. They finally recommended that the waste scavenger could be incorporated into the recycling process.

Ukoje,(2011) researched on the determinants of participation of stakeholders in solid waste management in Zaria. As such other categories of solid waste management in Zaria, Nigeria. The study analyzed domestic solid waste management in the study areas being managed by individuals, private hands and local government effort in controlling solid waste in the area.

Abubakar, (2012), examined the public participation and perception of waste management. The management of waste generated and the peoples involvement and the effort of government in management of waste in Jos metropolis. The findings were that there was not great people participation in the management of the environment but to some extent joint participation by the State and the Local Government authorities. Kasham, (2009) focused on the direct relationship between population growth increase and solid waste generation as well as indiscriminate dumping of waste, questioned the practice today as effective way of getting rid of valid solid waste, in Sabo area of Kaduna metropolis. Stephen, (2012) assessed the effects of municipal solid waste in Kaduna south local government area and emphasized on population growth and physical size of the environment and what the residents think of it. Ibrahim, (2012) basically studied refuse generation and disposal in Tudun-Wada Area of Kaduna South. The research studied dumping of refuse recklessly by the inhabitant resulting in poor disposal method which leads to general contamination of the environment.

Akos, (2009) used frequency, percentages and other descriptive techniques to carefully analyzed the environmental problems of waste refuse dump sites in Kakuri area of Kaduna south. It examined the indiscriminate dumping and dumpsites and ways of tackling the menace. Joseph, (2008) assessed the problem of solid waste management in Kaduna metropolis. The study viewed solid waste management techniques in the metropolis and possible consequences thereof. Based on the available literature no study has examined solid waste management techniques in an integrated manner which calls for research attention. The techniques of burning, burying, open dumping and others are not effective and sustainable because the existing techniques had failed, this calls for a

research of this magnitude, therefore there is need to understand how the management of waste could properly tackled to proper solutions.

The following research questions are posed to fill the gap.

- i. What are the characteristics of waste generated in Kaduna North Local Government Area?
- ii. What municipal solid waste management techniques are adopted by individual and agencies in the study area?
- iii. What is the capacity of waste management agencies in terms of equipment and personnel to deal with the waste challenges in Kaduna North?
- iv. What are the challenges of waste management in the area of study?

1.3 AIM AND OBJECTIVES OF THE STUDY

The aim of the study is to assess the municipal solid waste management techniques adopted by individuals and government agencies of Kaduna north local government area of Kaduna State. The objectives are to:-

- i. examine the characteristics and volume of municipal solid wastes generated in the area of study;
- ii. examine the management techniques for solid waste adopted by individuals and agencies in the study area;
- iii. assess the capacities of waste management agencies in tackling of waste management and
- iv. examine the challenges of waste management techniques in the study area.

1.4 SCOPE OF THE STUDY

The study covers five major wards in the study area namely; Kawo – HayinBanki, UnguwanDosa, UngwanSarki, UnguwanRimi, MagajinGari, UnguwanKanawa and Badarawa wards. The research is limited to municipal solid waste management techniques which originates from industrial, commercial, and residential areas of Kaduna north. The study examine and assess the composition, and various techniques of managing waste, characteristics of municipal solid wastes generated in these areas per day as well as the techniques adopted in dealing with the challenges of wastes management. Time and limitation of resources would not allow for extension of the research to other parts of the local government are sections such as UnguwanShanu, Abakpa, and other related areas such as RafinGuza.

1.5 JUSTIFICATION OF THE STUDY

The research of this magnitude is definitely very important to both, the community and the government to fine-tune ways and techniques of control and management of wastes. In recent time. Various water channels at UnguwarKanawa, Badarawa, UnguwarDosa are blocked by wastes. This serve as an impetus for flooding in some areas such as Abubakar - Kigo road, off Constitution road Kaduna, Badarawa, which is a common area during the rainy season that are prone to flash flooding. Parts of the causes of this flooding incidences is the solid waste that blocked the drainage channels and making it difficult for water to move freely. A study of this nature will bring out the shortcomings in the management techniques of the solid waste towards adopting the effective technique and proper a sustainable techniques of managing solid waste in the study area and for further studies for researchers.

CHAPTER TWO

CONCEPTUAL FRAMEWORK AND REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Chapter two conceptualizes the key issues of the study and also contains review of related literature. It is a systematic arrangement of issues on solid waste management techniques and consequently the management of waste. It is intended to establish the adopted solid waste management techniques in the area and current stage of knowledge on the subject matter and divided into subsections for clarity of presentation.

2.2 CHARACTERISTICS OF MUNICIPAL SOLID WASTE IN THE AREA.

Among all the classes of wastes (solid, liquid and gas) solid wastes is most popular and most difficult to manage locally because it does not flow, evaporate, diffuse, dissolve or be absorbed within the surrounding. United Nations System in Nigeria, (2001) in a study on Nigerian cities described them as some of the dirtiest, most unsanitary and at least aesthetically pleasing in the world due to inadequate waste management. Only about 30 – 50% of generated wastes are collected in most Nigerian cities and recycling of waste is not practiced to a significant level. Botkin and Keller, (1998) considered wastes as resources out of place which implies that there nothing live waste but resources since it can be reused or recycled or be given a rethink. Many of our wastes management programmes simply involves moving waste from one location (Primary source) to another location (Secondary source) before eventually moving it to final dumpsites, where it is not actually being managed. Human populations are both concentrated in the rural and urban areas and both generates wastes.

These variables include settlement structures, population density, household size and characteristics of accommodation. Others are age, number of children and level of education; employment structure, (in agriculture, trade, civil service, and others). This is in association with consumer habits and standard of living. The seasonal variations, number of household composting, etc, and tourism industries and number of accommodation above are socio-economic parameters and factors that immensely contribute to solidwaste generation.

2.2.1. It is possible that one factor correlates with the wastes generation in a region. Whereas in other sub urban areas this factor is not linked to waste generation. Socio-economic parameters can easily be defined, whereas it is difficult to calculate the input in the input-output models. Besides wastes from households municipal solid wastes normally contains a share of wastes from trade, commerce, industry and public service which collect together with households waste within the scope of municipal collection.

In Nigeria, people living in the urban areas are now used to constant sight of huge heaps of garbage in open spaces especially as it produces offensive odour which disturb life. By 1989, an estimated 2.2 million tons of garbage per year was generated in Nigeria which is equivalent to about 20kg of solid waste per capita. Of this, less than 30% of these solid waste was evacuated leading to rapid build up of garbage and refuse waste. This is a clear evidence that the volume of solid waste is over whelming. (United Nation, 2011)

2.2.2 Linzner, (2009) made a detailed detail analysis of development in waste generation and management is a problem due to lack of comparable definitions and statistical information across most cities in developing world. Municipal solid waste is a waste collected by the municipalities independently from household and corporate establishment. The category consist of the collected recyclables, organic wastes, residual

waste, bulky waste and the hazardous wastes from household such as detergents, hair washing gels, etc. Municipal waste management/collection in term and the quantities of composition of municipal solid waste composition of municipal solid wastes will therefore be different from one part of the municipal to another. Thus, statistical information should be used with caution. Reliable time seal of data can only be obtained with great effort. This is because information and interpretation differs between areas with the same location in a settlement because of the standard of living and purchasing power.

2.2.3 Tambuwal, (2003) in a similar manner analyzed the effects of solid waste disposal on road traffic flow along Sultan Abubakar III road, Sokoto municipal, revealed that the heap of solid waste was the result of daily generation of solid waste from the adjacent household without individual concern and government concern and the main road becomes the major dumpsites. This led to heaps of garbage which causes blockage and obstruction to reduce free flow of traffic along the highway; which resulted in many unprecedented accidents on the loads. Improper solid waste disposal and management in most urban centres in Nigeria results in many health problem due to biogases produced in the anaerobic digestion (CH_4) spread diseases such as malarial vectors cholera (amoebic and ente-amoebic dysentery) Typhoid fever caused by *Salmonella typhi* and others.

2.2.4. Shittu, (1998) in a work on Samaru–Zaria, remarked that diseases such on malaria, and typhoid fever are caused as a result of improper solid waste disposal and management. Solid waste generate environmental problems, shortage of lands, toxic waste, or related harmful unused chemicals which may have negative impacts on the landmass and may

even affects the biodiversity within the soil voids. Having reviewed some related studies on waste management, it is observed that the issues on waste is a topical and inter disciplinary issue. Therefore, in Kaduna North Local Government Area, data are needed to see the current state of issues. The subsequent chapters focused on these.

Many environmentalists express great concern over which the nature of interaction within the environment disturbs most authorities and environmental managers particularly the local and state authorities. Many of the environmentalists have varieties of notions as to what the concept of solid waste is all about. Others are agricultural wastes (biodegradables) residential wastes, including yard wastes, commercial (market) and many municipal disposals.

2.2.5. Advance Centre for Engineering. (ACE),(2000) reiterated that the composition of solid waste stream is influenced by the type of economic activities and waste disposal techniques of the inhabitant of the region concerned. Freduah, (2008) discovered that solid wastes consist of organic compounds and inorganic compounds; 50.1% plastic and leather material, 5.5% papers 4.2% metal scraps, 2.5% stores and ceramic materials 1.8% cobble and other solid materials 35.9%. The significant change was due to possibly improvement in economic activities an improved standard of living. Solid wastes are considered as garbage, refuse and materials generated from commercial and agricultural operations as well as from commercial discharges without consent. Semi solid materials resulting from human and animal activities that are useless; unwanted or rather hazardous (Doan, 1998). (Cointreau, 1982) was of the view that solid waste is any non-air and non-sew-age emissions created within and disposed of by an area, including household waste or garbage (food wastes) commercial refuse construction and demolition debris, dead

animals and abandoned vehicles. Solid waste management is a problem that is experienced by all countries in the world. It is an issue mostly witnessed in urban areas as a result of high surge in population growth rate and increase in per capita income thus posing a danger to environmental quality and human health. An investigation into waste management is now becoming increasingly critical in developing countries (Kyessi and Mwakalinga, 2009).

2.2.6 Ayininuola and Muibi, (2008) observed that solid waste management have become more pronounced in recent years, as a result of inadequate collection and disposal of waste. In most cities, waste are not properly collected and where proper collection is ensured, only a small fraction receives proper disposal. Dung-Gwom, (2007) considers it as debatable that waste is useless, thus defined waste as material that has no any economic value to whoever disposes it but could be valuable to others. According to Akinola and Salami, (2001) solid waste management has become a serious problem in Nigerian cities. The mountainous heaps of solid waste that disfigure most urban centres, and continuous discharge of industrial contaminants into streams and rivers without treatment motivated the Federal Government of Nigeria to promulgate decree 58 for the establishment of Federal Environmental Protection Agency (FEPA).

2.2.7 Rushton, (2010) examined the hazards caused by improper management and some management issues with insufficient liquid content to be free flowing. Solid waste is any garbage refuse sludge from a waste treatment plant, water treatment plant, air pollution control facilities and others from agricultural wastes. Ajadike, (2001) observed that solid wastes are generated by human activities ranging from relatively innocuous substances such as food, paper, and toxic substances such as paints, batteries, asbestos, health care

Sewage Sludge, spent nuclear fuels rods. Mabogunje, (1988) viewed wastes as any unavailable materials arising from, individual, domestic, industrial or any human activity which has no economic value. It can also be substances which requires disposal in order to maintain healthy environment. Akpu and Yusuf, (2009), were of the view that solid wastes are classified into two major categories the organic (biodegradables) and non-biodegradable (inorganic).

2.2.8 Read,(2001) considered solid waste a measure of human imperfection, which nations have been able to absolutely decouple from economic growth and like other developing nations finds it extremely difficult to develop initiative for relative control. Yusuf, (2009), noted that solid waste are generated majorly from clustered or nucleated household consisting mainly of food and yard wastes and the inorganic solid wastes majorly from the Government Reserved Areas (GRAs) due to capacity and purchasing power. This poses challenges and affects the healthy nature of the general environment. Nabegu, (2006) in an analysis of solid wastes characteristic identifies the following, food scrap, paper and card board, textiles materials, plastic materials glass remains and pieces, metal scraps, Ash and dust particles as well as vegetables as green waste that are biodegradable.

2.2.9 Similarly, Ibrahim (2006) identified population as the main determinant of the volume of waste generated per household. This clearly shows that the more increase in population, the more waste generated. An instance is environmental report of solid waste generated by some Nigerian cities in 2001 estimated volume of solid wastes for four years, 1982, 1985, 1990 and 2000. For Kaduna the estimated volume in tons are as follows 1982 (- 257, 837), 1985 (280, 925) 1990(324, 084) and 2000,(431,314) tons of

solid waste. The significant increase in volume of solid waste generated could be associated with increase in population and economic prosperity and improve standard of living or a flagrant neglect of manage.

2.2.10. Agboola, (1993).also submitted that other sources of solid wastes are commercial centre which produce papers, plastics, and other forms of packaging materials. Though, there is no specific source of solid wastes ordinarily sourced from non-point, it can be generated from a pointal facets and non-pointal facets depending on areas.The main concern in this research work is municipal solid waste management techniques.

2.3 MUNICIPAL SOLID WASTE MANAGEMENT

2.3.1.Suberu, (2012). significantly assessed the potentials of SWM(solid waste management) for power generation considering the route of thermo-chemical conversion as an alternative measure to land filling and open dumpsite of waste commonly practice in Lagos Metropolis. The premise for the research was quantity of solid waste generation in Lagos metropolis which symbolizes the greater opportunity for electricity generation in terms of energy from biomass of waste resources.

2.3.2 Seo (2004) identified four methods of Solid waste management, thus, landfilling incineration, composting, and anaerobic digestion. Incineration and composting are mere of reducing technologies, ultimately residues from these methods must be landfilled. However,sanitaryland filling is the cheapest means of solid waste management, but only if suitable land is within economic range of the source of the wastes; typically, collection and transportation account for about 75% of the total cost of solid waste management. Jisalo (2008) reported that on-site disposal has become increasingly popular during the

past decade as a way of minimizing the waste problems at its source. The most widely used devices for on-site disposal are incinerators and garbage grinder. Garbage grinders are becoming increasingly prevalent in homes for disposal of kitchen food waste garbage in flushed sanitary sewer system.

2.3.3 Botkin and Keller (1998) considered waste as a resource out of place since the waste can be reused, reduced and recycled. Recycling methods of solid waste management is the most efficient but expensive to operate. Joel, (2013) examined the pattern and techniques for managing municipal waste disposal and the consequent on the health of the population. The finding revealed that the unprecedented waste generation in the metropolis is spurred by population growth. That the major municipal solid waste include biodegradables, non-biodegradables, recyclables and inert materials. These were household and industrially generated waste materials. Finally waste were dumped at roadsides, channels and drainages and neighborhood uncompleted buildings and that very few used secondary dumpsite.

2.3.4. Baritone (1995) observed that in Nigeria solid waste management varies in many ways and the techniques adopted depend on the availability of equipments, skills, solid waste administration economy and weather. There is a burgeoning business in recycled items Aluminium melting, has been doing well in the local craft industries over the years, making pots out of discarded Aluminium products. Beverage cans in Nigeria are mostly made of Aluminium. Given the recent violent use for petrol and kerosene bombs they have been put to, the cans can generate suspicion from people. Has never faced any challenge, like people asking him what he intends to do with them, in view of their relation to violence in some parts of the north.

2.3.5. Schubeller,(1996) saw composting and anaerobic digestion of solid wastes as a source of biogas that contributes a lot to environmental problems. According to the author composting produces primarily carbon dioxide (CO₂)to general global warming and influence of one formation which causes decrease in agricultural production.

2.3.6. Burd, (2010) conducted a researched for solution on plastic as it takes a longer time before it degenerate. Plastics one of the most indestructible of manufactured materials for it to eventually decompose, plastics takes over 1,000 years to decompose, which means before a plastics decompose there must be micro-organisms to facilitate the decomposition. Burd, (2010) in an experimental research immerse plastics into the ground, along with yeast solution that encourages microbial growth and then isolating the most productive organisms. The preliminary results were encouraging, so he kept at it selecting the most effective strains and inter breeding them. After several weeks of temperature, oftweaking and optimizing temperature, bond was achieved at 43% degradation of plastics in six weeks, at almost inconceivable accomplishment. With 500 billion plastics bags manufactured each year and plastics growth that expands rapidly by day, a low cost and non-toxic method for degrading plastics is the staff of environmentalist dreams. In essence Burd developed a colony of microbes that eats plastics to cause degradation within the shortest time possible (Daily Trust, 2010)

2.3.7. Ibrahim, (2002) categorically stated that solid wastes are generated from unavoidable sources which are domestic or residential, commercial, industrial, agricultural and administrative centre. Industrial and residential areas generate the highest volumes of solid waste which are very difficult to manage.

Among all the classes of wastes (solid, liquid and gas) solid wastes is most popular and most difficult to manage locally because it does not flow, evaporate, diffuse, dissolve or be absorbed within the surrounding.

United Nations System in Nigeria, (2001) in a study on Nigerian cities described them as some of the dirtiest, most unsanitary and at least aesthetically pleasing in the world due to inadequate waste management. Only about 30 – 50% of generated wastes are collected in most Nigerian cities and recycling of waste is not practiced to a significant level. Botkin and Keller, (1998) considered wastes as resources out of place which implies that there nothing live waste but resources since it can be reused or recycled or be given a rethink. Many of our wastes management programmes simply involves moving waste from one location (Primary source) to another location (Secondary source) before eventually moving it to final dumpsites, where it is not actually being managed. Human populations are both concentrated in the rural and urban areas and both generates wastes.

2.4 CAPACITIES OF WASTE MANAGEMENT AGENCIES AT WASTE MANAGEMENT.

2.4.1. Mmom (2011) studied environmental sanitation and public health challenges of resident rapidly growing city of Port-Harcourt. The study that was instituted to identify diarrhea risk factors in Port- Harcourt to measure the prevalence of, and, understand the spatial distribution, revealed that a close nexus exist between urbanization, sanitation and public health. The study further revealed that diarrhea is prevalence at 14.4% which is attributed to poor refuse management and disposal within the vicinity in case study. According to Bankole (2004) solid wastes management situation in Nigeria can be analyzed using Mazmanian and Kraft epoch of environmental policy. Government

regulations of solid wastes management have been utterly ineffective, despite policies defining management goal minimal legislation. Nigerian government in the fledgling stage of epochs one, beginning to pass national involvement, development of an administrative infrastructure to regulate pollution establishment of pollution control measures as a national priority and end of the pipe management.

2.4.2. Mabogunje, (1988) was of the view that solid waste generated by human activities range from relatively innocuous substances such as food and paper wastes to toxic substances like papers, paints, batteries, asbestos, fibers, health care wastes, sewage sludge derived from water treatment wastes, high level radioactive materials, nuclear fuel rods (though not available around here). Other forms of solid waste are household Waste, municipal wastes, commercial wastes, construction and rubble wastes, (inert waste) as well as the Incinerated wastes and manufacturing waste.

2.5 CHALLENGES OF WASTE MANAGEMENT.

2.5.1. Sambo, (2008) claimed that it is no longer news that waste generated from homes and factories from homes and factories can be turned into wealth through the 3Rs (Reduce, Re-use and Recycle) processes and as such agencies and groups have advocated for the adoption of the process as a means of sustainable environmental management and boosting the economy of the country. As part of strategies to curtail the threat of global warming, the Federal Government of Nigeria has established different agencies and launched different campaigns in the fight for sustainable environment, yet Nigerians still indulge in indiscriminate dumping of waste, thereby leading to open burning of waste generated, instead of turning them into wealth and total management of the waste.

2.5.2 Seadon, (2006) the advocacy by different government and private agencies to explore the economic viability of waste in the country as a means of sustaining the country and improving the economy and health of the nation has been ongoing and yet much has not been done about the issue. What we have is rather an issue of collecting waste from one location to another without putting it to any good. In most societies, there is an overture in solid waste management with shift from just collection and disposal to making viable use of such waste by turning it to wealth. Many economies of the world have benefited from this approach, which has made the environment sustainable, and the degradation reduced. In Nigeria, turning waste into wealth is rather a cliché as there is no visible achievement. Government institutions, private agencies and stakeholders only pay lip service to the issue of turning waste into wealth.

2.5.3. Ukairo (2014) focused on how stakeholders have been actively involved in the development of practicable and efficient solid waste management system. This will include the waste-to-wealth programme. It must be noted that although this programme is essential and in line with global best practices, however, it will be like putting the cart before the horse by engaging in such at the moment without basic supporting infrastructure like the solid waste transfer stations and the availability of enough stock (solid waste) to feed a plant of such magnitude.” While many residents await a modern waste treatment strategy, several dumpsites have turned haven of scavengers who make a living thereof, picking metals bottles and other recyclables of interest to them. Solid wastes are disposed through landfill method while in some quarters they are burnt thereby contributing to environment degradation.

Ayantunji, (2014) reiterated that concerned citizen said the government could take a leaf from other developed economies that have integrated waste management into their system and turning it to a source of revenue instead of a liability. According to Wai-Ogosu,(2015) the National President of the Nigerian Environmental Society (NES), the environment in Nigeria today is under serious stress, it is being battered from all angles and because of inadequate planning, cities decay is setting in because of waste management problem. Waste management problem in all our cities. However, experts have identified the importance of having an effective waste management system in the country. Proper sorting of waste is expected to be done even before dumping by the residents. Sorting of refuse is one activity that is left in the hands of scavengers, and the most lucrative parts of the refuse to them is the metals and household appliance, while others are discarded. For effective waste management, the residents would need to be sensitized on sorting their wastes properly from homes.

2.5.4. Dauda,(2015) observed that waste management is not only a problem in Nigeria because the government or agencies are not doing what they should do, but because the problem starts with individuals. Many people do not know how to sort their waste and engage in indiscriminate dumping. “For us to turn waste into wealth, people have to do a lot of sane-wealth and of sensitization programme and enforce people to change their attitude towards waste dumping. Titilayo, (2014) mentioned that during the flag off of new centenary cleaner environment campaign recently in Abuja, there is need to sensitize the residents on how best to sort their waste. The author advocated for a reward method to resident who can sort their refuse properly, in order to encourage others to do it.

Walid, (2014) in ensuring a cleaner environment the role of advocacy and sensitization cannot be overemphasized. It is our hope that this would be sustained so that it will make the necessary impact and indeed form the desired attitudinal change for a cleaner Nigeria”, it follows, therefore, that the system is equally evolving, especially in the area of the use of adaptable technologies in line with global best practices. “Most developed and developing societies of the world are tilting towards the use of solid waste as a resource thereby creating wealth out of waste and minimizing environment degradation associated with aging system of open dumping”.

2.5.5. Ukairo, (2014), noted that for solid waste management to be sustainable there must be a waste management blueprint with medium and long term policies and guidelines. The author said it will guide relevant agency of government in the stage-by-stage implementation of adopted solid waste management programme. Initiatives that are paramount in SWM (solid waste,management) are reduced, process of modification or design change such as reduction (in levels of obsolete materials or replacement). Re-use (of materials such as drums, bottles, skips, spent oils pallets and constructions and demolition Waste). Recycle, (of scrap metals, lead and acid batteries, papers, stabilize materials used as slaps turning Aluminium into new products for re-use.). An overview of solid waste management in Nigerian complex. Therefore, MSW(municipal solid waste) management had continually been an intractable problem beyond the capacity of one tier of government. This has resulted into refuse heaps dotting the urban areas or landscape in heavily populated Cities as only about 30% of waste is being collected in Nigeria. (NESREA, 2009).

Transfer stations as a prelude to the subsequent construction and commencement of the waste-to-wealth project, perhaps under an arrangement programme. Solid waste recycling would not only present a source of revenue but it can also help in the fight against the depletion of the ozone layer. The emission of Green House Gases often resulting from open burning of waste indiscriminately by individuals pollutes the environment. Various environmental challenges of waste management in Nigeria can be attributed to the wrong attitude of the public, poor planning as a result of lack of will to do the right thing and lack of legal framework and enforcement of existing regulations. Ukairo, (2014). The best thing to do is to get the private public partnership involved in waste collection, sorting and disposal to help facilitate waste management and save the environment from further harm. The practice of recycling solid waste, has, however, been in existence for a long time“.The commitment of scavengers in picking up scraps from dumpsites and what they do with the picks is an indication of how important recycling is.”

2.5.6. Isah, (2014). The researcher added that the potentials of the waste, if properly managed, will create job opportunities amongst other benefits. However, experts are of the view that proper waste management will be of socio-economic benefits in terms of provision of jobs, reducing the adverse impact on health and eliminating the adverse effects on the environment through reducing, reusing and recycling. Similarly, Bonet, (2004) in a research on the causes of frequent occurrence of flooding of MoroRiver discovered that the inhabitants of Moro and nearby villages close to the upstream dump their waste products in the river, as such the solid waste often increases the volume and material the of the river such that during the rainy season the channel of the river becomes smaller and eventually overflows its banks and the whole nearby environment become floodedflashly.

2.5.7. Joel and Fansen, (2013) found out that Kaduna Metropolis is presently confronted with unprecedented challenges of managing waste, especially as it relates of problems to the collection and disposal, and suggest that in order to ameliorate this situation of municipal solid waste generation in Kaduna Metropolis proper solid waste management that is inclusive should be embarked upon. In most cities in Nigeria due to inadequate disposal points of solid wastes, the immediate environment such as uncompleted buildings, channels, drainages whether constructed or not, becomes constant dumpsites and this blocks most channels and drainages.

By the time the equatorial rain comes, water smooth passage becomes very difficult, and whatever level and situation water find its way by even avoiding the prepared channels to overflow into houses and overland, this leads to regular flash flooding of AbubakarKigo road area of Kaduna metropolis which occurs in a period of 5 – 10 years (Yusuf, 2009). In developing nations, a poor sanitary practice endangers human health and the environment (Mmom and Mmom, 2011).It is evident that 7% Of the world's death and 8% of the global disease burden are caused by disease related to unsafe sanitation (World Health Organization, 2012).Poor hygiene, mismanagement of solid waste and lack of sanitation facilities accounts for 50% of death caused by disease burden which is seen as more in the world poorest countries (Cairncross, 1996).

2.5.8. Salhofer (2001) reiterated that waste generation rate is a very important number concerning development and controlling of solid waste and its management in a given environment. It represents that data base for the planning of treatment and disposal of solid waste and as well as collection efforts. Several factors are responsible for solid wastes generation, individuals, households, commercial outfits, industrial growth

aspirations. Waste is not just an environmental issue as many people still believe, it's a threat to human health since a dirty environment is such that breeds or cause epidemic disease in a given environment such as malaria carries vectors, cholera, typhoid fever etc. Annan, (2001). Although, refuse disposal and waste management are the constitutional responsibilities of the local and state governments, it has become obvious that they are flagrantly incapacitated because they don't have the financial strength nor do they have the required human resource skills and organization to effectively tackle the problem. The matter is made worse for the metropolitan cities that have more local governments than others. Each of the local government councils doesn't have the resource base and collaboration by way of joint administration has been politically impracticable. The inadequacies in management of waste had turned into a monster in most urban centres in Nigeria.

2.5.9. Babatunde, (2009) pointed out that solid waste are main source of food for rodents, and related reptiles. These quickly proliferates and spread to other neighbouring houses and eventually becomes vectors of diseases. Lassa fever, (contact with rodents droppings) trichinosis and histoplasmosis, snakes on a vantage position may transmits a deadly venom (snake poison) which may affects the normal health of individuals within the environment. Nwankwo, (2004) sees indiscriminate dumping of solid waste as the main causes of some deadly diseases. A research conducted in Jere in 2006, on wastes and its effect on the environment shows that most of the ailments cases at the primary health care centre were as a result of waste disposal at wrong location, especially on drainages, dumping close to sources of water point that most people utilizes for their domestic purposes.

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 INTRODUCTION

This chapter conceptualized the study area and the methodology of this research work. It considers the study area under the following themes. Location and physical settings, climate, soil and vegetation, relief and drainage, people and socio-economic activities such as agriculture, commerce and industry, sports and recreation, education, health, water supply and transportation and communication the methodology comprises nature of data, data sources, sampling techniques and method of data analysis.

3.2 THE STUDY AREA

3.2.1 Location and size

Kaduna has a literal meaning of “Kadduna” the plural of (crocodile) because, the number of crocodiles were found along the river Gurara banks, a river that crosses the main town of today's Kaduna. Kada means a crocodile and Kaduna (plural of crocodiles). This is the historical origin where Kaduna got its name. The location of Kaduna is on latitude $7^{\circ}25^1E$ and latitude $7^{\circ}25^1E$ and on longitude $10^{\circ}25^1N$ and $10^{\circ}32^1N$ and was created in May, 1967 (from the former north central state) and was further subdivided into Kaduna and Katsina states in 1987, with the capital remains Doka with a land mass of $46,053 \text{ Km}^2$.

Kaduna North LGA is a central local government area in the heart of Kaduna main town with its headquarters at Doka village. The local government area has a land mass of 72 km^2 . Kaduna North LGA is a city undergoing rapid expansion in economic growth,

population and urbanization characterized by high density and low income populations especially in the indigenous core areas, this is due to better job opportunities and rising or improved standard of living.(Akos, 2015). Kaduna metropolis has been ranked number 13 on the list of the most populous cities in West Africa and number 5 among Nigerian cities behind Lagos, Kano, Ibadan, and Abuja.The city has been over the last few years experiencing rapid physical growth with an annual growth rate of 5.72% (Akpu and Tanko, 2012).

Kaduna is an industrial centre of the northern Nigeria, so many products are manufactured in Kaduna which include textile materials, machineries, Steel processing and Aluminium products. There is also a refinery which refines petroleum products, others are bearings and pottery is highly prized from Kaduna; especially from Nokculture .

The main high way through the city is Ahmadu Bello way. Many of the places were named from the past Sultans, Emirs and decorated civil war heroes, while others were named after the majority tribes that inhabit such places such as Unguwankanawa, Barnawa, Unguwan Fulani. Kaduna north has a large market rebuilt after the great inferno of 1990s named as Chechnya market.

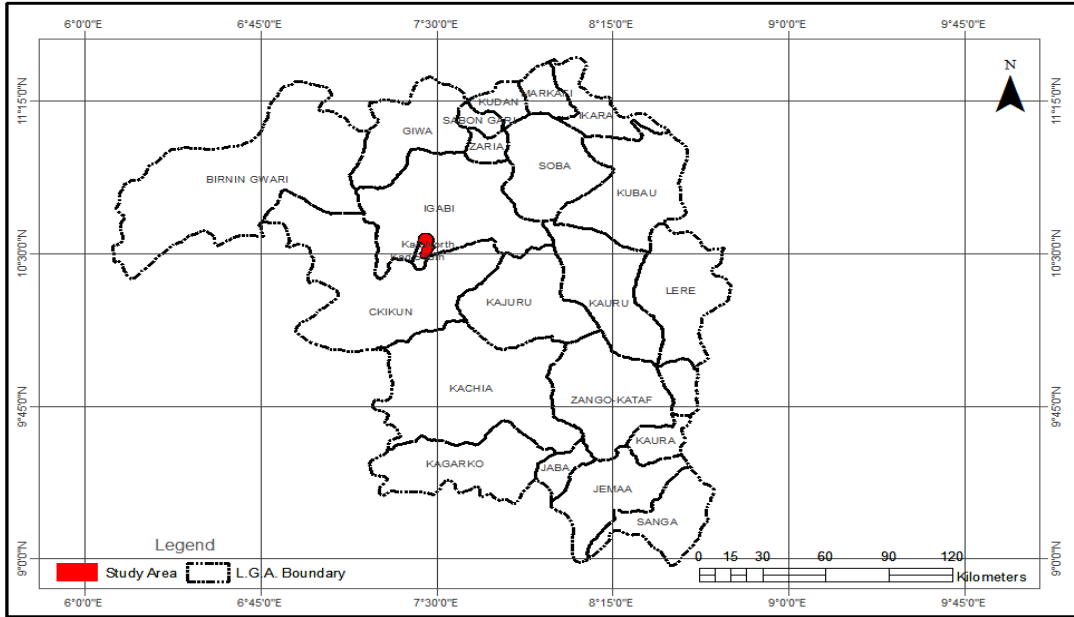


Figure 1 : State showing Kaduna North inset.

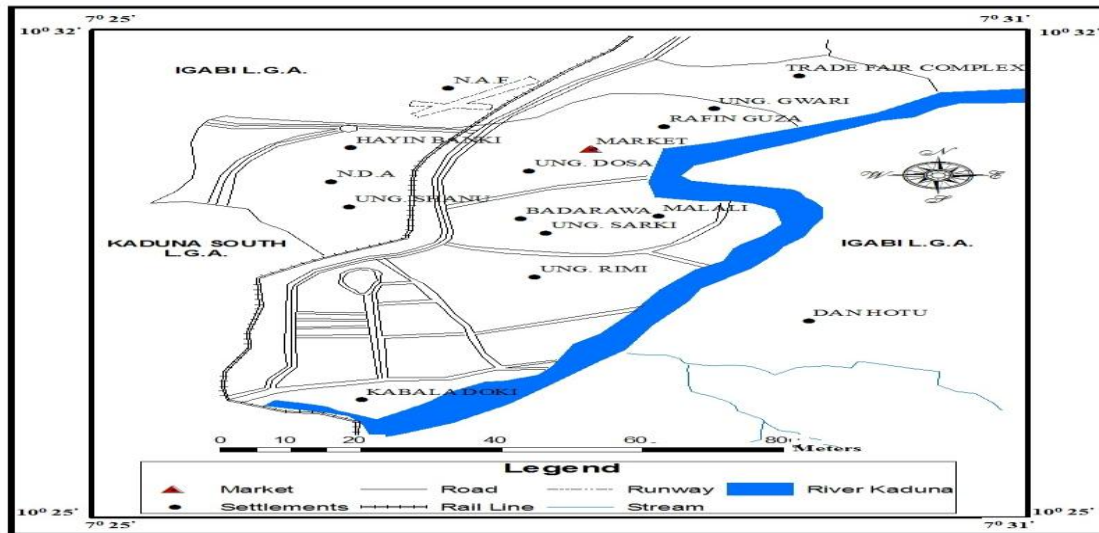


Figure 2: Kaduna North LGA Showing Study Area.
Source : Ministry of lands and survey

3.2.2 Physical Setting

Kaduna north LGA is located on the Hausa-plains of Northern Nigeria. Though, a clustered settlement, generally Kaduna north LGA does not experience variety of agricultural practices due to its urban nature. The major drainage is the Gurara River which cut-across the main town along the side southern axis of Ahmadu Bello Stadium and a number of minor tributaries. Kaduna north LGA shares similar characteristics with Kaduna metropolis hence discussed within that frame.

3.2.2.1 Climate

Kaduna metropolis has a tropical continental climate (Aw) with distinct wet and dry seasons reflecting the oscillation of Inter-tropical Convergence Zone (ITCZ) which is a clear zone where moist tropical maritime air mass (mT) meets dry tropical continental air mass (cT). The mT originates over the Atlantic Ocean, while the cT originates over the Sahara Desert. Northward incursion makes cT to prevail in the area and this marks the rainy season. The zone is characterized by relative moderate temperature of between 27° - 35°C during the extremes of the year in the months of April to May.

The rainfall received in this zone is about 1750-2000mm during the course of the year with intense rainfall received in the months of June through to August, which eventually fades from September to October. The dust-devil is always experienced from the month of January to February which is accompanied by intense cold and very thick layer haze which reduces visibility for about between 2-3 kilometer. Sani, (2015). The rain has the advantage of causing fast decaying of biodegradable waste thus reducing the quantity of

waste and as well add manure to soil voids and increase farm yield, to some controlling the generation of solid waste in the study area.

3.2.2.2 Relief

Kaduna Metropolis is an area which is part of the extensive but gently undulating peneplain, capped at high elevation by patches of laterite terraces of iron oxides concretions of broken up concretion of ironstones and some quartz. Jatau, (2013) The eastern part of the city which is mostly bounded by the River Kaduna has a mean elevation of 550m above mean sea level. The north western part is comparatively higher with mean elevation of 620m above mean sea level.

3.2.2.3 Geology

The geology of Kaduna metropolis is typically basement complex rocks comprising of high grade Igneous and Metamorphic rocks. These are made up of magmatite, mica, and quartzite, schist, granite-gneiss, biotite, prophylicbiotite and grandiorite.(Sani, 2015).Weathering of such crystalline Basement Complex rocks under tropical conditions are well known to produce a sequence of unconsolidated materials whose thickness and lateral extent vary extensively (Dearmaun, Dayness and Irfah, 2001).

3.2.2.4 Drainage

Kadunametropolis is drained by river Kaduna which divides the city into North and South and its major tributaries.River Romi with its wide and steep valley in the East and River Mashi in the west.Other tributaries include Ruruwai, Keke, Danhonu, Kuba and Kuyi. (Jatau, Fadel, and Agelaga, 2013). After passing through Kaduna Metropolis River Kaduna moves southwards to Zungeru and finally into River Niger near Pategi.

3.2.2.5 Soil and vegetation

The soils around the study area are majorly loamy and patches of Ferralitic soils at the Boundaries with the Igabi local government area. Though, little agricultural practice is being carried out due to the clustered nature of the settlement, agricultural practice is not Pronounced. Though, there patches of black earth which are all good for agriculture and local construction houses using the available Ferralitic soils. The vegetal species in this area are mostly ornamental and hedges. There are abundant tall grasses (*Andropogon Gayanus*) used in fencing and thatching and related decorative outfits (culturally based). Others include *Aristida Pennisetum*, *Ctenium Terminalia*, and *Acacia spp.* However, human activities associated with urbanization have seriously modified the vegetation composition and amount to the extent that now, Trees are mostly often found as ornamental ones and comprising of exotic species. There are patches of interspaced vegetation such as whistling trees, Mango *mangifera Indica*, Sheabutter, *Isobertina Doca*, Maligna species, Eucalyptus and Neem trees which are partly of medicinal values. The waste generated add value to the soil as organic matter which enriched the soil for effective agricultural practice. This reduces the content and quantity of the waste generated in the study area.

3.2.3 People

The people of Kaduna North are enterprising simply because the people are mostly heterogeneous, because all human aspects of Nigeria are found in this local government along with the indigenous tribes. The dominant people are the Hausa-Fulani's, Gbagyi who are the origins of Kaduna Town, Adara, South Ward, Agworok, Bajju, Kaninkon, Atyap, Jabas as the origins of Kaduna, outside these tribes, the major tribes are

Yorubas, Igbos, Idomas, Igala, Ebiras few Efik, and Ibibios tribes. All practice one or the other type of trade to keep body and soul together. The population of Kaduna State is 6.066 million people and Kaduna north is 361,694 people on expanse of 72Km² The Kaduna northlocal government area capital isDoka village

3.2.3.1.Agriculture

Agriculture is not so pronounced because of the clustered nature of the settlement because of urban set-up. Poultry is the most practiced type of agriculture virtually found in most houses, in some places are large farms that can contain about 5,000 - 10,000 birds. For now quail birds are reared in most houses because of the medicinal and commercial value of their eggs which are sought for every now and then. People from Abuja do comes to Kaduna north for Quail eggs for their medicinal value and others demands for hatchery for sale to others, but most importantly the requirement of the eggs for its medicinal value. In the GRAs, (government reserved areas)grapevine farming is also practiced and products taken to Abuja and partly sold in Kaduna, but most of grapevine are taken to Abuja. There are also cowpea, sugarcane farms here and there. Perennial fruits such as citrus, mango and guava are also farmed.Sani, (2015).

3.2.3.3 Commerce and Industry

The Abubakar Gumi and Chechniya markets are located in Kaduna north local government area because of its central location, thus, most commercial activities are centred around these markets. Rural people come in to purchase retail products and bring in a number of vegetable requirement in an interdependence. Petty traders are also found outside the markets set-up. Other markets location are Kawo, that weekly opens on

Tuesday, UngwanDosa, opens on Saturday, UngwanKanawa opens weekly on Fridays but UngwanRimi is always a market daily because it's a major market.

Kaduna north LGA used to have some industrial outfit, but the economic melt down had forced some industries to close or shut down, but even then there are some that are still functional. Among these are Dicon, (defence industry corporation of Nigeria) on the main street (Ali Akilu) road, produces military warfare, Dabo Motors, New age Networks, Nigerian Television. A.J. Suleiman (an electronic gadget marketer). DITV (desmims independent television) Brilla FM (a sport radio outfit) State radio stations sited at strategic locations in Kaduna north. Famous banks in Kaduna north are First Bank Nigeria Plc, Keystone bank that now bears Mainstreet bank, Keystone bank, Union bank, EcobankPlc, Skye bank, Spring bank, Insurance companies etc.

3.2.3.4 Education and Health

Kaduna State is tagged as centre of learning because of numerous institutions that are found within the territory of the State. Some prominent secondary schools are Airfoce secondary school, Kaduna Polytechnic Demonstration secondary school, Government College Kaduna, Kaduna Teachers' College, Sardauna Memorial College etc. Higher places of learning are College of Education (Jama'atu) UnguwanSarki, Kaduna State University, State Teaching Hospitals, Nigeria Defence Academy (NDA), Nigeria Teachers' Institute Training Centres at Kawo. Health Institutions includes Nursing Home, General Hospital Kawo, Kaduna State University Teaching Hospitals and very many Primary Health Centres around the local government. There are also some private clinics such as Giwa Hospital, Chasel Clinic, Alba Clinic, Rakiya Hospital etc. Water supply is mainly from the State Water Board newly located boreholes, wells around the local

government. Due to so many institutions in the study area this generates a lot of papers as waste, though biodegradable it can also be combusted to help in management of the waste in the study area and can as well be recycled by paper mills in Kaduna North.

3.2.3.5 Transport and Communication

Road connectivity in Kaduna north are well connected, it has a major route across called Ali Akilu and Ahmadu Bello Way, a partially functional railway system (though operating locally) One local and an International Airport located at Afaka village around Mando area and Airforce and tactical Command base. All these physical and human elements and their use or unused generate different forms of municipal solid wastes. This is because human use the physical materials to generate socio-economic activities that leads to solid waste. Though there are cluster of transportation in the rush hours, a lot metal waste are generated which calls for management in the study area and depending on the type of the metal it can be recycled at Tafa near Abuja.

3.3 METHODOLOGY

3.3.1 Reconnaissance Survey

The researcher carried out a reconnaissance survey in October, 2015. It helped in getting familiar with the study area. Some spot assessment were made with respect to the economic activities of the people that generate waste. Other activities done included visiting the dump sites of the solid waste and preliminary interaction with residents of the study area. The outcome of the reconnaissance survey guided other aspect of the research.

3.3.2 Types of Data

- i. Household solid waste characteristics, waste generation and management technique for different categories of waste.
- ii. Capacity of solid waste management institution to manage the volume of waste generated.
- iii. Bio-physical and socio-economic characteristics of Kaduna north and prompt generation of Waste.
- iv. Data on challenges faced by individuals and agencies, capacities and challenges of waste management techniques. Management of waste such as staff strength, operational capacities, machineries and so on.

3.3.3 Sources of Data

The data for this research were primarily sourced. The primary sources of data include questionnaire administration, field observation, and personal interview with the respondents. Literature materials were obtained from the internet, journals, Unpublished materials, Magazines, Serials and other related literature materials and Newspapers.

3.3.4 Sample and Sampling Techniques

The study area has a population of 367,694 thousand (NPC, 2009). It covers five wards within the Kaduna North Local Government area namely: HayinBanki, Unguwan Dosa, Badarawa, UnguwarSarki, UnguwarRimi. The sample size is based on population of the study area. The Krejcie and Morgan (1970) table of determining sample size was conducted and adopted where an area with population between 75,000

and 999,999, the sample size could be 385. Hence for this study 385 samples were use

To determine the sample size for the study. (Yamene, 1976)

$$\frac{N}{1 + N (0.05)^2}$$

Where N= Total population understudy 0.05 or (5.0%) is accepted error margin.

The total population of the five selected settlement is 361,067 using the formula above gave rise to the breakdown on 385 respondents was sampled (see Table 3.1). More so to obtain the proportion of questionnaires to be administered in the selected settlement (Yamene, 1976) sampling method for determination of respondent was used.

Where n = population of each selected settlement

N = Total population of selected settlement

The purposive random sampling and sampling techniques was considered more appropriate for identifying cases for detail investigation (Abumere, 2002;Suleiman, 2009) and was then adopted. Copies of questionnaires were administered to the people in the selected settlements until the total number of questionnaire assigned to those wards were achieved.

The National Population Commission (2006)population census figure was projected to 2015 and the projection was done using Kaduna state growth rate of 3.5% using the formular (NPC, 2009).

$$P_o = p_t$$

Where:

p_t = population in the later period

p_o = population in the earlier period

n = time interval between the two period

r = rate of growth

e = exponential sign

Table 3.1 :Sample Size per settlements

S/No	Wards	Population selected areas	of Estimated Population 2015	No Questionnaire Administered
1	HayinBanki	90,000	96,55290	90
2	UnguanDosa	85,000	93,26480	80
3	Badarawa	75,000	83,96076	76
4	UnguanSarki	70,000	78,62075	75
5	UnguanRimi	41,067	49,16864	64
Total		361,167	515,822	385

Sources: National Population Commission (NPC, 2009)

4.5 Method of Data Analysis

The study made use of descriptive statistics such as the of mean, averages, frequency distribution, and percentages to summarize the data in tabular forms for easy analysis and interpretation. Data will be produced such as graphs and charts that will produce the result of research clearly.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

This chapter presents the results obtained from the administration of questionnaire in order to analyze the domestic solid waste management principles in the study area. It includes the demographic and socio economic characteristics of the respondents, types of domestic solid wastes generated in the study area, domestic solid waste management principles employed in the study area, key players in domestic solid waste management in the study area, effectiveness of the domestic solid waste management techniques employed in the study area as well as a comparison of the types of domestic waste management practices. The chapter is arranged in subsection for systematic presentation.

4.2 DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS.

The data obtained from the field showed that 58% of the respondents were males, while 42% were females. This pattern could be traced in part to social and religious factor as a result of less dominant role performed by women especially in Northern Nigeria where a microcosm is the area. According to Jiggins (1994) women's perspectives and values for the environment are somewhat different than men's. Women give greater priority to protection of and improving the capacity of nature. Dankelman and Davidson (1998) also observed that women play a key role in managing their natural surroundings and adopt several mechanisms to deal with the kinds of environmental crisis they face. In addition, Akwa, (2009) noted that women are generally responsible for human waste disposal of children and cleanliness of latrines and other facilities. Men, on the other hand, tend only to handle waste when they are paid for it, or when it is specific to their activities.

The age distribution of the respondents showed that 8% were less than twenty years of age, 22.3%, 39.1%, 23.5% and 7.0% were between 20 -30, 31-40, 41- 50 and above 50 years of age respectively. This showed that majority of the respondents (about 92%) were above 20 years of age and were able to provide the information necessary for the study. This age distribution corroborates (Olorunfemi, 2009) in that adults can speak authoritatively on behalf of their family members on issues relating to waste generation and management. The information provided by the respondents were therefore valid representation for the entire household

Similarly, the study shows that the respondents who had attained Quranic and Primary education constituted 37% while the respondents who have attained secondary and tertiary education constituted 63%. This shows that the level of literacy in the study area is high due to the concentration of higher institutions of learning, secondary schools and the migration of educated people in search of employment opportunities and this could have a positive impact on their perception of waste in general and its management techniques.

Also, the study shows that about 13% of them were farmers, 40% , 28%, 6% and 10% of the respondents are businessmen, civil servants, house wives and other activities such as carpentry, driving and welding. This shows that they were engaged in one form of activity or the other that could generate waste. The level of income an individual earns could greatly influence the amount of waste generated. Thus, information on the respondent's monthly income showed that about 12% of the respondents earn below ₦ 20,000; 24%, 42% and 19% of the respondents earn between ₦ 22,000- ₦ 37,000, ₦ 42,000- ₦ 57,000 and earned above ₦70, 000 respectively. Their income levels show that

over 50% of the respondents earned above ₦ 60,000 (above the Nigerian minimum wage) and therefore, have the capacity to generate household solid wastes. According to (Adedibu and Okekunle,1989) personal income influences waste generation due to its impact on individual consumption pattern. In addition, the rate of solid waste generation per capital increase as the standards of living improves. The management techniques such as composting, incineration and recycling is not yet properly put to use, where the management techniques is not sustainable. Majority of the waste materials are disposed on daily basis and respondents complained that the management system is poor.

4.3 CHARACTERISTICS OF MUNICIPAL SOLID WASTE GENERATED IN THE STUDY AREA.

Results in Table 4.1 shows the distribution of the kinds of solid waste generated in the study area.

Table 4.1 :Types of Domestic Solid Wastes Generated in the Study Area

Type of waste	Frequency	Percentages (%)
Paper	76	23.24
Organic	234	71.56
Plastic	9	2.75
Metal	4	1.22
Textile	3	0.92
Others	1	0.31
Total	327	100

Source: Field Survey, 2015.

Table 4.1 observed that about 72% of all the domestic solid waste generated in the study area were mainly organic wastes in nature, or rather garbage in content with about 85%

water content in the area for the fact that the vast majority on the inhabitants of the constituted the low income earner and partly the have nots (poor people) whose daily consumption of food were largely from the organic items, where the items were food waste and yard waste. The waste materials generated were mostly garbage which microbes' acts on to cause decomposition of the waste and the waste materials had about 80% water content which makes heavier than the rest of the waste matter found in the study area. Partly composted waste are bagged and taken to farms to add to the organic matter content capacity. Also 23.24%, 2.75%, 1.22%, 0.92% were from paper, plastic, metal and textile wastes respectively. The paper waste can be combusted to reduce the waste materials in the study area and can be left to decompose on its own in the presence of moisture and slight heat and is attributed to the presence of Kaduna State University (KASU) at UnguwanRimi in the study area, as students tend to generate



Plate 1: showing loading of metal waste to recycling industries at Kawo.

Source : Field survey, 2015

paper waste from photocopied materials(plate. 1) and others are empty boxes from packaging of materials, compound wasteleathers and used basket from other



Plate 2 : Showing a huge collection of waste heap which has collected without disposal for years.

Source : Field survey, 2015



Figure 3: Routine Waste collection at Kawo motor parkby rear truck collector.Source: Field Survey 2015.

This means that a very large percentage of the domestic municipal solid wastes generated in the study area were biodegradable material because of the high density per square kilometer and the nature of food consumed and of course the purchasing differs among settlers were about 96% compared to the non-biodegradable wastes generated in the study area about 4%, and this is because feeding habits between the rich and the poor vary to a great extent due to consumption of packaged and processed foods and value high purchasing power. In a similar study in Calabar, Afangideh, Kinuagbeye and Atu (2012) reported that majority of the wastes generated in Calabar were biodegradable waste compared to non-biodegradable waste which when decomposed and can be harmful to human health

4.4 THE MANAGEMENT TECHNIQUES FOR MUNICIPAL SOLID WASTE.

The results on the various techniques for the waste management in the study area are as shown in Table 4.2

Table 4.2: Domestic Solid Waste Management techniques in the Study Area

Techniques	Frequencies	Percentage %
Burning	71	21.71
Burying	52	15.90
Open dumping	202	61.77
Others	2	0.61
Total	327	100

Source: Field Survey, 2015.

From the Table 4.2 it can be deduced that the major domestic waste management techniques employed in the study area are open dumping, burning and burying. About 62% of the respondents dump their wastes openly, This is not the best practice for solid waste management in the study area, such waste are dumped in any open field irrespective of whether the open land was a plot or an uncompleted building in the area. About 22% bury their wastes while about 16% burn their wastes. Efe, (2010) a similar research reported that there were no authorized dumpsites in Ughelli and the major method of waste disposal are open dumping, land filling and dig and bury. Plate 2 presents black soil/relics of burnt waste in Badarawa area.



Plate 4 : An area in Badarawa where partly decompose biodegradables with soil particles (ready for use as manure in the Farms.)

Source: Field Survey 2015.

This is an indication that most residents dump their domestic solid wastes on the streets, gutters, channels or any available open space or any uncompleted building where the organic aspect of the waste decomposes. Open dumping could be a source of health problems for the residents and can make roads inaccessible by obstructing the free flow of traffic. It can also lead to flash flooding due to blockage of gutters and other water channels during the rainy season. Burying is also carried out in the area especially around the Nigeria Defence Academy,(NDA). What all the residents do is to dig a hole and throw their wastes there and cover it when it is filled up, but it is not a practice of composting of waste because the appropriate steps for composting were not taken. Some of the residents reported that burning their wastes is convenient for them but it causes air pollution by releasing Dioxin and Furan into the atmosphere as a result of constant burning of mixed collection of waste in the environment.

This shows that managing domestic solid waste such as recycling and proper composting and incineration are not fully carried out in the study area and the exploration and use local initiatives and techniques which could go a long way to improve solid waste management is not carried out in the study area. It is also an indication that the domestic and commercial solid waste management techniques in the study area do not conform to sustainable waste management strategy. According to Ayo, Ibrahim and Mohammed, (2010) the domestic solid wastes management techniques usually adopted developing countries result in significant threats to human health and the entire environment in the study area.

4.5 CAPACITIES OF SOLID WASTE MANAGEMENT AGENCIES IN TACKLING CHALLENGES OF WASTE MANAGEMENT.

Though the State and Local governments could not properly sustain the general clean up of the waste, private solid waste managers were brought in to partake in pay as you throw in order to achieve the third objective of the study, the results on the key players in domestic solid waste management in the study area is shown in the Figure 4.1. It has become very glaring that both state government and local government authorities could not effectively manage the continuous generation of solid waste which allows for private hands to come on pay as you collect basis. The percentage of individuals and private organization explains the inadequacies of solid waste management in the solid waste management issues. The incapacitation results from inadequate technical and material equipments to effectively manage the solid waste in the area in question

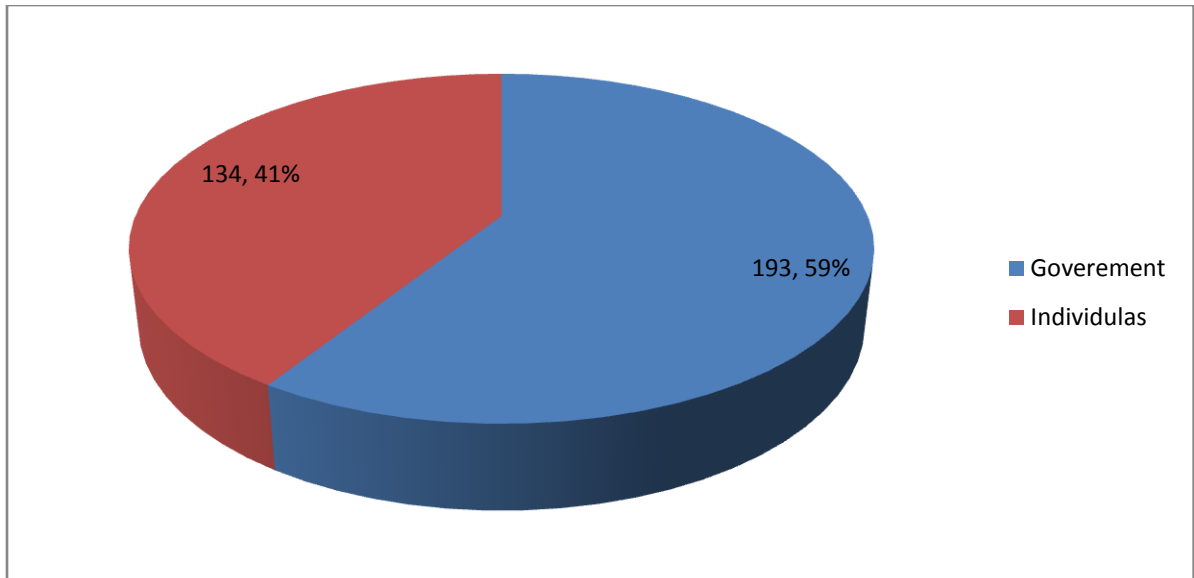


Figure 4: Key Players in the Domestic Solid Waste Management in the Study Area.

Source: Field Survey, 2015.

TheFigure 4.1, showed that 59% of the respondents reported that the government plays a key role in managing domestic municipal solid waste in the study area through the Kaduna State Environmental protection Agency (KEPA) while 41% of the respondents reported that individual households play a key role in managing domestic solid waste in the study area through different avenues like the use of trucks and wheel barrows to Secondary dumpsites. This shows that the private sector participation in managing domestic solid wastes is glaring in the study area. See references in plate :3.



Plate 5: Solid waste managers at Kawo in Kaduna North collecting routine wastegenerated at Kawo for dumping at final dumpsites.

Source: Field Survey, 2015

4.6. THE EFFECTIVENESS OF THE MUNICIPAL SOLID WASTE MANAGEMENT TECHNIQUES IN THE STUDY AREA.

The results on the frequency of waste generation and disposal in the study areas shown in the Figure 4.2. It is glaring that most of the wastes generated in the areas where majority of the people are poor and feeds mostly of foods that contain much organic content and garbage where it explain the reason behind the bulk, the daily generation of waste become paramount.

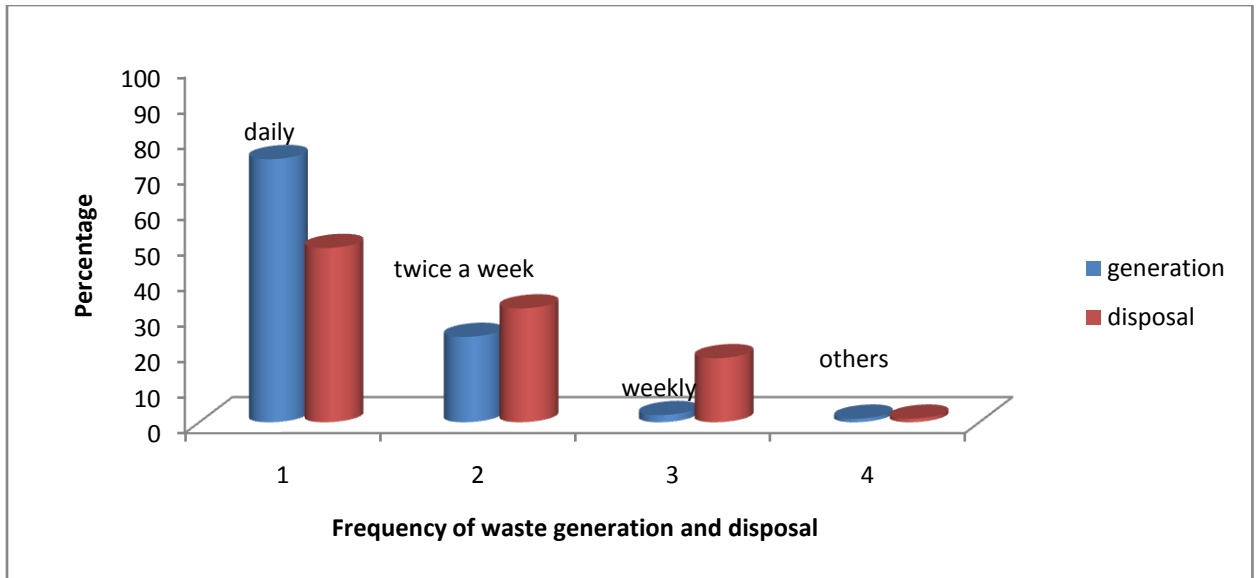


Figure 4.2: The frequency of waste generation and disposal in the Study Area.

Source: Field Survey, 2015.

Figure 4.2 explained that about 75% of the respondents because of the clustered nature of some wards in the study area the inhabitants disposed their wastes daily, about 24% and 2% disposed their wastes twice a week and weekly respectively on pat as you throw basis. Also, about 49% of the respondents dispose their wastes daily while about 32% and 18% disposed their wastes twice a week and weekly. This implies that the rate of waste generation is greater than the rate of waste disposal.

This shows that the residents in the study area are exposed to domestic solid wastes for longer periods of time than necessary. Most disposal takes place in the clustered areas of the study because of the constant generation of waste materials that mostly constituted majorly organic materials. This has resulted in accumulation of mixed waste streams in many areas (see plate 4). This was also coupled with the fact that in the government reserved areas less is being disposed off as a result of high purchasing power therefore disposition would be much along with peculiar generation. The percentage generation

and subsequent disposal would go hand in hand as management issues and environmental sanitation.



Plate 6: Mixed waste stream by the road side at Hayin Banki awaiting routine evacuation . **Source : Field Survey, 2015.**

According to Agbede and Ajagbe (2004), these wastes could provide breeding grounds for pathogenic organisms, attract insects and rodents and could even breeds Mosquitoes larvae which eventually grows to maturity and transmits malarial causative organisms and cause health problems to these residents. Table 4.3.shows the perception of the residents effectivenessof the solid wastes management techniques in the study area. This endeavours to find out from the respondents the effectiveness of general management of domestic solid waste within the study area. Majority were notsatisfied with the management as shown on the Table 4.3. While about 46% were those that have access to

relatively good management of waste in the study area with respect to GRAs and road sides.

Table 4.3 Perception of domestic solid waste management techniques in the study area

Value	Frequencies	Percentage %
Not Good	176	53.82
Good	140	42.81
Very Good	11	3.36
Total	327	100

Source: Field Survey, 2015.

Table 4.6, about 54% of the respondents reported that the domestic solid wastes management techniques in the study area are not good that is as it relates to collection and disposal, while according to 43% and 3% of the respondents, the domestic solid wastes management techniques in the study area are good in terms collections and very good when individual and private solid waste managers services for payment based agreed terms. When the respondents were further asked if the Kaduna State Environmental Protection Agency, (KEPA) was effective in the management of wastes in the study area, about 72% reported that KEPA was not handling the wastes effectively while about 25% reported that they were effective in handling the wastes.

The assessment of KEPA in the study area shows that more has to be done on waste collection and disposal and overall management of the waste generated in the study area.

It is obvious that the management and control of waste in the study area. The State

government in conjunction with the local government authority jointly endeavor to manage too a much waste in the study area and private and individual organization has to come in on a public private partnership approach to augment the current effort of the tiers of government. In some areas incinerators are not properly used (plate 5) while government agency appears to be evacuating the waste pilings (plate 6).



Plate 7::An incinerator in the study area where papers and related waste are burnt to clean up the environment.

Source :Field Survey, 2015



Plate 8: Weekly collected waste being evacuated at UnguwanRimi by the joint effort of State and Local government council.

Source: Field Survey, 2015.

Jha and Murthy, (2002) suggested that modern waste management presents a high level of complexity that requires many aspects to be considered for a suitable solution that encapsulates both the current state of the environment as well as its potential to provide support for future generations. Similarly, Onibokun and Kumuyi, (1999) noted that problems in cities have become burdensome despite efforts being made by city authorities and governments. Sustainable development according to World Commission on Environment and Development, (1987) refers to development that meets the needs of the present generation without compromising the ability of future generations to meet their needs. For sustainable development to take place, it means that wastes need to be managed effectively. Thus, it entails a sustainable solid waste management techniques that is environmentally, financially, and socially appropriate and acceptable.

Green waste, yard waste, plastic wastes, the domestic waste and the flying around types such as papers, leathers, used clothes, textile material, commercial waste, residential waste, manufacturing and processing waste, agricultural waste abounds in the study area. Management strategies in place in the study area are burning, burying and open dumping. And others. The key players involved in the management of wastes in the study area are the government, individual waste managers, private companies and households. The techniques of managing domestic solid wastes in the study area were found to be inefficient and unsustainable.



Figure9 : Leathered and other material waste at UnguwanDosa within the SMC(Sardauna Memorial College) premise.

Source : Field Survey, 2015.

These are mostly material waste that are generated around UnguwanDosa and environment. These collect over the years unnoticed by government agencies. Recently local farmers are sifting and utilizing the part composted waste as organic manure to improve farm yields.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This section gives a summary of the study carried out by the researcher, the conclusions based on the findings from the study, as well as the recommendations from the study for further research and policy development for sustainable environmental management.

5.2 SUMMARY

Green waste, yard waste, plastic wastes, the domestic waste and the flying around types such as papers, leathers, used clothes, textile material, commercial waste, residential waste, manufacturing and processing waste, agricultural waste abounds in the study area. Management strategies in place in the study area are burning, burying and open dumping. And others. The key players involved in the management of wastes in the study area are the government, individual waste managers, private companies and households. The techniques of managing domestic solid wastes in the study area were found to be inefficient and unsustainable. The study analyzed municipal solid waste management techniques in Kaduna North Local Government area of Kaduna State, Nigeria. It was discovered that no study had been carried out to analyze the municipal solid waste management techniques in the study area which brought about the need for this study. The aim of the research was to analyze municipal solid waste management techniques in Kaduna north local government area of Kaduna State, Nigeria and this was achieved through characterizing the types of domestic solid wastes generated in the study area, examining the domestic solid waste management strategies employed in the study area, identifying the key players in domestic solid waste management in the study area and ascertaining

the effectiveness of the domestic solid waste management strategies employed in the study area and comparing the types of domestic waste management strategies and their effectiveness in the study area. The rate of waste generation was found to exceed the rate of waste disposal in the study area because the frequency in which the residents generate domestic solid wastes was higher than the frequency in which they dispose the domestic solid wastes generated.

5.3 CONCLUSION

Waste pickers or scavengers in the informal sector have been fighting poverty through scavenging and creating new areas of employment as well converting waste to wealth as in the many develop societies. In essence, this leads to job creation, poverty reduction, Raw material sourcing at reduced cost, resource conservation, pollution reduction and general environmental protection.

The findings of this study showed that the techniques of municipal solid waste management adopted in the study area does not conform to sustainable waste management techniques which results in environmental pollution, degradation and health risks. This implies that much attention has not been given to municipal solid waste management in the study area. To ensure a healthy environment, municipal solid wastes need to be properly managed to control or limit pollution; this therefore calls for urgent precautionary measures to protect the population against the adverse impacts of pollutants as well as degradation of the environment.

Researchers willing to carry out further studies can analyze barriers and success factors affecting the adoption of sustainable municipal solid waste management techniques in the study area, analyze the effect of municipal waste management techniques.

5.4 RECOMMENDATIONS

From the findings of the research work, It is therefore, recommendable that the products of green waste and food waste should be properly harnessed to generate heat, biogas fuels, electricity in the nearest future as it is being achieved by most developed nations of the world. There is inadequate consensus as to whether the term should apply to re-use, recycle, reduction or refurbishing industries or only to products that cannot be used for its initial intended purpose, informal processing of electronic waste in developing countries of the world may cause serious health and pollution problems though these countries are also most likely to re-use or repair electronic scraps such as stale computers, music sets, stale GSM sets.

It was also rightly observed that other forms of material solid waste such as the Aluminium related products could be put to new materials for further use in the local environment such as melted aluminum pots, spoons, metal gates decorations. Based on the above the findings of this study following recommendations would be useful for further research work.

- Partially composted solid waste (mixture of sand and organic) should be used constantly in our farms as organic manure to improve farm yield and its quality. Improves capacity building in training the solid waste management and encourage best practice to sanitize the environment.
- More secondary dumpsites should be provided taken into consideration the increasing number of residents in the metropolis. It should be located even around the nooks and corners of the metropolis where primary sourced waste would have a point of drop.

- Individual agencies, private waste managers and local waste contractors “charged sourced” should be encouraged by the government possibly be allowed to access soft government loans for effective performance to back up their efforts. More incinerators be provided at designate locations in the metropolis to ease collection and burning and the problem of dumping at any available sites such as roadside and uncompleted building at a appoint in time.
- The State and the Local government area of study are grossly incapacitated to properly manage the emerging solid waste. Drainages and Channels should always be checked to take proper charge of environmental maintenance as this may bring about flash flooding in the surrounding area.
- Dumpsites should be fumigated to reduce the menace of breeding of vectors such as mosquitoes (malaria), houseflies (cholera), worms and others. Stagnant waters should also be treated to block the tracheal systems of insect larvae and to control to some extent the spread of diseases and also to prevent the waste water from eutrophication of the stagnant waters which may be polluted somehow.
- Optimizing the efficiency of the collection and transport system bears a huge cost and improve bin distribution and finally switch to evacuated bin volume as it may lead to polluter pays principle. Residents should be advised to sort out their wastes before disposing them to facilitate effective waste management and disposal and to enhance the re-use and reduction of mass wastes for other purposes

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APPENDIX A

DEPARTMENT OF GEOGRAPHY

AHMAD BELLO UNIVERSITY

ZARIA-2015

RESEARCH QUESTIONNAIRE

Dear Sir/Ma,

The researcher writes on a topic: **Municipal Solid waste Management Technique in Kaduna North Local Government Area of Kaduna state, Nigeria** ". The research work is in partial fulfillment of the requirement for the award of an **MSc Degree in Geography**. All information obtained will be treated confidentially.

Section 'A'

Please tick (√) where applicable

Demographic characteristics of the respondent

1. Age: Brackets: 15-20 () 25-30 () 35-40 () 45 and above ()
2. Sex: Male () Female ()
3. Marital Status: Married () Unmarried () Divorced () Separated ()
4. Number of Children: 0-5 () 6 and Above ()
5. Total Number of the Household: 0-10 () 11-20 () 21'-30()
6. Place of Birth: Kawo/HayinBanki () UnguwanRimi () Metropolis () UnguwanSarki ()
others (specify)_____
7. Place of resident:_____
8. Highest Level Education: NCE/OND () First Degree/HND () Masters and above ()
9. Occupation at Hand: Civil Servant () Trading () Students () Miscellaneous ()

Section 'B'

Solid Waste Generation and Management Techniques

10. What is the volume of waste generated in your household per week?

Half Bucket () One Bucket () Two Buckets () 2 and above buckets ()

11. What techniques do you always adopt in getting rid of waste generated? By Burning () composting () Reuse () Dumping at Available site () Dumping in Government provided Bins () or by burying () others (Specify) _____

12. Is it government or private solid waste manager that is/are responsible for solid waste collection in your vicinity? Government. () Private () Individual collectors () Others (Specify) _____

13. Which of the (12 above), is most suitable for your management techniques and disposal?

14. Which the following materials can be recycle or reuse. Boxes () Papers () Metals and karst iron () Aluminum ()

15. How many designated or open dumpsite do you have in your area whether government or private? _____

16. How are these artificially created dumpsite (Secondary dumpsites) are gotten rid of from the dumpsite? By government () Waste managers () individual waste collectors () By companies ()

17. What are the major environmental hazards or diseases caused by the menace of indiscriminate dumping? Flood(flash) () Air pollution () Traffic Congestion due to Garbage Dumps on road passages () Odour and Water pollution () Malaria () Cholera () Entamoebic dysentery ()

18. What salient advice do you have generally for individuals and government as regard solid waste management and maintaining the quality of the environment?

I _____

Ii _____

Iii _____

iv. _____

v. _____

19 Are you in any way aware of current or any other techniques of solid waste control and management?

i. _____

.ii. _____

iii. _____

iv. _____

v. _____

20. What are the capacities of the Local Government in terms of equipments and technical personnel in management of municipal solid waste in Kaduna North.?

Very competent () Inadequate equipment and personel () In conjunction with other waste managers of Companies () Not in any way effective due to inadequate equipments and technical personel. ()s