ANALYSIS OF SPATIAL DISTRIBUTION AND PERCEPTION OF THE RISKS OF ILLEGAL SOLID WASTE DUMPSITES IN MINNA NIGER STATE, NIGERIA

BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE INREMOTE SENSINGAND GEOGRAPHIC INFORMATION SYSTEM

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DECLARATION

I declare that this dissertation entitled **ANALYSIS OF SPATIAL DISTRIBUTION AND PERCEPTION OF THE RISKS OF ILLEGAL SOLID WASTE DUMPSITES IN MINNA, NIGER STATE, NIGERIA**, was conducted by me and has not been presented in the Department or anywhere for a degree. All quotations and sources of information are dully acknowledged by means of reference.

Taibat Yusuf …… ……
Signature Date

CERTIFICATION

This dissertation entitled **ANALISIS OF SPATIAL DISTRIBUTION AND PERCEPTION OF THE EFFECTS OF ILLEGAL SOLID WASTE DUMPSITES IN MINNA, NIGER STATE, NIGERIA**, was conducted by Taibat Yusuf. The dissertation meets the regulations governing the award of Master of Science Degree inRemote Sensingand Geographic Information System in Ahmadu Bello University, Zaria. It has been approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to the entire family of Yusuf Jimoh

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ABSTRACT

Many neighbourhoods in Minna have no controlled system of waste disposal. The waste sometimes blocks drainage channels causing flooding and proliferation of insects. This research therefore, aims at analyzing the spatial distribution and perception of the risks of illegal solid waste dumpsites in Minna Town, Nigeria. Global Positioning System (GPS) was used to obtain the coordinates of the major waste dumpsites in the area. Average Nearest Neighbour Analysis was used to determine the pattern of the dumpsites distribution in the area. Buffer of 200metres was constructed to determine the proximity of the illegal dumpsites to residents.The coordinates of each identified dumpsites were overlaid on the imagery covering the study area using the overlay analysis of the GIS. Questionnaire was administered systematically to 384 respondents in the neighbourhoods. Oral interviews and field observations were also carried out.The findings revealed that about 116 illegal dumpsites (100%) were found within the residential buildings and the Z-score value is outside the range of ±1.96 to 1.96 and the p-value is less than 0.05, it showed that the pattern of illegal dumpsites are significantly clustered in nature around the residential area in the neighbourhood. The buffer constructed showed that 77.0% of the dumpsite falls within the buffer zone, while 23.0% fell outside the buffer zone. The findings revealed that all the residents whose houses fell within the buffer zone were victims of diseases, proliferation of insects, air pollution, bad odour and dirty street, while those residents whose houses fell outside the buffer zone are also affected with air pollution, and bad smell from the dumpsites, but mainly when wind is blown in their direction. The result from the perception of the respondents showed that four (Bad odour, proliferation of insects, dirty street and air pollution) out of the nine items of risks posed by the solid waste dumps to the residence are seen to be very serious. The highest score is obtained from bad odour (91%). Proliferation of insects (73%) and dirty street (84) and others are seen to be moderate to the residence in the neighbourhoods. The overall picture is that the people feel that the presence of the solid waste dumpsites in their neighbourhoods has a lot of risks on the residents. The study recommends that dumpsites should be located further than 200 meters from human settlements and should be properly managed so as to minimize its risks on the environment. Neighbourhoods should open dumpsites in remote areas with no residents closer to them to avoid the effect of the dumpsite on the nearby residents and monitor the dumpsite properly. Neighbourhood also have to control the litter and monitor their volume. The neighbourhood need to be educated

on the effects of dumpsites on their health this will limit the indiscriminate emergence of dumpsites in the area.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Chris (2003) observed that the phenomenon of rapid urban economic growth and urbanization are the main culprits, which besides bringing higher standards of living, have also brought problems related to the growth of dense and unplanned residential areas, environmental pollution, lack of services and amenities, solid waste generation, and growth of slums. The author stated that human activities create wastes and it is the way these wastes are handled, stored, collected and disposed of, which can pose risk to the environment and to public health. In urban areas, especially in the rapid urbanizing cities of the developing world, problems and issues of Municipal Solid Waste Management (MSWM) are of immediate importance. Solid waste is broadly defined as non-hazardous industrial, commercial, agricultural and domestic refuse including household organic trash, street sweeping, hospital and institutional garbage, and construction waste. Generally, sludge and human faecal wastes are regarded as liquid waste thus outside the scope of municipal waste management.

United State Environmental Protection Agency USPEA (2008) defined solid waste as a form of household garbage, leftover food and other wastage that include old household items such as paper plastic waste in the form of kitchen equipment or any other products that are consumed during everyday activities.

According to USPEA(2008)Solid waste management is the proper disposal and management of the garbage that is generated by the various industries, human settlements,

institutions and other places where activities of production and consumption of products and services take place.

According to Adams, Cormier and Lau(1998) a solid waste management system in normal parlance is a system that puts in place all activities pertaining to handling of all the garbage in a scientific manner. These activities include recycling programs, establishing incinerators, and providing land or dump filling sites building infrastructural facilities related with garbage collection. Waste management continues to be a rising challenge as population grows along with the industrial development of countries. The existing methods of waste treatment include; landfills gasification, ocean dumping, incineration and recycling

According to UN HABITAT (2010) the emergence of solid waste can be dated back to the beginning of human civilization, where garbage generated was inform of bones and other parts of animals. At that time, the generation of solid waste did not pose any serious health hazards to the environment as this solid waste was in the degradable nature and is easily mixed up with the soil. Today more products are in existence. The industrial revolution at the beginning of 19^{th} century caused an enormous increase in the production of different types of goods that resulted into the generation of solid waste that caused air and water pollution

Industrial waste, which in most cases is termed hazardous waste, is a waste that is quite dangerous as it consist of toxic chemical substances. This type of waste is highly dangerous to human, plants, animals and the overall environment. Improper disposal of the industrial solid waste may lead to disease, sometimes environmental damage and death. Hospital waste is generated day in day out, by various hospitals, clinics, research centres, pharmaceutical companies and healthcare centres. This type of solid waste is infectious. The focus of this research is municipal solid waste which is the household waste.

According to Barton (2000) Municipal solid waste (MSW) includes commercial and residential wastes generated in municipal or noted areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. Municipal dumping is becoming increasingly difficult considering the closeness of sites to residential areas, river water channels, or other fragile ecosystems which could lead to adverse environmental pollution and degradation as well as health hazards.

According to Sakai*et al* (1996) properly designed and well-managed dumpsites can be hygienic and relatively expensive. Poorly designed or poorly managed, dumpsites on the other hand, can create a number of environmental problems such as groundwater contamination, wind-blown litters, and attraction of vermin in addition to uncontrolled emission of dumpsites gases such as methane, lead, cadmium, mercury and other toxic substances into the air.

Butu, Agede and Bichi (2014) observed thatmunicipal solid waste in most cities contains human excreta, animal excreta, hazardous chemical pollutants and sharp object which can facilitate the spread of disease and injury particularly among children playing near waste dumpsites and employees in waste management sector.

Xi and Jiang (2003) stated that solid waste constitutes a major source of environmental hazard if not properly managed. The activities of human and animals produce waste and the way these wastes are handled, stored, collected and disposed of can pose risk to the environment and to public health. The increase in industrialization and urbanization has resulted in poor state of municipal solid waste management in many cities of the world, particularly in developing countries.

According to Sandra(1995) in Nigeria, open or uncontrolled dumping is largely practiced and consequently, causing pollution, foul odour, breeding ground for rodents and mosquitoes,

which has a very great negative impacts on the public health and wellbeing, also its affects the quality and sustainability of the environment as well as the efficiency and productivity of the economy.

Mohammed(2004) stated thatMinna in Nigeria, being among the fast growing cities in the world is faced with the problem of solid waste disposal. The implication is serious when a country is growing rapidly and the wastes are not efficiently managed. Waste generation scenario in Nigeria has been of great concern both globally and locally. In Minna, domestic solid waste dumpsites constitutes one of the major environmental challenges, the problem is compounded as the town continues to urbanize rapidly. The major problem affecting the management of solid waste in Minna is the inadequacy of collection points within the residential areas, which results in the dumping of waste in drainage, roadside, open space, farms, backyards, uncompleted buildings and water bodies in some places. This results in various health and environmental issues. These adverse consequences pose threats to human health and environmental hazard in Minna.

Igoni Ayotamuno, Ogajim and Robert(2007) stated that the problem of solid waste management in Minna town is not different from other urban areas in Nigeria where poor waste disposal leads to illegal waste dumpsites which are found dotting the streets without any consideration to the aesthetic and health hazards. The indiscriminate dumping method of solid waste disposal is considered as both naïve and dangerous. In some part of Nigeria, refuse is generally buried, though some heedless burning is sometime observed.

Campbell(1987) stated thatRemote sensing data can be an aid in identifying and locating of garbage dumping sites and in monitoring the changes in land use within and near the hazardous waste and sanitary landfills Geographic Information System (GIS) can be applied as a

decision making instrument for analyzing of waste dump sites and their management.Atejioye and Anifowose(2005) noted that the traditional manual method used for analysis of the factors could be time consuming and tedious work. However, there are high probabilities of errors while combining the spatial and non-spatial data.

1.2 STATEMENT OF THE RESEARCH PROBLEM

An observation of the residential areas in Minna reveals that some open spaces and some drainage channels serves as dumpsites which are left unattended to causing air pollution, bad odour, flooding, dirty streetand breeding ground for rodents and mosquitoes and also used for open defecation and playgrounds for children.

Although attention has been paid to solid waste research and the fact that it has health and environmental impacts, attention to determining population exposure to the hazards posed by poor disposal, the areas under constant threat of hazards and distribution of waste dumps is highly limited. It is the belief of this research that a better understanding of the location and distribution of disposal points and their effects to household are important for a better management of the solid waste. Therefore, the objectives of this research are to determine the location, proximity, distribution of solid waste dumps and the perception of the residents on the dumps. Some studies have been conducted on the issues of solid waste in some areas, this includes;

According to Anthony(2011) the problems associated with solid waste generation and disposal has been the focus of considerable environmental attention during the last quarter of the twentieth century as communities all over the world have begun to recognize its hazards.Arthur (2010), stated that in developing countries, millions of people live without a waste system, wide

spread dumping of waste in water bodies and uncontrolled dumpsites aggravates the problem of generally low sanitation, which poses serious threat to the surrounding environment and health risk to the population by contaminating drinking water and soil. These dumps make very uneconomical use of the available space, allow free access to waste pickers, animals and flies and often produce unpleasant and hazardous smell.

According to Mohammed(2004) inMinna indiscriminate dumping as well as unattended waste constitute offensive odour, pollute ground water sources and decrease environmental quality and aesthetic. The high incidence of improper waste disposal in drainages results to flooding during rainy season. Uncollected refuse finds its way into open drains, which become blocked, and the dammed up stagnant water encourages the breeding of mosquitoes, resulting into many cases of malaria, typhoid, cholera and diarrhea.

A couple of studies have been undertaken on solid waste management, examining the genesis, causes and effects of solid waste in Nigeria. Relevant to this study include those carried out by the following researchers.

Ariko (2009) analyzed the characteristics and the impact of solid waste disposal on the environment in Tudun Wada Zaria.The result showed that there are different methods of waste management in the form of waste collection and disposal which have evolved over the year. The result also showed that due to rapid urbanization, inadequate funding and skilled manpower amongst others, the methods of waste management were not effective. The author stated that the most common method is open burning.

Butuand Mshelia (2004) assessed municipal solid waste disposal and the effect on environment in Kano metropolis, Nigeria. Questionnaire was administered to the area that has the highest heaps of solid waste on the major streets and open spaces. The study showed that

soil, air and water pollution in the study area were caused by pathogenic and chemical element from these heaps of solid waste that dot some of the major streets and open spaces.

Butu, Agede and Bichi (2014) studied municipal solid waste generation, disposal and effect on the environment in Kura, Nassarawa state. Using questionnaire, interview and observation. The researchers found out that population growth and unplanned urban expansion results to unorganized house to house or street to street collection of solid waste. The study showed that solid waste dumpsite serves as hideouts for rodents and snakes which are dangerous to health.

Mohammed (2014) appraised solid waste management system in Minna, Niger State. Using questionnaire and interview. The study found out that the improper management of solid waste was as a result of population growth and insufficient facilities for waste management. The study also showed that private sectors responsible for management of solid waste are not effective. The study concluded that there should be provision for enough manpower and equipment for proper evacuation of the waste.

In Minna, little effort has been put in the problem of waste management. This leaves a gap in knowledge which forms the focus of this study. The methodology in this research is different from that of Mohammed (2014). Thus, it becomes necessary to analyze the spatial distribution and perception of the effects of illegal solid waste dumpsites to the residential area in Minna, Niger state using Geographic Information System (GIS).

This research provided answersto the following questions:

1. Where are the illegal dumpsites located in the study area?
2. What is the pattern of distribution of theillegal dumpsites?
3. What is the proximity of theillegal dumpsites to residential area?

4. What are the perceived risks ofillegal dumpsites to the residents in the study area?

1.3 AIM AND OBJECTIVES

The aim of the study is to analyze the spatial distribution and perceptual effects of illegal solid waste dumpsites on the residents in Minna metropolis. The aim was achieved through the following objectives which are to:

i. identify and map the illegal dumpsites in study area.

ii. determine the pattern of distribution of the illegal dumpsites in the study area.

iii. determine the proximity of the illegal dumpsites to residents.

iv. examine the perceived risks posed by the illegal dumpsites to the residents in the study area.

1.4 SCOPE OF THE STUDY

Analysis of spatial distribution and the perception of the effects of illegal solid waste dunpsites in Minna, Niger State, Nigeria. The study covers Minna town in Niger State which consist of twenty-four (24) neighbourhood they include, Bosso town, Shango, Sauka Kahuta,Barkin Sale, Kpakungu, Minna Central, Tudun Fulani, Chanchaga, Bosso Estate,Tayi Village, Bosso Extension, Tunga, Tudun Wada North,Tudun Wada South, Makera, Sabon Gari, Maitumbi, Nassarawa, F-Layout, Nigeria Army Barrack, Fadipe, GRA, Dutsen Kura Hausa and Dutsen Kura Gwari. The study is concerned with the analysis of spatial distribution and the perceptionof the risks of illegal solid waste dumpsites on the residential area in Minna metropolis. The study dealt with the identification and mapping of illegal dumps in the study area, determining the distance of the dumpsites to residence and analyzing the risks associated

with the spatial location of the dumpsites to the residents in the study area. The research covered waste dumps situation as at 2016.

1.5 JUSTIFICATION OF THE STUDY

According to the 2006 National Population Census (NPC), the population of Chanchaga Local Government Area (where the study area is located) was 201,429 and it was reported that one third of this population live in the study area (Niger State Planning Commission, 2011). As the population grows there is an increasingcommercial, residential and infrastructural development due to population growth and urban expansion and this directly affects the amount of waste generation and disposal. This demand is certainly on the increase as the population is half a million currently.This therefore shows that the study area is residential in nature. Thus, it is of vital importance to study the solid waste dumpsites locations as well as their spatial distribution for both planning intervention and management purposes. The data generated would form a data base for consultation in subsequent similar situations.

Human beings are bound to produce waste whether in residential areas or work places. Rapid urbanisation, industrialisation, population growth, wrong live style, poor living standards in developing countries has resulted in too much refuse being exposed to the environment which then poses health hazards to the local people. Dashe (1997) noted that without the perception of a guide into the future environmental program, a crash is inevitable. Therefore, there is need to understand the various ways individuals participate in environmental protection and waste management especially at the house hold level with a view to integrating them into the environmental management program since it is generally believed and accepted that municipal

solid waste constitutes the second most contributing source of waste generated anywhere, anytime worldwide.

Poor distributions of solid waste dumpsites leads to a number of problems including indiscriminate waste disposal, this habit causes flooding in the environment, traffic congestion and sometimes unpleasant odour and water stagnation (Dashe, 1997). This study provides answers to how solid waste dumpsites are close to the residential areas and the effects on the residence. This research is therefore important because it is beneficial to the Niger state government with respect to policy making towards ensuring a healthy environment.

CHAPTER TWO

CONCEPTUAL FRAMEWORK ANDLITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents the conceptual framework of solid waste, perception, dump sites, types of dumpsites. And it also presents the review of the related literature on the spatial distribution of illegal dumpsites in Minna, Niger State.

2.2 CONCEPTUAL ISSUES

2.2.1 Concept of Solid Waste

Peter, Karl and Jurg(1996)definedsolid waste as refuse from household, non-hazardous solid waste from industrial commercial and institutional establishment, market waste, yard waste and street sweepings. It is actually difficult to present the complete meaning of the term "solid waste" in a single definition. In a broader perspective waste can be defined as items which are no longer in use and are not expected to be in future(Kurian, Nagendram and Palanivelu, 2001).Jilani (2002)defined solid waste as the collective name for all the component parts of solid waste both domestic and industrial which may be found in human environment.There are however, other technical descriptions of the term "solid waste" which include the following. According to Arinsola (2004) solid waste can be defined as non-liquid material arising from domestic, trade, commercial, agriculture, and industrial activities and public services. The two important types of solid waste are municipal solid waste and hazardous solid waste.

United State Environmental Protection agency (USEPA, 2008) definedsolid waste as materials that are discarded as "waste" and handled as solids, as opposed to waste that is flushed down sewer and handled as liquids.Solid waste is unwanted solid materials such as garbage, paper,

plastic and other synthetic materials metal and wood. Solid waste has been defined in various ways by different experts. The American solid waste act of (1995) defined solid waste as "garbage, refuse and other discarded materials resulting from industrial, commercial, agricultural operations and from community activities" (Sani, Christopher, Shitt, and Jibrin, 2010).

2.2.2 Perception

Perception can be defined as our recognition and interpretation of sensory information. Perception can also include how we respond to the information. Visually perception is the ability to see, organise, and interpret one's environment. We can think of perception as a process where we take in sensory information from our environment and use that information in order to interact with our environment (https://study.com , 19/05/2018).

2.2.3 Concept of Waste Dumpsite

Dumpsites is dumping of waste either legally or illegally onto land situated in public space without adequate public services which are sometimes removed shortly after they are created, but most will persist for an indefinite period of time. Historically, countries dealt with solid waste by burying it in the ground, covering it up, and forgetting about it. Another approach was the uncontrolled burning of waste to reduce volume. The subsequent ash was then buried in the same manner as waste. According to Kurian, Nagendram and Palanivelu (2001) in a recent study of World Bank over 50 landfills in Asia, Africa and Latin America identified current practices, emerging features and necessary improvements in the land disposal of solid wastes. The authors defined dump as a location where people leave garbage or other unwanted things such as toxic waste the government is responsible for designing and maintains legal dump sites

or landfills, while people might create illegal dump sites by discarding waste in other places. The word “dump” has meant to throw down or drop since the 14th century, and it has meant both the action of discarding as well as a place where things are discarded since around the late 1800s and early 1900s.

2.3 LITERATURE REVIEW

Nwachukwu (2008) assessed solid waste generation and disposal in Onitsha metropolis. Questionnaire and Simple linear regression was used. In testing the two research hypotheses postulated for the study. The study found out that the first test showed that solid waste generated in Onitsha metropolis increases as the population increases, and secondly, the rate of solid waste disposal (40%) in Onitsha is out-paced by the rate of its generation (60%). This study recommends among others the privatization of solid waste management system as well as adequate funding of agencies responsible for refuse collection and disposal in Onitsha metropolis.

Arroyo (2008) assessed the control of water pollution in environmental studies. Interview and observation were used. The study found out that inadequate waste management contributed to water pollution, air pollution and dirty street in the area. The study concluded that communication is the appropriate methods to enhance awareness on solid waste management among the community. The author further advocated the support of activities such as the monthly or weekly environmental sanitation vaccination campaign against the spread of hepatitis B and assisting flood victims during rainy seasons.

Pothimamaka (2008) examined community learning process: a model of solid waste reduction and separation in Bang Sue District, Bangkok Metropolis, Thailand. The author

combined both quantitative and qualitative research methods. The study found out that the best practice of solid waste management in the area is reduction of waste generated at the source. The study revealed that majority (80%) of people in the area are taught how to deal with solid waste by separating it in their homes, schools and work places. The study concluded that solid waste should be recycled.

Yongsi, Hermann, Ntetu, Sietchiping and Bryant (2008) examined the health risks of different waste disposal system in Cameroun. Questionnaire was administered and statistical analysiswas used. The study found 14% diarrheic prevalence, 30% malaria and 40% other diseases among the respondents and a strong statistical association was found between household refuse management methods and incidence of diarrhea among the respondents. The author concluded that the dumps should be located at a far distance from the residents.

Ogwueleka (2009) assessed solid waste management involving nine cities in Nigeria. Questionnaire was administered and the author discovered that (90%) majority of the total solid wastes generated in the cities are organic in nature. The study revealed that there was gross inefficiency in the solid waste management in practically all the cities. The author found out that poor performance was attributed to inadequate funding (30%), personnel (30%), equipment (20%), and technological constraints (20%). The study concluded that there should be adequate provision of solid waste management facilities.

Babayemi and Dauda (2009) assessed solid waste generation and disposal in Ogun State. The study found out that there is high rate of waste generation in Abeokuta without a corresponding efficient technology to manage the wastes. 201 questionnaire were administered to respondents in Abeokuta Ogun State, (35.8%) used waste collection services, (64.2%) used

other waste disposal options, (16.4%) used both, (68.7%) and (58.7%) were aware of waste collection service and waste management regulations respective.

Ogwueleka (2009) assessed municipal solid waste characteristic and management in Nigeria. Questionnaire was administered to the respondents and the study found out that an average Nigerian is estimated to generate about 0.49 kg of solid waste per day with households and commercial centres contributing about 90%of the total urban waste. The Nigeria waste stream generally consists of plastics, paper, textile, metal, glass. The author found out that enormous quantities of solid waste are generated daily in the major cities of Nigeria, but exact figures are difficult to determine due to the fact that proper records of collection and disposal are not kept by the authorities responsible. The study discovered that waste generation and composition is greatly influenced by population, income, economic growth, season, climate and social behaviour, and the waste density generally ranges from 280370 kg/m3, Waste generation rate is 25 million tons annually and at a daily rate of 0.44-0.66 Kg/capital/day. The author also found out that refuse is stored in 1.5m3 containers in the residential areas while 1.6 m3 containers and built-up dumps are used in the commercial, industrial and some residential areas.

Kalu, Modugu and Uboch (2009) examined solid waste management policy in Benin metropolis. Using questionnaire, the study found out that 80% of waste in the area is deposited either on the roads, or road sides, unapproved dump sites, in water ways (drainage system), or in open sites. The authors found out that solid waste poses 70% health hazard and adversely 30% affects flora and fauna as well as the environment especially when it is not appropriately collected and disposed. The author observed that solid waste disposed on sites including high ways, farmlands, forest plantation are encroached upon which takes its toll on biodiversity

conservation. The study recommends that there should be enlightenment on waste management policy

Aliyu (2010) analyzed municipal solid waste in Kano metropolis through the collection of secondary data from the government agency (Refuse Management and Sanitation Board, REMASAB) responsible for the management of solid waste, interviews with stakeholders and field surveys. The study showed that the household sector in Kano metropolis produces the largest amount of waste in the city accounting for 62.5% and the waste generated by various institutions in Kano accounts for only 5.8%, while industries located within residential areas contributed 2.9%. The study estimated that Kano metropolis generates about 3085 tons of solid waste per day. The study also found that Kano metropolis's solid waste consists to a large extent of organic and other biodegradable matter (43%) and constitutes 68.26% by weight of solid waste generated in the study area. The study recommended, among other things, that the government should put in place facilities and opportunities to enhance proper management of solid waste and promote recycling and reuse of waste and should embark on environmental awareness campaigns to sensitize the citizen develop the right attitude about waste disposal.

Otti (2010) examine solid waste management in Onitsha metropolis. The study using questionnaire and interview, observed that in the area waste generation and hap-hazard dumping is due to poor management. The author found out that heap of refuse that are dumped indiscriminately along the streets 30%, drains 10%, open dump 60%. The author also found out that it devalues resources, pollutes soil, pollutes water resources and constitutes potential health hazards to plants 5%, animal 15% and people 80%. The study recommends that government should make provision for adequate solid waste management.

Momoh and Oladebeye (2010) assessed awareness, attitude and willingness of people to participate in household solid waste recycling programme in Ado-Ekiti. Using questionnaire, the study found out that70 percent of the people are not participating in recycling of waste in the area. The study found out that waste disposal 65% and lack of management 35% constitute serious health problem in the area. The study recommends enlightenment on recycling and, should create market for the recycled waste.

Onwughara, Nnorom and Kanno (2010) assessed issues on roadsides disposal habit of municipal solid waste in Umuahia, Abia State, Nigeria. The study found out that Umuahia has a total population of about 1.2 million people who produced 250 metric tons of waste in 2005 and 350 metric tons of waste in 2007 daily. The study observed that 80% of the MSW generated by market traders consists generally of mixed waste containing hazardous and non-hazardous component which are either separated treated, nor recycled before disposal by the municipality. The study concludes that there should be waste collection projects planned in the area for proper disposal of waste in the area.

Salam, (2010) examined the health impact of solid waste management among residents around the Mangwaneni Dumpsite in Swaziland. Questionnaire was administered to 78 respondents and stratified by the distance of their homes to the dumpsite. The study discovered that the first group living within the 200m (70%) experience bad odour and air pollution, while the second group live from 200m and beyond (30%) also experience bad odour but only when wind is blown in their direction. The study concluded that the dumps should be located above 200m.

Nkwocha, Pat-Mbano and Dike (2011) assessed the efficiency of the solid wastes collection services in Owerri municipality and observed that the level of efficiency in waste

collection was only about 61%, a situation they attributed to a wide range of socio-economic and technical factors.

Ukoje (2011) analyzed the participation of stakeholders in solid waste management in Zaria, Nigeria. Questionnaire was administered to household and stakeholder. The author utilizes the cluster and random method of sampling to select the neighbourhoods, households and stakeholder groups for data collection. The study revealed that there is a lack of recognition and cooperation with non-public institution stakeholders in the solid waste management framework in Zaria. The author also discovered that there is inadequate collection and disposal of solid waste by the stakeholders.

Adekunle, Adebola, Aderonke and Toyin (2011) assessed recycling of organic waste through composition for land applications in Nigeria. Questionnaire was administered. The study observed that improper waste handling and management pose great threats to the environment. The authors found out that 80% of waste management practiced in Nigeria involves the collection of mixed waste materials and subsequent dumping at designated dumpsites. The author also found out that majority (85%) do separate waste materials at source or any point during its management. The study concluded that sorting of solid waste management should be introduced in the area.

Fakere, Fadairo and Oriye (2012) examined domestic waste management and urban residential environment in Akure. Using questionnaire and interview, the study found out that the volume of solid waste generated in the area is 25 million tons annually and at a daily rate of 0.44-0.66kg/capital/day.

Agwu (2012) assessed issues and challenges of solid waste management practices in Portharcourt city. Questionnaire observation and interview were used. The author observed that

industrial, agricultural and biomedical waste profiles in the area is still little. The author observed that solid wastes comprise of all the wastes arising from human and animal activities that are normally solid. The author found out that collection, disposal processing, treatment and recycling is the problem of waste management in the area. The study also found out that corruption, work attitude, inadequate plants and equipment are the factors militating against effective solid waste management practice in the area.

Adekunle, Adebola, Aderonke, Pius, and Toyin (2012) assessed population perception impact on value-added solid waste disposal in developing countries using Port Harcourt as a Nigeria case study. Qualitative research survey and structured questionnaire were employed. The study revealed that no participant really sorted waste materials at source; rather, an overwhelming majority (81%) mixed or mingled their wastes together in a given waste bin and 19% practiced indiscriminate disposal. By this, they disposed of their waste materials at convenience, without discretion on environmental impact of such an action. This, cumulatively, gave a total of 100% of the study population involved in non-segregation of waste at source.

Okeniyi and Anwan (2012) analysed solid waste generation in covenant university. Using questionnaire and interview the study found out that the average waste generated per day in Covenant University Ota, food waste exhibited the highest percentage of (26.2%) and followed by polythene bag (19.3%); and plastic bottles (13.6%), metal cans (11.5%), paper (10.5%), plastic food pack (7.2%), other combustible wastes (5.6%) and polystyrene food pack (5.6%).

Mohammed (2014) appraised solid waste management system in Minna. The study found out that in Minna metropolis, several tones of municipal solid waste is left uncollected on the streets each day, clogging drains, creating breeding ground for vectors and spreading diseases and creating a myriad of related health and infrastructural problems. The author observed that

substantial part of the urban residents in Minna metropolis has little or no access to solid waste collection services. The author found out that lack of proper land use planning resulted into the creation of informal settlements with narrow streets making it difficult for collection trucks to reach many areas. The study revealed that waste generation is high due to increase in population density and are disposed on land in open dumps.

Anyanwu and Adefila (2014) examined the nature of solid waste management in Kura, State, Nigeria. Primary and secondary sources of data collection were adopted. A field survey was undertaken to determine the types, volume, composition and methods of managing solid waste in Karu urban areas. The volume of waste was measured from three selected households in the four residential areas namely Mararaba, Masaka, Ado and New Karu. Two hundred and thirty (230) samples were selected using combined systematic, randomization and stratified sampling techniques among the households as well as the staff of the municipal waste management agency. The study employed descriptive statistics to analyse the data. The found out that solid waste were generated from households in Mararba (28.8%), Masaka (22.9%), New Karu (25.7%), and Ado (22.6%) in that order. The study also showed that the methods of solid waste disposal range from direct dumping (43.6%), open burning (23.0%), dust bins (32.4%), composting and dumping in drains accounted for (1.0%) in the study area. The study recommended among other things that government should provide basic facilities; equipment, adequate funds, and qualified personnel to manage the various wastes generated and increase public awareness through enlightenment campaign against the danger of indiscriminate dumping of wastes as they affect human health. And appropriate policy should be put in place to encourage partnership with private individual corporations with a bid to ensuring quality of the environment

Butu and Mshelia (2014) examined the municipal solid waste disposal methods and the environmental issues associated with the management of solid waste in Kano Metropolis, Nigeria. Primary data were obtained through administration of structured questionnaires to a random size of population in the areas that have the highest heaps of solid waste on the major streets and open spaces. Oral interviews and field observations were also carried out for holistic and detail assessment of the environment. Secondary data were obtained from desk review. The study showed that major streets, several open spaces and even water ways are being used as refuse dump sites. The study further showed that population growth and uncontrolled urban expansion are responsible for the continuous growth of these refuse heaps at the shoulders of the major streets, open spaces and water bodies. The authors found out that there is no organized house to house or street to street collection of the solid waste in some parts of the metropolis. The study revealed that the major environmental issues resulting from improper disposal and poor management of solid waste in Kano metropolis are physical nuisance of the waste to the environment, the solid waste are blown around by winds or rainstorm making the environment dirty, the waste sometimes block drainage channels during rainstorm causing flooding in the metropolis. The heaps of the solid waste serve as good hideouts for reptiles, rodents, and other dangerous insects. The study recommends that a strong legislation with severe sanction be put in place and they should be a continuous public enlightenment on the danger of municipal waste to the general public. It is also recommended that available market be created for these waste that can be recycled.

Martin (2014) assessed municipal solid waste pollution problem in Juba, South Sudan. The study highlights the current pollution situation in Juba, with specific focus on waste management system. The study was purely quantitatively descriptive, including various data

collection techniques (interviews, field observation and systematic literature reviews). The study revealed that average household municipal solid waste generated was 2.88 kg/day and the/capita/day was 0.38 kg. Thus, the entire city, with a population of about 231,776, generates approximately 667.5 tons/day. Illegal dumping was also observed as well as open air burning. The wastes were disposed off in river bank/streambeds, especially at night and burnt on the road sides, open spaces and near the houses. All these malpractices pose a serious health and environmental hazard to the water bodies. The study also noticed that 69% of the wastes were disposed of randomly by the householders themselves, 22% by Juba city respective waste management units and 9% by private companies. The conclusion of this assessment showed that the municipal solid waste pollution poses high risk to human health and the environment.

Partrick, Lee, and Che (2014) assessed solid waste disposal practices in relation to sex, age and educational level in the Wa Municipality. The research instruments used for the study were questionnaire, interview and personal observation. The study revealed that sex, age and educational level negatively correlated with the solid waste disposal methods in the Wa Municipality. The study also revealed that, open dumping of solid waste is a common practice in the Wa Municipality. The study recommended that the Wa Municipal Authorities should stop the use of the open dumping site and construct an engineered landfill for the disposal of solid waste in the Wa Municipality.

Aguoru and Alu (2015) studied solid waste disposal and management methods in Makurdi and Environs. Using questionnaire the study found out that population is increasing day in day out and the impact on the environment is also becoming enormous. The study discovered that many residents possessed waste containers for collection of waste but its method of disposal is questionable. The study found out that Benue State Environmental Sanitation Authority, private

sector participation, are responsible for the collection and disposal of all types of waste generated in Makurdi and Environs. The study discovered that waste is poorly collected and dumped at the dump sites irrespective of its composition. The study observed that there is no form of waste compositing, sorting or segregation carried out neither is there an engineered landfill site for solid waste Management. The study concluded that there should be frequent public enlightenment on methods of solid waste collection and disposal.

Yekeen (2015) assessed the exposure to Health Hazards from solid waste Dumps in Nigeria urban centres. Using interview and questionnaire the study found out that the waste dumps represent an informal adjustment to weak capacity of the waste management agency. The study found out that solid waste constitutes health risk as people of various age groups are exposed to the hazards of the waste dumps. The author also found out that as a result of the exposure, the waste dumps are of serious concern to the people. The study concluded that open dumping of solid waste within residential neighbourhoods should be eliminated while the capacity of the waste management agency and the environmental behaviour of the people should be improved.

Musa, Saidu and Musa (2016) examined the challenges of solid waste management in Minna and environs. Data for this study were obtained through the administration of questionnaires, direct interview and review of existing literature. The data obtained from the field were analyzed using pie chart. A total of three hundred questionnaire were administered to some selected residents and business centres in Minna. The study found out that 56% of the respondents keep their waste containers inside the building, while 25% of the respondents keep their containers outside their building. 60% of the generated wastes are disposed off on the major streets of Minna for the waste disposal agencies to collect, while 40% of the disposal method is the

collective burning of the waste 63% of the respondents stated that the wastes generated were collected regularly by those in-charges while 37% stated otherwise. The study observed that people of the study area had poor attitudes and perceptions toward solid waste handling. The study concluded that there should be more provision of waste management facilities in the area.

Minna in Nigeria, being among the fast-growing places in Nigeria is faced with the problem of solid waste disposal. The implication is serious when a country is growing rapidly and the wastes not efficiently managed. Waste generation scenario in Nigeria has been of great concern both globally and locally. In Minna, Solid waste disposal problem is a concern to both the governments and residents of the area. This problem has become most worrisome in Nigeria where the generation is always on the increase because of increase in population and some socioeconomic factors. Having reviewed some accessible literature on solid waste from different backgrounds and perspective, there is a need to examine the situation in Minna Town in the residential areas. This will bridge the gap existing in the study area particularly among an elitist community in Nigeria.

2.3.1 Types of Solid Waste

According to Hopskinville(1976) solid wastes are residuals from homes, businesses and institutions, and are referred to as trash garbage, rubbish, refuse, discards and throwaways that enter a local system for collection and disposal. Feacham, Garry and Mara (1976) explained that solid waste can be classified in different ways. The first is the division of solid wastes or refuse into two broad groups; domestic and industrial solid waste. Secondly, simple system that recognizes three categories of solid wastes namely animals, vegetables and minerals.

Adedibu (1983) stated that solid wastes are non-gaseous and non-liquid wastes resulting from a wide range of community, industrial, commercial and agricultural activities. He further grouped solid waste into eight classes namely: domestic, municipal, industrial, agricultural, institutional, pesticide, residential, and hazardous wastes.

Barton(2000) stated that municipal solid waste includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes.

Chaz (2002) stated that four pounds of trash a day are generated by each man, woman and child in cities of developing countries in Africa. These wastes include substantial amounts of paper and cardboard (40%) as well as yard waste (18%), metals (9%), plastics (8%), and other products. Where does it all go? More than 70% of this material is buried directly in landfills. He further classified solid wastes into steel cans, yard wastes, high density polyethylene, newspapers and aluminium packaging. The author concluded that for solid waste effective collection, disposal, recycle, reuse and renewal it has to be segregated into biodegradables and non-biodegradables. Biodegradable wastes are waste materials that are capable of being broken down by micro- organisms into simpler substances or basic element which include organic waste, Examples include; kitchen waste, vegetables, fruits, flowers, leaves from the garden and paper. Non-biodegradable waste can be further segregated into recyclable wastes; plastics, paper, glass, metal, etc. The above indicates the various dimensions of waste classification and the need for an agreed classification scheme. However, whatever classification is put in place, the issue of management is critical.

According toChris (2003) there is a large variation in solid waste depends on the commodity usage and lifestyle of the people.The term municipal solid waste refers to solid waste from

houses, streets and public places, shops, and offices, which are often the responsibility of municipal or other governmental authorities. Solid waste from industrial processes are generally not considered “municipal.

According to UN HABITAT (2010) solid waste is divided into different types based on their sources. Broadly, the types of solid waste include; Municipal waste, Hazardous waste, Hospital waste, Agricultural waste and Industrial waste. Municipal solid waste is known as household waste. Waste mostly consists of household waste, sanitation waste, waste from streets, demolition debris that arises during the construction and demolition of buildings and other construction activities. Industrial waste, which in most cases is termed hazardous waste, is a waste that is quite dangerous as they consist of toxic chemical substances. This type of waste is highly dangerous to human, plants, animals and the overall environment. Improper disposal of the industrial solid waste may lead to disease, sometimes environmental damage and death. Hospital waste is generated day in day out, by various hospitals, clinics, research centres, pharmaceutical companies and healthcare centres. This type of solid waste is infectious.

Municipal Solid Waste commonly known as trash or garbage is a waste type consisting of everyday items we consume and discard. It predominantly includes food wastes, yard wastes, containers and product packaging and other miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Examples of inorganic wastes are appliances, newspapers, clothing, food scraps, boxes, disposable tableware, office and classroom paper, furniture, wood pallets, rubber tires, and cafeteria wastes. The term residual waste refers to waste from household sources containing materials that have not been separated out or sent for reprocessing. Flinttof (1984).

Flinttoff (1984) classified solid waste into three categories. They are municipal solid waste, industrial solid waste and hazardous solid waste.

Municipal solid waste: These include refuse from households, non-hazardous solid (not sludge or semi solid) waste from industrial and commercial Establishments, and refuse from institutions (including non-pathogenic waste from Hospitals, market waste, yard waste and street sweepings). Sometimes, construction and Demolition debris is also included.

Industrial Waste: Industrial waste is generally referred to as a material from a Manufacturing process that has no value to the manufacturer and that has to be disposed of insome manner. With rising economic standards and with many imported consumer goods (particularly food items), Nigerians increasingly have access to packaged goods, often using plastics, which makes waste disposal difficult. The development and widespread use of new packaging substances such as plastics have improved the standards of living for millions, but they have also introduced new threats to the environment, as typified by the histories of dichlorodiphenyltrichloroethane (DDT) and polychlorinated bi-phenyls (PCBs). Thus, industrial development also brings in its wake problems of environmental pollution that often need abatement. In Nigeria, the four most industrialized States are Lagos (home to approximately 60% of the Nigerian industries), Rivers, Kaduna and Kano. Collectively, these States share approximately 80% of the Nigerian industry. Clean-up of industrial waste is costlier than prevention. The lowest level in the hierarchy (avoidance, utilization, minimization, recycle, reuse etc.) and the one that all other levels strive to eliminate is remediation of the impacts of wastedischarged to the environment. The key industries in Nigeria are cement and asbestos, fertilizer and agro-chemicals, metallurgy and mining, tanneries, textiles and petroleum and petro chemicals. At present, the petroleum industry contributes over 85% annually to Nigeria‘s foreign exchange revenues. Environmental pollution

from these industries is regulated by National Environmental Standards and Regulations Enforcement Agency (NESREA) and various state and other regulatory agencies. Among these agencies, the relationships are overlapping and not harmonized for regulatory environmental enforcement.

Hazardous Waste: A special class of waste known as hazardous waste, mostly discharged into the environment from industrial and related sources attracts special attention and management considerations because of their harmful nature to man and other components of the ecosystem. A waste classified as hazardous waste, by definition and convention usually has one or more of the following four characteristics: ignitability, corrosively, reactivity and toxicity. These definitions show that a wide range of substances of different physical forms (liquid, gaseous, solid, or in solution) fall into the class of hazardous materials which may become waste. Hazardous wastes have been known to cause serious environmental and epidemiological disasters as a result of the lack of or inadequate handling and management of these wastes.

2.3.2 Solid Waste Management

The assertion of (Rosenbaum, 1974) is that solid waste is an unofficial measure of prosperity which may not be true for a developing nation. According to Barton (1991) solid waste management is one among the basic essential services provided by Local authorities in most country to keep urban centres clean. However, it is among the most poorly rendered services, the systems applied are unscientific, outdate and inefficient; population coverage is low; and the poor are marginalized. Waste is littered all over leading to sanitary living conditions. Local Government laws governing the urban local bodies do not have adequate provisions to deal effectively with the ever-growing.

According to Baron (1995) Solid Waste Management is a polite term for garbage management. As long as humans have been living in settled communities, solid waste, or garbage, has been an issue, and modern societies generate far more solid waste than early humans ever did. Daily life in industrialized nations can generate several metric units of solid waste per consumer, not only directly in home, but also indirectly in factories that manufacture goods purchased by consumers. The author stated that Solid waste management is a system for handling all of this garbage; municipal waste collection is solid waste management, as are recycling programs, dumps, and incinerators. To the great benefit of archaeology, early solid waste management consisted of digging pits and throwing garbage into them. This created a record of the kinds of lives that people lived, showing things like what people ate, the materials used to make eating utensils, and other interesting glimpses into historic daily life.

Peter, Karl and Jurg (1996) defined solid waste as refuse from households, non-hazardous solid waste from industrial, commercial and institutional establishments (including hospitals), market waste, yard waste and street sweepings. Semisolid wastes such as sludge and night-soil are considered to be the responsibility of liquid waste management systems. While hazardous industrial and medical wastes are, by definition, not components of municipal solid waste, they are normally quite difficult to separate from municipal solid waste, particularly when their sources are small and scattered. Finally, debris from construction and demolition constitute "difficult" categories of waste, which also require separate management procedures. The authors noted that it is usually advantageous to execute service provision tasks in partnership with private enterprises (privatization) and/or with the users of services (participation), but the final responsibility should remain that of the government. In many countries public authorities or their private contractors do not collect 100% of Solid Waste. There are other, informal uncontrolled

methods of waste collection, treatment and disposal. Even if not controlled and managed by authorities, solid wastes from this fraction are part of municipal solid waste management and must be considered.

Brunner and Merl (2002) gave two alternative definitions for solid waste, first that they are "wastes which are produced by private households (residual source), small trade, working places of the tertiary sector (commercial source), open areas, and which are collected by public authorities, second that they are waste(s) generated from residences, community establishments, institutions, and to a limited extend, industrial facilities. The authors see solid waste as goods that can be further split up into other goods, like paper and cardboard, organic waste, metal, glass, plastics and mixed waste. From the citation in the definition of solid waste above, one can see that Solid Waste is not only defined by where it is produced (households, small trade, etc.), but also who is responsible for it: public authorities. Hence public authorities are the ones who should manage the waste. In fact, they do, but not everywhere to a full extend.

UN-HABITAT (2003) stated that solid waste management is an essential task which has important consequences for public health and wellbeing, the quality and sustainability of the urban environment and the efficiency and productivity of the urban economy. In most cities of developing countries, waste management is inadequate: a significant portion of the population does not have access to a waste collection service and only a fraction of the generated waste is actually collected. Systems for transfer, recycling and/or disposal of solid waste are unsatisfactory from the environmental, economic and financial points of view. With rapid urbanization, the situation is becoming critical. During the past fifty years, cities in the developing world have undergone rapid urbanization. Between 1987 and 2015, the number of urban dwellers is expected to double. Nearly 90 per cent of this increase will take place in the

developing world, where growth rates exceed 3 per cent a year, three times that of the developed count.

Ogwueleka (2003) argued that United States of America though, is known to be the most prolific producer of solid waste on earth; yet the country has not produced the filthiest cities. Therefore the heaps of solid waste visible in cities of developing countries cannot be regarded as one of the indices of prosperity; it is a failure of urban management strategies to cope with the inevitable by-product of human development activities (Afon, 2006).

Brunner (2008) defined Management as a cyclical process of setting objectives, establishing long-term plans, programming, budgeting, implementation, operation and maintenance, monitoring and evaluation, cost control, revision of objectives and plans, and so forth. Management of urban infrastructure services is a basic responsibility of the municipal government.

According to Brunner (2008) municipal solid waste management is every activity that deals with solid waste from its generation to transport, transformation and storage. Solid Waste Management encompasses the following functions and concerns:

1. **Planning and Management:** - Strategic planning, Legal and regulatory framework, Public participation, Financial management (cost recovery, budgeting, accounting, etc.), Institutional arrangements (including private sector participation), Disposal facility.
2. **Waste Generation:** - Waste characterization (source, rates, composition, etc.), Waste minimization and source separation.
3. **Waste Handling:** - Waste collection, Waste transfer, treatment and disposal, Special wastes (medical, small industries, etc.).

2.3.3 Solid Waste Management Composition and Techniques

Municipal Solid Waste varies in composition, which may be influenced by many factors, such as culture affluence, location etc. Municipal Solid Waste management depends on the characteristic of the solid waste including the gross composition, moisture contents, average particle size, chemical composition and density, in which the knowledge of these usually helps in disposal plans (Sally, 2000). In Nigeria today, urban centres are experiencing an increased rate of environmental deterioration, with refuse dumped along drainage channels. Most cities in Nigeria are faced with waste Management problems**.**The following are the component of solid waste (Sally, 2000).

2.3.3.1 Solid waste generation

Developed countries also generate waste that is less degradable; because of high level of industrialization (Conitreau, 1982; Filani and Abumere, 1986; White and Hindle, 1997). According to Afon (2006) it has been emphasized that the quantity of solid waste generation in the economical advanced countries is more than in the developing countries. Paradoxically, developing countries have recorded more failure in the efforts to manage the solid waste generation effectively. Reason for this includes the lack of adequate information on the quantity of waste generation and lack of understanding of the socio economic and demographic factors affecting waste generation (Rushbrook and Pugh, 2000).

2.3.3.2Solid waste collection

Solid waste collection is generally considered to be the most important component of any waste management system because it is the most expensive and visible part of the system. Therefore, properly designed and executed waste collection systems can result in significant savings and reduction in environmental and public health risks UNEP/IETC, (1996).

.Holmes (1984) argued that 70% of solid waste in low-income areas consists of material which decomposes, there is a high proportion of vegetable matters decomposition of the waste proceeds more rapidly in the hot and humid climate than in temperate regions. After two days offensives odours are produced and infestation by flies and rats may occur. Regular collection is essential. Sudhir, Srinivasan and Muraleedharan (1997) stated that informal waste collectors are also subject to fluctuations in the prices of recyclable materials and the control recycling dealers have when buying collected materials.

According to Ogwueleka (2003) incorporating the rag-pickers in the Solid Waste Management program will contribute to the overall sustainability of the community. These informal waste collectors dump waste at the most convenient distances they can move, thereby polluting the air. Less than 60% of municipal solid waste generated is collected in developing countries. Zurbrugg and schertenlieb (1998) describes that one to two thirds of the solid waste generation in developing countries is not collected.

Informal waste collectors also known as rag-pickers make a large contribution to Solid Waste Management by separating out recyclables from wastes as a source of income. Informal waste collectors are relied on for roughly one-fifth of recyclable collection from public waste bins (Beukering, Sehker, Gerlagh and Kumar, 1999). Rosario (2004) argued that even though they contribute to the Solid Waste Management system they are often discriminated against and

harassed by local authorities. Waste collectors hold one of the lowest social standings of Indian society, as a residual effect of the caste system in which waste collectors were among the lowest castes. Stigma continues to follow those who collect waste as a source of income. Beall (2010) stated that the denigrating social conditions in which the informal sector works reinforces unequal social and power structures dealing with Solid Waste Management.

2.3.3.3 Solid waste storage

According to Flintoff (1984) storage of solid waste can be grouped into two; that is storage at household and the communal level: Ideally, household solid waste should be stored in a strong container of sufficient capacity which is easy to empty and clean, and has a well-fitting lid. According to Holmes, (1984) galvanised steel and plastic bins can satisfy these criteria, the use of communal storage containers to which householders carry their waste to remain a common option for low income communities. Metal drums can be used provided that they are more supply to replace those which become damaged and more than one drum should be provided at each point. Skip-trucks which when full can be hoisted on to a standard vehicle, empty containers areother option for communal storage. This method usually depends upon the local authority possessing the equipment. Unfortunately none of these means of communal storage is satisfactory. Whilst the ideal communal container does not appear to exist, Flintoff (1984) proposes a container of capacity 2 cubic meters with steel doors and flaps which is more hygienic, restricting access and ease of emptying.

2.3.3.4 Solid waste disposal

The United States Environmental Protection Agency (USEPA) 2008 has devised an approach it calls "integrated solid waste management." "Integrated solid waste management" means using a combination of five ways to dispose of solid waste as much as possible. The important word and the definition is "combination." No single approach to managing solid waste will solve the problem completely, only by combining methods which can truly manage our waste. The USEPA's techniques to manage solid waste are: Source Reduction, Recycling, Composting, Waste-to-Energy Incineration, and Landfills.

2.3.3.5 Landfills

According to Miller(1990) there are several different ways to manage the solid waste produced in mining, processing, manufacturing, and using resources, but most can be categorized into two different approaches. The high-waste approach involves leaving it somewhere, burning it, or burying it (in a sanitary landfill or any hole in the ground). The low-waste approach is twofold: attempting to produce as little solid waste as possible, and diverting as much solid waste away from landfills and incinerators. Over the past few years, the former has been viewed as cheap and irresponsible, and the latter has been viewed as initially expensive but morally gratifying.

Environmental Research Foundation (2011) conducted a research on landfill. The study found out that a secure landfill is a carefully engineered depression in the ground (or built on top of the ground, resembling a football stadium) into which wastes are put. The aim is to avoid any hydraulic [water-related] connection between the wastes and the surrounding environment, particularly groundwater. Basically, a landfill is a bathtub in the ground; a double-lined landfill is

one bathtub inside another." Three types of landfills are normally used for solid waste disposal and they are: secured or sanitary landfills, controlled landfills and open dumps. As defined above, secured or sanitary landfills are highly lined at the base to prevent infiltration by percolating liquids, controlled landfills are waste dumps where the refuse are merely covered with soil, and in open dumps there is no standard for refuse dumping. In developing nations, a great proportion of solid waste generated are dumped either in controlled landfills or open dumps which constitute sources of health risks to surrounding residents.

In a bid to examine the link between environmental pollution arising from waste dumps and public health, the United Nations Environmental Programme (UNEP) conducted a pilot study of the Dandora Waste Dump in Kenya. The study, as tentative as it was, showed that a link exists between the two. The extensive tests carried out on the soil and water around the dump site in comparison with samples from other sites as well as medical tests carried out on humans living around the dumpsite shows evidence of infections from water, land and air pollution. The leachates generated in the landfills and open dumpsites are sources of pollution which is inimical to public health (UNEP, undated).

2.3.3.6 Incineration

Miller (1990) observed that burning solid waste in incinerators kills disease-carrying organisms and reduces the volume of waste by 90% and weight by 75%. In waste-to-energy incinerators, the heat released from the burning of solid waste can be used to heat nearby buildings, or sold to generate electricity. Unfortunately, the good news ends there. The author stated that solid waste incinerators emit small but noticeable amounts of lead, cadmium, mercury, and other toxic substances into the air we breathe. The most frightening item piped into

the atmosphere is dioxins, which are carcinogenic. Most importantly, these incinerators also produce energy. The heat produced by burning trash can be recovered through a steam turbine that produces electricity. In some instances, the steam itself is used to provide heat (TN-SWEP, 2009).

2.3.3.7 Composting

What do we do with all the food on our dinner plate that will go to waste? There are options: throw it away in the trash can, dump it down the sink via disposal systems in the plumbing, or compost it. Anything that is naturally degradable can be compost. Food and organic waste created by food processing plants, kitchens, galleys, animal feedlots, yard work, and municipal sewage treatment plants. Paper, leaves, and grass clippings can be decomposed in this process in backyard compost bins, and the end result can be used in gardens and flower beds. Composting yard waste reduces the amount of solid waste in developing countries by nearly 18%. Presently, less than 1% of developing countries waste is composted (Miller, 1990).

2.3.3.8 Recycling and recovering

According to miller (1990) recycling and recovering entail the reduction of waste and recovering it at the same time. The author stated that manufacturers who deals with hazardous waste management can attempt to reduce the toxins and harsh chemicals in their products. For example, Bowling Green State University in Ohio decided to switch from paper cups to glass cups. The author noted that they saved over a million paper cups from the landfill, and they saved over $32,000. Japanese retail executives are appealing to "green" customers by reducing the amount of paper and bows used to wrap purchases. The author observed that McDonald's

Corporation is "committed to buying recycled." They claim they have bought over $1 million worth of recycled products since 1990, they carry corrugated cardboard in every restaurant, they drastically reduced food wrappings, and they now use brown paper bags instead of their bleach-white paper bags. The author observed a mere 13% of American waste is recycled, an equal amount is burned in incinerators, and the rest heads to the dump. But recycling remains the most popular environmental activity among the peoples of industrialized nations, simply because we do it as often as we throw something away. The percentage of paper that is being recycled in other nations sends a clear message to Americans: we are not doing enough. Americans only recycle 28% of the paper we use, although we lead the world in paper consumption and paper waste. France, Sweden, Switzerland and Finland recycle at least one-third of their paper expenditures. Japan, Mexico, and the Netherlands are at a 44% rate, which is the highest in the world. The American federal government alone uses two per cent of all paper products in this country, but half of the trash thrown away is paper.

According to Adams, (1999) recycling programs are springing up in every corner of the globe, recycled goods are being utilized and recycled again, and Americans are at least doing something on environmental on a regular basis. These resource recovery programs extend the globe's mineral supply by reducing the amount of virgin materials that need to be removed from the globe to meet the demand. Resource recovery saves energy, causes minimal pollution and land disruption, cuts waste disposal costs, and extends the life of landfills by preventing waste from residing there. The author observed that American industries are not purchasing recycled paper and aluminium due to high prices, which causes a financial domino effect. All the bundled papers and crushed cans that the public has consciously and diligently placed on their curbs are the ultimate victims of the effect, which sends these recyclables towards the landfill. National

environmental leaders are urging Congress for national minimum standards on recycled contents in recyclable manufactured goods. Some newspapers already do this on their own (like The Independent Florida Alligator and The Miami Herald) due to environmental conscience, local and state laws, and/or economic sensibility. (An example of the latter is due to the skyrocketing cost of virgin newsprint; recycled newsprint is less expensive.) If this was implemented as a federal law, industries would be mandated to purchase the recycled goods for manufacturing, thereby eventually reducing the cost, and making it economically feasible to avoid using virgin products.

2.3.3.9 Solid waste transportation

Flintoff (1984) stated that the management of solid waste involves the transfer of waste from one location to another; access width, and the type of waste storage in use are relevant to the vehicle design. However, in steep or inaccessible areas waste may be manually carried to transfer stations in bucket or shoulder panniers connected by a bar. The author observed that the use of either pedal or motorized tricycles to power a frame carrying potable containers speed up transfer operation and increase the radius of collection, they are appropriate in areas of low population density. Carts drawn by bullock, horses or donkeys can pull much larger loads over longer distances than tricycle systems, although they are very slow. In many cities this does not present too much of a problem as traffic congestion prevents rapid transit by any sort of vehicle.

Flintoff (1984) and Holmes (1984) suggested that for consistent transit of waste, the small single-axil mini tractor units common in south Asia can carry between 1000 and 3000 litres depending upon the trailer design. Coffey (1989) suggested that the use of a small container handling vehicles can result in operating cost four times less than those from conventional

western compactors vehicles. It is important to ensure that the design of communal containers and transfer stations enable the local authority to adopt the most efficient solution. Cointreau (1997) observed that animal carts are quite and do not consume fossil fuel. Tractor-trailer unit are much quicker than animal cans.

2.3.3.10 Recycling

Miller (1990) stated that plastic has approximately four lives; usually beverage and laundry containers see their third or fourth life in other forms, such as plastic picnic benches or plastic park benches. Recycled paper, after the de-inking process, can go about three lives; after that, the pulp fibres within the paper degrade.

Young (1995) stated that to reduce solid wastes, people must reduce discarded products; we can cut back on the amount of trash we produce by buying things with changed product packaging and content. This is buying items from companies that use recycled products. It is called recycling, and the whole process of recycling what you buy and buying recycled things is called completing the cycle. Reducing and reusing will not work unless a market exists for this material, and the consumers of these recycled goods should be the public.

According to Agunwamba, Ukpai and Onybuenyi(1998) efficient recycling could save 18.6% in waste management costs and 57.7% in landfill cost in Nigeria. Once an item has been used, recycled, and reprocessed, and appears on the shelf a second time, it is said to be in its second life. Glass and aluminium have unlimited lives theoretically, they can be recycled and reused forever. Ruzi (2001) stated that recycling can be inefficient in Nigeria as a whole, these methods of solid waste management like controlling or incineration, but is environmentally more desirable.

Ogwueleka (2003) stated that one way to manage solid waste is to reduce the waste we generate at the source. This is called "source reduction". There are no formal recycling of resource recovery programmes in Nigeria and no policy on composting. The author stated that for manufacturers, "source reduction" means producing less waste at a manufacturing facility itself. It also means designing products that have the least amount of packaging necessary to keep the product safe and of a high quality so as to meet the needs of the consumer. For individuals, "source reduction" means reducing how much you use of an item, or deciding whether to use it at all. Writing on both sides of a sheet of paper before throwing it away is an example of source reduction. The author observed that 60 per cent of wastes collected in Nigeria are organic waste and only 8% are recovered for reuse. TN-SWEP (2009) gave example of using durable clothing, appliances, furniture, and recreational equipment carefully and responsibly so that these items do not wear out so quickly.

2.3.4 Goals and Principle of Solid Waste Management

WHO (1971) stressed that solid waste management is an important facet of environmental hygiene and needs to be integrated with total environmental hygiene planning. Its storage, collection, planning and disposal can lead to short-term risks. In the long term, there may be dangers arising particularly from the chemical pollution of water supplies.

Sanitary landfill could be used in filling up borrow pits, valleys, erosion, gully sites, and other depressions; thus, using refuse to reclaim land. In general, no method of disposal can totally destroy the hazardous components of wastes. Each method leaves a residue of some kind (Nuclear Regulatory Commission(NRC) 1983).

Levin and Morris (1983) explained that over a long period of time it may be impossible to prevent the release of toxic leachates or gases from the landfill. Toxic leachate from the landfill pollutes the ground water and soil. Murray and Raymond(1984) stated that incineration creates both gaseous emissions and ash, which may contain metal or hazardous compounds such as carbon monoxide, hydrocarbons and particulate matter.

According to Malombe (1993) irregular services rendered to producers of refuse by municipal councils compel them to find ways of disposing of refuse. The author observed that the main methods adopted by the producers are burning, composting, or indiscriminate dumping.

Composting is an aerobic microbial driven process that converts solid wastes into stable, sanitary humus.

Baron (1995) stated that when human cities began to be more concentrated, solid waste management became a serious issue. Houses that did not have room to bury their garbage would throw it into the streets, making a stroll to the corner store an unpleasant prospect. In response, many cities started to set up municipal garbage collection, in the form of rag and bone men who would buy useful garbage from people and recycle it, or waste collection teams, which would dispose of unusable garbage.

Smith (1996) stated that improperly prepared and operated sites may result in toxic heavy metal, hazardous, pollutants and products of aerobic decomposition seeping from the site into underground aquifers and subsequently polluting urban water supplies. The leachate from these toxic heavy metals can also degrade the soil, it can cause the soil to be acidic and the soil cannot be used for agricultural purposes again. The author concluded that open dumping reduces the aesthetic value of the environment and causes street litters. It also poses as a potential hazard to

human health. It brings about rats, flies, and other rodents which can transmit disease and cause epidemic in the environment.

According to Peter, Karl and Jurg (1996) to achieve the goals of Solid Waste Management, sustainable systems of waste management must be established. Waste management should be approached from the perspective of the entire cycle of material use, which includes production, distribution and consumption as well as waste collection and disposal.

Uchegbu (1998) pointed out that the major reason for processing refuse is for volume reduction. The author further explained that as a result of low level technology, lack of finance and high level of illiteracy in the developing countries, open dumps are much in practice. The closure of existing open dumpsites and the introduction of sanitary landfills are of urgent priority. Even when complementary disposal technology such as composting and incineration are practised, a landfill is still required and is the backbone of any sustainable disposal system (UNEP, 2003).UNEP (2000) stated that Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.

Chaz (2002) stated that the unsightly dumpsites of municipal solid wastes are characterized by various non-biodegradable household Petrochemical products such as polythene bags, plastic containers, Styrofoam, packages and the tyres.According to Chris, (2003), recycling inorganic materials from municipal solid waste is often well developed by the activities of the informal sector although such activities are seldom recognized, supported, or promoted by the municipal authorities. Recycling of solid waste is a method of solid waste management that have been practiced since ancient time. For example, metal implements were melted down and re-casted in

prehistoric time. Today, recyclable materials are recovered from municipal refuse and recycled. Reuse of organic waste material, often contributing to more than 50% of the total waste amount, is still fairly limited but often has great recovery potential. It reduces costs of the disposal facilities, prolongs the site's life span, and also reduces the environmental impact of disposal sites as the organics are largely to blame for the polluting leachate and methane problems.

World Bank(2004) gave the fundamental objectives of domestic solid waste management are to minimize the pollution of the environment as well as utilizing the waste as a resource. These goals should be achieved in a way that it is financially sustainable and the methods and strategies that can be affordable over a long time should be adopted and with minimum risk to the persons involved. Strategies for participation exist in a wide variety of forms ranging from government involvement in community development activities to peoples participation and often take place at the same time.

According to Bellany(2007) monitoring involves constant examination and recording of the waste components and quantity of waste disposed over a period of time and also the compliance of the waste generators to the waste management policies .Collection is the component of waste management, which comprises lifting, and removal /passage of a waste material from the source of production to either the point of treatment or final disposal. Collection of generated solid waste is the crucial part in MSW management. Efficiency in collecting solid waste and segregating it decides how well solid waste is managed. Collection includes not only the gathering of solid waste, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a material processing facility, a transfer station or a landfill disposal site.

UNEP (2009) stated that processing is preparing MSW materials for subsequent use or management, using processes such as baling, magnetic separation, crushing, and shredding. The term is also sometimes used to mean separation of recyclables from mixed MSW. Recycling is the process of transforming materials into raw materials for manufacturing new products; this may or may not be similar to the original product. Disposal is the final handling of solid waste, following collection, processing, or incineration. Disposal most often means placement of wastes in a dump or a landfill.

According to Arthur (2010) most of the municipal solid waste in developing countries is dumped on land in a more or less uncontrolled manner. These dumps make very uneconomical use of the available space allow free access to waste pickers, animals and flies and often produce unpleasant and hazardous smoke from slow-burning fires. On-site disposal has become increasingly popular during the past decade as a way of minimizing the waste problems as its source. The most widely used devices for onsite 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.

The goals of Solid Waste Management are to:

1. Protect environmental health
2. Promote the quality of the urban environment
3. Support the efficiency and productivity of the economy
4. Generate employment and income

Most of the wastes generated in most municipalities are not collected. They usually end up as illegal dumps on streets, open spaces, and wastelands. Despite the importance of adequate solid

waste management to the urban environment, the performance of many city authorities in this respect leaves much to be desired.

According to Martin Medina (2010), found out that the nature of human life produces wastes continually which result into pollution. And one kind of these wastes is called municipal solid waste which is the general waste collected by municipalities, and it is generated mainly by households, commercial activities and street-sweeping, as well as construction and demolition debris.

According to Huang, Wang, Dong, Xi, and Zhou, (2006) most municipal solid waste is produced in the daily life of local citizens, including dust, titles, paper, plastic, textiles, glass, metal, wood, and residual food. However, human is trying at same time to find consistent solutions for managing municipal solid waste and to prevent pollution. Nevertheless, these later can't be prevented and disappeared if the human is still in the earth. Hence, it is our concerns to reduce the pollution by following reduce, reuse, and recycle, which are called the 3R principle.

According to the world commission on environment and development "WCED" (1987), sustainable development is defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In this context, the 3R principle seeks to provide the natural resources for future generation by reducing the use of these natural resources and reuse and recycle it as most as possible. As well as it reduces pollution by waste minimization and prevent the environment.

According to World Bank, (2005) the 3R Principle (Reduce, Reuse and Recycle) of waste management, is to first reduce waste generation and separate potential recyclables at source to improve the quality of materials for reuse, including organics for composting or anaerobic digestion that cannot be reduced but should be reused if possible. Wastes that cannot

be reused or reduced should be recycled, particularly secondary materials such as metal and paper. Wastes that cannot be recycled should be recovered, usually through bacteriological decomposition or should be incinerated or landfilled. And the goals of reduce, reuse, and especially recycle have become the only acceptable ways of disposing of waste (Daniel, 2003). The policy that incorporates waste reduction, reuse, recycling and composting called "zero waste" which means zero disposals and zero warming from waste. Indeed "zero waste" seems to be a difficult but not impossible task. If various options for waste management can be integrated and applied over long period, waste minimization can be addressed effectively and sustainably (Adedipe, Sridhar, and Baker, 2005).

2.3.4.1 Reduce

The first step in waste management is to try and prevent the generation of waste by reducing at source the waste produced. This is the prevention principal "avoidance of waste" (Adedipe, Sridhar, and Baker, 2005; and Bhoj and Bounsouk, 2005). And one of the best ways to reduce the amount of solid waste that must be disposed of is to limit the consumption of raw materials (Sabir Syed, 2006). Reducing packaging can reduce total waste produced and total resources used (Daniel, 2003). Reducing waste can be also through reducing the use of plastic bags, reducing the use of plastic and paper plates, cups and plastic utensils, and consume more reusable items. ISSN 2039-2117 (online) ISSN 2039-9340 (print) Mediterranean Journal of Social Science MCSER Publishing, Rome-Italy Vol 4 No 3 September 2013,131

2.3.4.2 Reuse

Where reducing is not possible, the wastegenerated should be reused. Reusing items can be by repairing, selling or donating these items to charity and community groups, and therefore this can reduce waste. Reuse is preferable to recycling since the item doesn't need to be reprocessed. In addition to environmental consideration, sensitive reuse schemes can have important social and cultural benefits (UNEP, 2003). In some developed countries such as Japan, Sweden, Belgium and Denmark, the index of reuse of solid waste is over 90% (Lino and Ismail, 2012). Moreover, reusing plays an acceptable role in developing countries. In China for example, in order to avoid using plastic bags, the Chinese government has created a policy since 2008, to pay for the plastic bags, and encourage using reusable bags. So, all supermarkets in China sell the plastic bags which pushed people to reduce using it, and provide reusable bags to use instead of the plastic bags. Another example in developing countries, refillable glass bottles are still widely used, and families routinely take the empty bottles to grocery stores when they purchase beverages. If someone doesn't bring an empty bottle when purchasing a beverage in a refillable bottle, must pay a deposit equivalent to the cost of the bottle. This encourages the return of reusable bottles, which is in parallel encouraging the reuse principle. Recently, repairing furniture, bicycles, and others are more expensive than buying new products. In many countries reuse centers have been established. These centers aim to break the short product to waste cycle extending the life of the products through repairing them and selling them at a low price. The reuse centers can also be used as means of creating employment for people with problems in entering the job markets or suffering from long term unemployment. In Japan and other industrial countries, "industry clusters" have been planned, where the waste of one industry is the resource of another (Adedipe, Sridhar, and Baker, 2005).

2.3.4.3 Recycle

Recycling is taking a product or material at the end of its useful life and turning it into a usable raw material to make another product. It can be promoted by encouraging separation at the source which can be achieved through financial incentives, stimulation, legislation and rising of environmental awareness (Jasem, 2005). The recyclables have to be collected from many sources, including households, business, and construction sites. Then these collected recyclables transported to a materials recovery facility, where they are sorted and processed before being sent to manufacturers. According to European Environment Agency "EEA" report, 2013, many European countries increased the share of municipal waste recycling, and the highest rates are in Austria, with 63 %, followed by Germany (62 %), Belgium (58 %), the Netherlands (51 %) and Switzerland (51 %). In order to insure the recycling of waste, China has established a number of recycling and disposal waste cooperatives (Miao, Hong, and Qun, 2012). Moreover, resource recycling of domestic waste is a major strategic emerging in China, and it is an even more crucial energy saving and environment friendly strategic emerging industry which will continue to grow in the future. And there will be a vast market for second hand materials in China (Chang, Mengdi, and Qian, 2012). However, recycling is a manufacturing process, and therefore it too has environmental impact but these impacts are less than landfill and incineration, as well as they are less than producing new products with virgin materials (Daniel, 2003). The convention that resulted in Kyoto protocol realized in Japan, in 1997, established that industrializes countries must reduce their emissions during the period 2008- 2012. And the developing countries had a big potential for reducing their emissions. China, for example had the biggest annual reductions of emissions with 46% (Lino and Ismail, 2012).

2.3.5 The Importance of the 3R Principle

The most importantly is that 3R principle helps us toward sustainable living. Making people think about the impact of their consumption and production of waste can help to encourage us to make lifestyle decisions to reduce the waste we create and reduce the impact on the environment. Reduce, reuse and recycle help to save natural resources for the future (Sabir, 2006; Mohan, Gavin, Ranjith, and, Tharumarajah 2011; Lino and Ismail, 2012). In addition, as more items are reduced or reused and recycled, the amount of waste that needs to go to the landfill or incinerator is also reduced, in this way we can save the costs of landfill and incineration as well as we can save landfill space (UNEP, 2003, Lino and Ismail, 2012).

Furthermore, recycling and reuse create more job opportunities, as recycling continue to grow, more workers will be needed to collect, sort, and process recyclables. And reuse centers can also be used as means of creating job opportunities (Ankit, Ashish, Mukul, and Atul, 2005; and Kun Yue, 2012). Applying 3R principle creates less air pollution and reduces climate emissions, such as CO2 and greenhouse gas emissions (UNEP, 2003, Conrad and Jan, 2010, Mohan et al, 2011, Lino and Ismail, 2012). Moreover, recycling saves energy (Conrad and Jan, 2010; Kun Yue, 2012; Sifang, Hui, Zeng, and Yangsheng, 2012), and it reduces water pollution and water consumption (Lino and Ismail, 2012). There are countries that do not have their own natural resources but they can import waste material, such as paper as raw material for their manufacturing industries.

2.3.6Types of dumpsites

Legal dump sites usually involve waste management experts who gather approved types of household and industrial waste in designated areas, where they bury or burn the waste.

According to Kurian, Nagendram and Palanivelu(2001) anillegal Dump Site is a land disposal site at which solid wastes aredisposed of in a manner that does not protect the environment, is susceptible toopen burning, and is exposed to the elements, disease vectors and scavengers. These unplanned heaps of uncovered wastes, often burning and surrounded by pools of stagnated polluted water, rat and fly infestations with domestic animals roaming freely and families of scavengers picking through the wastes is not only an eyesore but a great environmental hazard.As a default strategy for municipal solid waste management, open dumps involve indiscriminate disposal of waste and limited measures to control operations. Very often, open dumping sites are swamp lands or low-lying areas with the wastes being used for reclamation. Liners are rarely used and little consideration is given to the water table and groundwater pollution and/or gas migration.

The authors observed that shortage of cover, lack of leachate collection and treatment, inadequate compaction, poor site design, and many rag-pickers working at the site are common. The high percentage of organics, combined with much plastic, which forms layers when compacted, contributes to the build-up of methane gases at dumps. In cities where plastic shopping bags are used to put out wastes for collection, waste pickers sometimes set refuse on fire in order to recover valuable inorganic items. Spontaneous fires also break out in dumps. This greatly adds to the air pollution from dumps. The roads leading to dumps and those on dumps themselves are often elementary, becoming impassable in the wet season.Since most large dumps have hundreds of extra workers in the form of waste pickers, and the municipal workers are not provided with protective gloves, the health risks at dumps are much higher than in sanitary landfills inindustrialized countries. These workers are exposed to risks from human faeces,slaughterhouse wastes, landfill gases, toxic dust, infectious biomedical wastes,snakes,

scorpions, broken glass, and explosions. Thus, these dump sites are essentially uncontrolled, creating considerable health, safety, and environmental problems. The authors defined legal dumpsites as a location design to meet the standard of World Bank, 2014 (Dumps should be cited 200 metres away from residence) or according to the rules and regulations of the authority.

According to Marc (2006) the location of the dumpsites should be properly planned and managed to avoid risks to human health and the environment, at large. Corrective and management measures are likely to be expensive, complex, and pose serious threats to the environment and its habitants.

According toMiller(2010) a few decades ago, people preferred to manufacture products that could last longer; they tended to repair rather than replace goods. As the industrialrevolution promoted consumerism, nearly every city and town established an illegal dump site, where citizens brought items that could not be otherwise reused,sold, or recovered. With the population growth, people produced more garbage thereby, turning city dumps into mountains of stinking and toxic garbage. The garbage situation in less developed parts of the world is a serious concern to environmentalists and health experts. Lesser affluent countries often cannot afford modern trash collection systems or technologically advanced landfills, so mountains of trash pile up on residential streets and in open-air dumps, creating health, safety, and environmental hazards.

Accordingto Niger State Environmental Sanitation Edict (1996) illegal dumpsites are unregulated informal sites where individuals or industries dump a variety of solid or liquid waste with no formal treatment or pollution controls. They are piles of waste and debris left in a noticeable quantity which are commonly found in backyards, drainage and abandoned buildings.They may be unsanctioned or informally accepted by the government but likely there are no standards for treatment or control of waste, and little control over what types of wastes are

dumped. Municipal landfills may be operated by the government or a private entity but are often poorly constructed and employ only limited measures for protection against pollution. In addition, abandoned municipal sites are often not properly capped or covered to prevent pollution. Legal dumpsites are site recommended by the state government which are cleared within a period of time. In Minna, the legal dump sites recommended by the state government are enclosures constructed from concrete, fixed storage bins, mobile storage bunkers, metal drums and skip trucks. The enclosures which are constructed from concrete, although left open are particularly located within the low income neighbourhoods such as Chanchaga, Hill Top Bosso, and Dusten Kura. The mobile storage bunkers on the other hand are of two types; the red and yellow bunkers. Both are placed at the market places and at road side within the residential neighbourhoods. The skip trucks and metal drums are located on major roads in the area. The provision of these container are stipulated by the Niger State Environmental Sanitation Edict (1996) is the responsibility of the Local Government Council, while the Niger State Urban Development Board (NSUDB) provides the specification of waste disposal sites that guaranties the safety of surface and groundwater systems. Since 1998, the Niger State Environment Protection Agency (NISEPA) has been responsible for the provision of these receptacles within each neighbourhood and more than 30% of these are receptacles are in bad shape.

In Minna the main legislation relating to solid waste collection and disposal is schedule 4 paragraphs (h) of the 1999 constitution of the Federal Republic of Nigeria gives mandate to the local Government councils on solid waste collection and disposal. According to Edict 1996 of the Niger State Environmental Protection Agency (NISEPA) which came into operation on first of June 1996. Section 7 paragraphs (k) of the Edict regulates the collection and disposal of refuse disposal and that the Agency shall regulate operational mechanism for refuse collection,

transportation and disposal of solid waste from residential areas, commercial and industrial establishments, and public places. Part ii section 12 subsection 7 (a) of the Niger State Urban Development Board (NSUDB) 1999 Edict without prejudice to the provisions of the existing laws relating to refuse disposal, the board shall have the powers of collection, disposal and transportation of solid waste. Section 7 paragraph (1) Edict of the NISEPA 1996 defines "garbage and solid wastes" as including domestic and industrial waste. It also specifies garbage containers, means of transportation, and the periodicity of solid waste collection. Schedule 4 paragraph (5) of NSUDB Edict It declares specifications and identification of solid waste disposal site in urban areas without specifying what type of methods of treatment on the waste (e.g. dumping, composting and incineration). Other relevant laws are:

i. NSUDB Section 12 subsection 24 of 1999 provide specification of waste disposal sites that guarantee the safety of surface and underground water systems
ii. NSUDB section2 subsection 25 of 1999 the setting up and enforcement of standards for adequate sanitary facilities for the disposal of solid waste dwellings, housing estates and public facilities in urban areas;
iii. NSUDB section 12 subsections 1-5 of 1998 amended in 1999 regarding urban planning and the importance of having enough space for .public services and utilities through environmental consultants,
iv. NSUDB sectionl2 subsection26 of 1999 establishment of monitoring programmes including periodic surveillance of approved waste disposal sites and their surroundings
v. NSUDB section 12 subsection 27 of 1999 establishment of an early warning system for the identification of potential waste disposal hazards,

vi. Schedule 4 paragraphs 1 of NSUDB initiation and regulation of the operational mechanism for refuse collection and disposal

vii. Schedule 4 paragraph 2 of NSUDB provides technical assistances to local government planning authorities on waste management.

viii. Schedule 4 paragraph 3 of NSUDB enters into contract with public and private institutions on solid waste matter.

ix. Schedule 4 paragraphs 4 of NSUDB provision, maintenances and supervision of abattoirs, slaughter houses, hotels, clinic/ hospital to ensure acceptable sanitation. From the interview conducted with the Head of waste management and sanitation unit at NISEPA, He stressed out the effort of the State Government of Niger State in 2002 to have forbid the indiscriminate disposal of waste in drainages and open ground and formalized it by subcontracting of door-to-door waste collection by private waste collectors to aid the collection of waste in the urban areas, these will help reduced the traditional, informal private small-scale waste collector who collect waste from institution or market place and dumped them on open ground and drainages. Yet these were not achieved due to lack of definition of roles and responsibilities between the private contractors and NISEPA.

Section 8 paragraph (k) NISEPA of 1996 requires environmental impact assessments of new developments, including industrial projects. The Niger State Government established the Environmental Protection Fund to fund various relevant environmental projects (ecological garden in secondary schools, bill boards). The Fund is supported financially by UNDP, and the proceeds from fines paid by those contravening environmental regulations. NISEPA presently is advocating setting up a system of incentives to be offered to organizations, individuals, and

others, to carry out projects for environmental protection; and covers the protection from pollution of the land, water and air environments. In particular, the N1SEPA Edict stipulates the following:

Section 7 paragraphs (e): Forbids the handling of hazardous substances and wastes which will endanger the environment and the ecosystem, without a license from the competent administrative authority.

Section 7 (e, ii): Makes it mandatory for all those who violate or discharges hazardous substances responsible for damages they may have cause Section 7 (e, iii) cause penalty to be paid for such violation and to negotiate appropriate compensation to be paid to victims of such discharged.

Section 7 (e, IV): reinstate, rehabilitate or cause the affected environment to be restored to its original state at the expense of the defaulting party

Section 7 (m): States that collector of garbage and solid waste shall maintain their garbage bins and vehicles in a clean state. Garbage bins shall be covered tightly so that no offensive odours shall emit, and also to avoid becoming a source for attracting and growing flies and other similar insects or a focus for attracting stray animals. The garbage contents shall be collected and transported at suitable intervals according to the conditions of each area. The quantity of garbage shall not exceed the capacity of any of these bins at any time.

2.3.7 Municipal Solid Waste Generation and Management

According to Tchobanoglous, These and vigil (1993) waste generation is an integral part of human activity influenced by social dynamics and economic development. Although nature has the capacity to dilute, disperse, degrade, absorb and reduce the impact of unwanted residues in

the environment, ecological imbalances have occurred where the natural assimilative capacity has been exceeded.

Agunwamba, Ukpai and Onybuenyi (1998) assessed solid waste management in Nigeria Cities. The authors observed that many Nigerians consume and discard indiscriminately without regard to the environmental impacts that may follow. The authors found out thatthose vehicles for waste collection include; open tippers, side loaders, moveable container trucks and rear loading compactors which most are not functioning. It was also observed that the curb system of collection is used in single detached residential areas and apartments; 1.5 m3 bins. The set-out/set-back system is practised in some residential areas in places like Onitsha. The authors found out that in apartments, institutions and commercial areas communal bins; movable and stationary containers are used.

Ogu, (2000) examined private sector participation and waste management in Benin City. The author interviewed 591 households in the area, and found out that 60 per cent of the respondents had no solid waste collection service. The study found out that waste management in the area is very poor. This can be attributed to inadequate resources, and the privatization scheme set up in 1995 to address the environmental issues. The study stressed the need for private partnership with government in providing adequate delivery services to the public.

Goldman and Ogishi (2001) assessed the economic impact of waste disposal and diversion in califonia. Using questionnaire and interview, the study revealed that the cost of dumpsites has prompted some municipal government authorities in the area to adopt cost-reduction programme as well as conservation tenets of "reduce, reuse, and recycle" to reduce the level of waste generation and recycle others, whether bio-degradable or non-biodegradable items, and the study observed that it is the best practice of waste management. The study observed that the activities

do not only have positive environmental impact on the communities involved, but also have an important impact on the economic dimension.The study concluded that there should be community education of consumers and producers on waste reduction methods, while institutions and businesses that could buy up discarded materials should be facilitated to enhance recycling and reuse.

Ahmad (2002) assessed the responsibility of women maintaining a healthy and clean household. Using questionnaire and interview, the author found out that women are responsible for maintaining a healthy and clean household. The finding revealed that women who are more severally restricted to their homes are more liberal in their tendency to waste sorting and sanitation at large.

Post (2007) examined waste reduction strategies in Jamaica. The author specifically focused on women participation in solid waste management in order to meet the waste reduction goals set forth by the Jamaican governments. Both qualitative (through in-depth interviews with national and regional institutions within the solid waste management system) and quantitative (through questionnaire survey on the household) research methods were employed. The findings revealed that the greatest potential for initiating waste reduction strategies exists at the household level through community-based programs. The study concluded that there should be diversion of food waste from the waste stream to domestic animal feeding.

Abel and Afolabi (2007) analyzed the quantity of solid waste generation in Oyo. The author used questionnaire and interview,the study found out that Oyo town is facing serious environmental problem, such as flooding, air pollution, bad odour and dirty street, arising from poor solid waste management. The study observed that solid waste is generated at a (96%) rate beyond the capacity of the city authorities to handle the waste. The author found out that it has resulted in

poor solid-waste management system that portends (80%) of the environmental crisis in Oyo. The study concluded that there should be effective solid waste management system.

Awomuti (2008) analysed waste generation rate and pattern in Illorin. Interview, questionnaire and observation were used, the study found out that the generation of solid waste in the area has increased (90%) drastically. The author found out that solid waste generation, collection, disposal and management problem is beyond the scope of the local and city councils. The author also found out that the study area is centred on the fact that major streets experience continual presence of solid waste varying from municipality (80%) and industries (20%). The study concluded that there should be public enlightenment on solid waste.

2.3.8 Effects of Inadequate Solid Waste Management

The cities of third world countries are growing at very rapid rates compared to those in the developed nations. For instance, a UN-HABITAT (2010) report observed that Africa is the fastest urbanizing continent having cities like Cairo, Lagos, Nairobi, Kinshasa among others growing at fast rates that would make them triple their current sizes by the year 2050. Such high rate of growth of cities has implications for the provision of urban infrastructural services to prevent the proliferation of urban slum.

The increasing growth of cities, therefore, has implications for municipal waste management among other social services required in the urban communities. Data from many of the cities shows inadequacy in urban social services like shelter, provision of safe drinking water and efficient management of solid wastes. The cities are therefore littered with ‘mountains’ of rubbish in landfills and open (in most cases illegal) waste dumps which are covered with flies and thus serve as breeding grounds for vectors like, flies and mosquitoes which transmit disease

like cholera, malaria and typhoid fever which constitute part of the highest killer disease in Nigeria. In some cases, they pollute surface and ground water, exposing the inhabitants to the consumption of contaminated water and food which is a danger to their health. The residents in these areas are also exposed to risk, such as bad odour, proliferation of insect, injury, dirty street, air pollution, fire outbreak, disease outbreak and flooding from blockage of drainage channels.

Gouveia and do Prado (2010) assessed health risk in area close to urban solid waste landfills in Brazil. Using questionnaire, the study found out that the waste landfills are generally safely constructed to minimise any form of negative externality, (e.g. pollution of ground water via leaching) to the surrounding areas. The authors found out that the use of sanitary landfills is not feasible for many waste management authorities of most countries due to cost constraints. The study discovered that in Brazil; only 47% of all the garbage collected was disposed of in sanitary landfills, 23% in controlled landfills while the remaining 30% were in open dumps.

Cointreau (2006) assessed environmental management of solid waste in developing countries.The study identifies the difference between occupational and environmental health risks through solid waste. The author found out that the first is limited to people handling wastes, like waste workers, pickers or scavengers; the latter affects the entire population. The study identify the occupational health risks, the term relative risk was introduced, comparing the diseases of waste workers and so on with a viable control group of the population

Wilsons (2007) examined development drivers for waste management in developing countries. The study found out that the negative impacts of solid waste on human health are well established. The study discovered that sanitation and hygiene aspects have become a so called "driver" for waste management. The study found out that people particularly in lower and middle income countries suffer from diseases caused by insufficient waste management.

Brunner (2008) examined the effects of solid waste activities on human health in developing countries. The author found out that there are disease agents that originate from solid waste activities which only can cause diseases or harm to humans if there is an environmental association between the two. The study observed that the result has been in existence for over 40 years, and it deals with health risks that are negligible in higher income countries, but still common in countries with lower income, like the transmission of the plague through biological hosts (rats) and biological vectors (fleas).

Ariko (2009) examined the effect of open burning of waste in environmental pollution in Nasarawa-Kudunam in Kaduna state. The study estimated the amount of carbon dioxide emitted per year to be 0.2% of the total gaseous emission, and other greenhouse gases are responsible for the increased rate of urban climate change in Kaduna metropolis as in other cities of the world. The author discovered that the inhabitants of Moro and other villages in Kaduna state at the upstream dump their waste in river Kaduna; as such the solid waste often increases in volume of the content of the river. At the peak of rainy season, the capacity of the channel becomes less than the water, the solid waste and other materials consequently; the water which is more mobile force itself out of the channel, and the result is flooding which has claimed some valuable properties worth millions of naira.

Ogunriola, Oluranti, and Adepegba (2012) examined the health and economic implications of solid waste disposal among sampled residents of two major refuse disposal dumps in Lagos, Nigeria. SPSS software was used in the data analyses. Descriptive analysis, linear probability and ordinary least squares regression models were also used in the analyses. The models examined the determinants of health status as well as the labour supply of the sampled respondents respectively. The study showed that pollution variables are statistically significant in

the determination of health status as well as the labour supply performance of respondents. The study found out that the policy measured would enhance the health status and improved labour market performance of residents proposed.

Etusim, Umeham, and Ezurike (2013) examined the effect of municipal solid waste in Okigwe municipal, Imo State, Nigeria. Questionnaire was used in this study, and the study identified 18 major waste dumps in Okigwe metropolis covering a land area of 36171.2m² estimated at N232, 60, 260. 12(66.7%) were found to disrupt movement of erosion while 6(33.3%) obstruct pedestrian and vehicle movement. The study revealed that out of the 2059.094kg MSW characterized, 930.45kg (45.19%) were biodegradables while 1128.64kg (54.81%) were non-biodegradables.

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 THE STUDY AREA

3.2.1 Location and Size

Minna the capital of Niger State is located between Latitudes 9^0 $36^/$ and 9^0 $61^/$ North of the Equator and Longitudes 6^0 $33^/$ and 6^0 $55^/$ East of the Greenwich Meridian (Maxlock, 1979). Minna urban area consists of two Local Government Areas, Chanchaga and Bosso spanning, from Malkunkele in north-east and Chanchaga in the South-eastern part of Minna, (see Figure 3.1).Minna is about 145 kilometres by roadfrom Abuja the Federal Capital Territory of Nigeria. It covers about 76,363Km^2 and it is located in the middle belt of Nigeria. Minna town is borderedby Shiroro Local Government Area in the North, Shiroro and Paikoro to the East, Paikoro and Katcha Local Government Areas in the South and Wushishi and Gbako in the West (MaxLock, 1979).

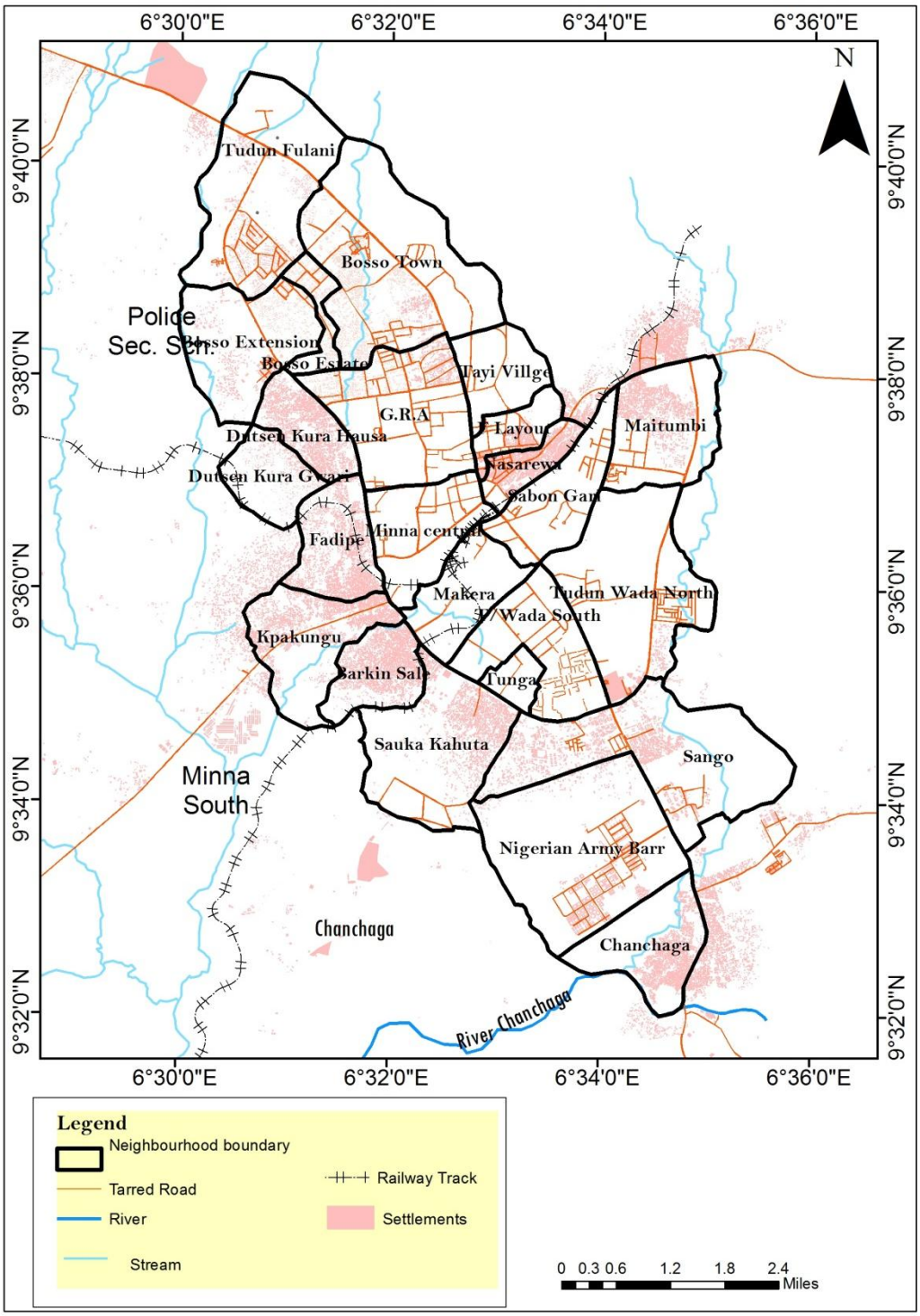


Figure 3.1: Minna Metropolis

Source: QuiuckBird Images, 2013

3.1.2 Climates

Maxlock, (1979), stated that the climate of Minna is the result of the general atmospheric circulation of air masses over the earth modified by surface topography and elevation. Minna is situated in the tropical region with tropical continental climate based on Koppen's Classification of climate. It is characterized by two main seasons, wet season between April to October and dry season between November and March. The principal air masses affecting the weather of Minna are the Tropical Maritime (mt) and the Tropical Continental air masses (ct). The broad rainfall pattern shows a distinct and fairly South-north gradient in which the annual rainfall decreases from the south fringe (Max). The highest mean monthly temperature is recorded in March with about 30.5^0C and the lowest minimum temperature occurs usually between December and January at about 25.10^0C when most parts of the state come under the influence of tropical continental air mass which blows from the Sahara Desert. Dry season commence in October. According toAti and Sawa, (2008) the annual rainfall ranges from about 1,2300mm to 1,600mm. It experiences high temperature all the year round, the mean annual temperature increases northward from about 30^0C to 37^0C

3.1.3Relief and Drainage

The topography of Minna consists of hills and mountains especially towards eastern and western part of the area. Due to these gigantic rocks, development has been restricted towards the eastern parts. All developments follow the line of the rock, which was halted by flat rock out crop at the extreme north. In most of the areas, the surface is composed of laterite, erosion and small stream that cut deep gullies leaving the residual crops generally eaten away by natural forces, such as rain and wind (Maxlock, 1979).

3.1.4 Geology

The major rivers that make up the drainage of Minna are the Bosso, Shango, Chanchaga, Ekpa, Suka and Gora Rivers. These rivers mainly have extensive tributaries that cover most part of the area and serve as major sources of water supply to Minna and its environs.The basic geology of the study area is a mixture of rock granites (Maxlock, 1979).

3.1.5 Soil and Vegetation

According to Oyenekenwa (2011), although there has not been any systematic soil survey covering the area, soils in the region represent an interface between intensive weathering of rocks and active surface and subsurface denudation system fuelled by intensive rainfall and rapid runoff. The soil type is primarily the result of the interaction between climate, flora and fauna, parent materials and geomorphic factors over varying period of time. Soils are developed from Precambrian basement complex rock comprising granite, schist, genesis and amphiboles which occur on an undulating welling dissected plain, developed on differenced basement complex. The surface soils are usually loamy sand to sandy loam. Most of these soils are gravely except the soil formed on colloidal material.

According to Ati and Sawa(2008), the vegetation of Minna is savannah andMinna lies in an ecological zone termed by plant geographers as the northern guinea savannah, a designation which implies a wood land vegetation type dominated by isoberlina doka, I. tometosa, and unpaccatogoencis tree species Andropogoneae herbs.The Fadamas of the larger rivers support savannah with occasional stream covered with dense riparian woodlands or forested area.

3.1.6 Population and People

According to the 2006 National Population Census, Chanchaga and Bosso Local Government Areas had a population of 234,619 people (Niger State Planning Commission, 2012) using the growth rate of 2.8 (World Bank, 2010)the population of Chanchaga and Bosso was estimated to about 309239 by 2016. There are three major ethnic groups (Nupe, Gbagyi and Hausa) in the State. Other minor tribal groups include – Kadara, Koro, Baraba, Kakada, Ganagana, Dibo, Kambari Kamuku, Pungu, Dukkawa, Gwada and Ingwai. Though the area is mainly Gwari settlement, it has since become heterogeneous in terms of people of various and diverse ethnic religious and cultural background (Niger State Planning Commission, 2012).

3.1.7Economic Activities

There are different types of economic activities in Minna metropolis. The main commercial zone in Minna area is Moblie, and is known as Central Business District (DBS). Being the state capital, virtually all the banks have their presence in Minna. Trading activities also takes places along the major roads and all the streets. The main market of the town is the central market (daily) and gwari market (weekly). The major industries include chanchaga clay products, Minna juice, food processing industry, bakeries and Julius Berger Construction Company. Tourism is under way but is yet to make its impact felt on the economy, because the potential are still being in the state of exploitation by the last administration headed by the last administration headed by Mu'azu Babangida Aliyu.

3.2 METHODOLOGY

3.2.1 Reconnaissance Survey

Reconnaissance Survey was carried out in Minna, Niger State, and a visit to NISEPA,NSTFE, and NSUDBand todifferent neighbourhoods in order to get acquainted with the study area andobserve general location and distribution of the dumpsites in the study area. This also gave the researcher an insight on various systems of dumping solid waste, and also identifying the legal dumpsites in the study area. The coordinates of all illegal dumpsites were read and recorded in the field at this time.

3.2.2 Types of Data

The data used for this study include information on;

i. A QuickBird 2013 Imagery of Niger State with resolution of 1mwas used to map out Minna town.

ii. Geographic coordinates of illegal dumpsites, acquired from fieldwork by the use of Global Positioning System (GPS).

iii. Data on the risk posed by the spatial distribution of illegal dumpsites to the environment in the area, acquired through the use of questionnaire.

iv. Data on dumpsites from Niger State Development Board (NSUDB), Niger State Environmental Protection Agency (NISEPA), Niger State Task Force on Environment (NSTFE).

3.2.3 Sources of Data

The source of data that was used in this research work is basically of two types: the primary and secondary data sources. The primary data sources were gotten from the field through, Observation, Questionnaire Surveyand GPS Survey. Literature materials like, Textbooks, Journals, Magazines, Pamphlets, Academic thesis and Government Officials Gazette form the secondary sources.

3.2.4 Procedure of Data Collection

GPS 76S was used to collect the coordinates of the illegal dumpsites. Questionnaire was used to capture the views of the people on the potential risks posed by theillegal dumpsites; information on legal dump sites was collected from NSUDB, NISEPA, and NSTFE,alsoinformation on the potential risk associated with the spatial distribution of illegal dumpsites was obtained through questionnaire distributed to the households.The questionnaire consists of 16 items and it was divided into three sections. Section: A contains demographic characteristic. section: B contains waste management and section: C contains the risks posed by the dumpsites.

3.2.5 Sample Size and Sampling Techniques

Available population census figure showed that Minna had a population of 234,619 in 2006. Using the national growth rate of 2.8 percent the projected population for 2016 is 309239. The formula used is as follow;

. $Pn = Pi\ (1+r/100)n$

Where Pn = Future Population

Pi = Base Year Population (2006)

r = Growth Rate (2.8%)

n = Projected Period (2006-2016 = 10 Years)

Bosso and Chanchaga therefore have a total projected population of (309239). Table 3.1 shows the total of 384 sample size which was selected from the study area based on Krejcie and Morgan (1972) sample size selection table, where it is stated that given a population size above 99999, sample size of 384 is appropriate.

The population size of each location is shown in Table 3.1. The proportion of questionnaire administered in each neighbourhood was calculated using the following formula,

$$n/N \times Q$$

Where n = Population of each neighbourhood

N = Total population of the neighbourhoods

Q = Total number of respondents

Table 3.1: The Neighbourhoods in the Study Area, their Population and the proportion of Respondents sampled

S/no.	Neighbourhoods	2006 Population	Estimated Population as at 2016	No of Questionnaire administered to Respondents
1.	Bosso Town	43,856	57,804	76
2.	Shango	6,494	8,559	11
3.	SaukaKahuta	4,274	5,633	7
4.	Barkin Sale	5,862	7,726	11
5.	Kpakungu	17,775	23,428	31
6.	Minna Central	19,496	25,696	34
7.	Tudun Fulani	5,083	6699	9
8.	Chanchaga	23,236	30,626	41
9.	Bosso Estate	5,083	6699	9
10.	Tayi Village	1,417	1,868	2
11.	Bosso Extension	6,012	7924	10
12.	Tunga	6,494	8,559	11
13.	Tudun Wada North	6,494	8,559	11
14.	Tudun Wada South	4,274	5,633	7
15.	Makera	6,604	8,704	11
16.	SabonGari	6,604	8,704	11
17.	Maitumbi	17,775	23,428	31
18.	Nassarawa	4,274	5,633	7
19.	F – Layout	6,604	8,704	11
20.	Nigeria Army Barrack	4,274	5633	7
21.	Fadipe	4,274	5,633	7
22.	GRA	4,274	5,633	7
23.	Dutsen Kura Hausa	6,604	8,704	11
24.	Dutsen Kura Gwari	6,604	8,704	11
	Total	**234,619**	**294,893**	**384**

Source: Niger Bureau of Statistic (2011) and Author's Analysis, (2016)

A total of 384 copies of questionnaire were administered. Questionnaire were administered to the twenty-four neighbourhoods of Bosso town, Shango, Sauka Kahuta, Barkin Sale, Kpakungu, Minna Central, Tudun Fulani, Chanchaga, Bosso Estate, Tayi Village, Bosso Extension, Tunga, Tudun Wada North, Tudun Wada South, Makera, Sabon Gari, Maitumbi, Nassarawa, F-Layout, Nigeria Army Barrack, Fadipe, GRA, Dutsen Kura Hausa and Dutsen Kura Gwari. Systematic sampling technique was used to administer 384 questionnaire to the respondents.

3.2.6 Data Processing

A high resolution QuickBird was used to capture the satellite image of the area. This image was imported into ArcGIS 10.0 environment and geo-referenced in order to define its existence in physical space. This was done by converting the map to Universal Transverse Mercator (UTM) projection system with World Geodetic System (WGS) 84 datum, for easy distance measurement.

3.2.6.1 Digitization

After the importation of the scanned image and subsequent geo-referencing, digitization of various geographic features was done by creating various shape file in the ArcCatalog extension of the ArcGIS, line shape file was used for line features such as road, rail line, while point shape file was used for point features like dumpsites.

3.2.6.2 Registration of coordinates

The coordinates of all the dumpsites were recorded during the GPS survey that was conducted. The recorded coordinates were saved as a .txt (plain text) file format. The coordinatesfiles were

imported into the digitized image of the study area in the Arc map 10.0 environments as 'XY data'.

3.2.7 Data Analysis

The data obtained for the study purpose were analysed by the use of spatial analyst tools and information were collected from different sources and were integrated to form a database of the study area. The process adopted in information collection and later incorporating it into the database such that it can be useful for the intended analysis discussed below:

Objective i; *to identify and map the solid waste illegal dumpsites in the study area*: The illegal dumpsites where identify because they are unregulated informal sites were individuals dump variety of liquid or solid waste with no format while the legal dumpsite were identify through the use of metal drums, mobile storage bunker, skip truck and fixed storage bins. GPS receiver was used to get their geographic coordinates. The coordinates were then imported from Microsoft Excel into Arc GIS environment and then overlaid on the base map. A point – in – polygon overlay was carried out to show the spatial distribution of illegal domestic solid waste dumpsites in the area.

Objective ii; *to determine the pattern of distribution of the dumpsites in the study area:* Average Nearest Neighbour Analysis tool was used to determine if thedistribution pattern of the illegal dumpsites is random, clustered or dispersed. If the index (Average Nearest Neighbour Ratio) is 0 itis clustered, if the index is less than 1 it is Random and if it is less than 2.15 the pattern exhibits Dispersed. The nearest neighbour index is given by:

$$\text{Nearest Neighbour index} = \frac{\text{observed distance}}{\text{expected distance}}$$

Objective iii; *to determine the proximity of the illegal dumps to resident:*

Buffers are rings are constructed around features at a specified distance from the feature. Buffer was used to determine which entities occur either within or outside a defined zone. This operation is an important spatial operation that is concerned with the determination of proximity of spatial features. A buffer zone of 200m was constructed around dumpsites to find out if some houses are too close or adequately located from the dumps. To reduce contamination of water, dumps must be located 200maway from facilities based on World Bank Standard (World Bank, 2004). According to Dikshit, Padmavatti, and Das (2000), a domestic solid waste dumpsite must be situated at a far distance away from biophysical habitats, such as water wetland, critical habitat and well to reduce the risk of contamination from dumpsite.

Objective iv; *to examine the perceived risk posed by the spatial distribution of illegal dumps in the study area*: questionnaire wereadministered to capture the views of the residents on the perceived risks of these dumpsites to the residential area. The study shows that several open spaces and drainage are been used as refuse dumpsites which causes

air pollution, flooding, hideouts for rodent, dirty environment, bad odour, disease outbreak,fire outbreak and proliferation of insects.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents and discusses the results obtained from the analysis of datadiscussed in chapter three. The data were used to achieve the objectives of the research work, these includes to; identify and map the illegal dumpsites, determine the pattern of distribution of the illegal dumpsites in the study area, determine the proximity of illegal dumpsites to resident and to examine the perceived potential risk posed by the illegal dumpsites to the residents in the study area.

4.2:SPATIAL LOCATION OF ILLEGAL SOLID WASTE DUMP SITES IN MINNA TOWN

Table 4.1 (Appendix ii) presents all the collected coordinates of the illegal dumpsites from the field. Table 4.2 presents a total of116 illegal solid waste dumpsites and their proportion in each neighbourhood.The spatial location of illegal dumpsites in the neighbourhoods is presented in Fig 4.1. Plate I and Plate II shows indiscriminate dumpsites in the area.

Table 4.2 Number of Illegal Solid Waste Dumpsites per Neighbourhood

S/N	Neighbourhood	Number of dumpsites	Proportion of illegal Dumpsites(%)
1	Makera	1	1.1
2	Sango	3	3.1
3	Minna Central	1	1.1
4	Sabon Gari		
5	Sauka Kahuta	6	5.1
6	Bosso Estate	1	1.1
7	Barkin Sale	10	9.0
8	Bosso Extension		
9	Kpakungu	7	6.0
10	Bosson Town	43	37.1
11	Tudun Fulani	2	2.1
12	Tayi Village	4	3.0
13	Tunga		
14	Maitumbi	4	3.0
15	Nassarawa	5	4.0
16	F-Layout	1	1.1
17	Nigeria Army Barrack		
18	Fadipe	5	4.0
19	Duten Kura Hausa	6	5.1
20	Dutsen Kura Gwari	4	3.0
21	Tudun wada North	5	4.0
22	Tudun wada South	4	3.0
23	G.R.A	5	4.0
24	Chanchaga	3	3.1
	Total	**116**	**100**

Source: Author's Analysis, (2016).

Table 4.2 shows the proportion and the total number of illegal solid waste in each neighbourhood. It shows that the highest proportion (37.1%) of illegal dumps is found in Bosso Town, Barkin Sale (9.0%), Kpakungu (6.0%), Sauka Kahuta (5.1%), Dutsen Kura Hausa (5.1%) and the least is found in Makera (1.1%), F-Layout (1.1%), Minna Central (1.1%), Bosso Estate (1.1%) and Sabon Gari, Bosso Extension, Tunga, Dutsen Kura Gwari, Nigeria Army Barrack, have no illegal dumps.The spatial location of illegal dumpsites in the neighbourhoods is presented in Fig 4.1.

During the survey the locations of the dumps showed that there are serious negative implications of the dumps on residence in the area. Some of the dumps were inside drainages (see Plate I) thereby obstructing the free flow of water and this could lead to flooding which is common during rainy season. A good number of dumps were within and adjacent residential structures. The one that is located at Makera is in contact with the wall of the residential houses of the people (see Plate II).

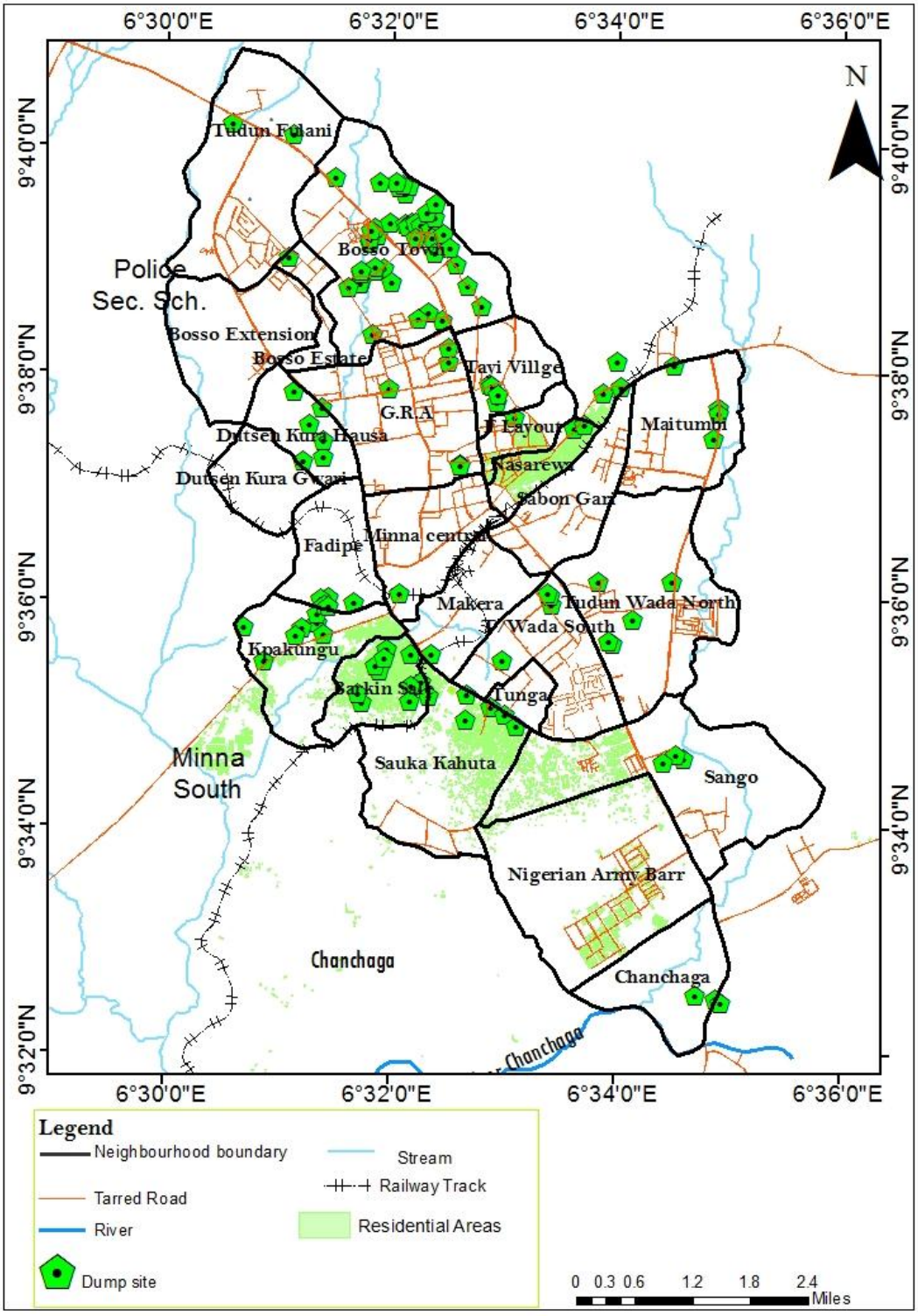


Fig.4.1: Spatial Distribution of Illegal Dumpsite in Minna

Source: Author's analysis, 2016

Plate I: Dump in drainage in Chanchaga.

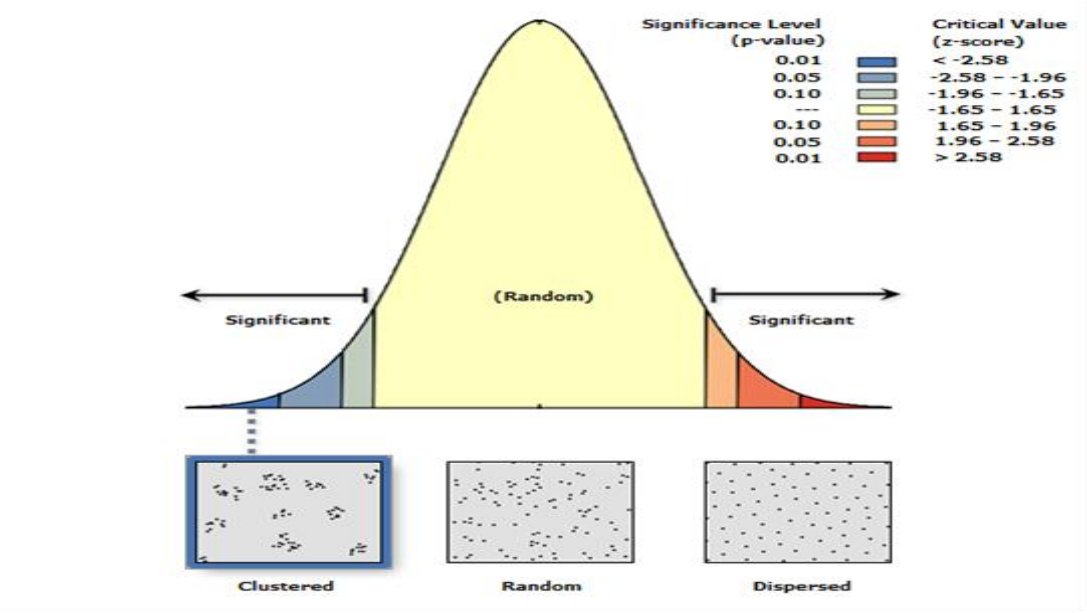
This is a drainage in Chgachanga filled up with solid waste. This dump causes flooding during rainy season

Plate II: Dump Beside Residence in Makera

This is a dump site located close to a resident in Makera. This dump creates bad ordour, dirty environment and proliferation of insect which leads to health implication.

4.3 SPATIAL PATTERN OF DISTRIBUTION OF ILLEGAL DUMPSITES IN MINNA

Using Average Nearest Neighbour analysis to obtain the Z-score and P-value of the spatial distribution of solid waste dumpsites in the study area the following result was obtained as shown on Figure4.2



Average Nearest Neighbor Summary	
Observed Mean Distance:	255.845861 Meters
Expected Mean Distance:	493.051754 Meters
Nearest Neighbor Ratio:	0.518903
z-score:	-9.912720
p-value:	0.000000

Figure 4.2: Average NearestNeighbour Distribution Curve

Source: Author's Analysis, 2016

Since the Z-score value of -9.91 is outside the range of ±1.96 to 1.96 and P-value 0.00 is less than 0.05, it is concluded that the pattern of distribution of solid waste dumpsites in the study area are significantly clustered around the residential buildings. The clustered nature of the spatial distribution of solid waste pattern in the study area is strongly as a result of poor

management of solid waste. This clustered pattern is associated with lack of provision of solid waste management facilities.Due to insufficient provision of solid waste management facilities there are more indiscriminate dumpsites in the area. This agrees with Ogwueleka (2009) investigated solid waste management involving nine cities in Nigeria,and found out the poor performance was attributed to inadequate funding, personnel, equipment, and technological constraints.

4.4 PROXIMITY OF ILLEGAL SOLID WASTE DUMPSITES TO RESIDENCES

Buffer of 200m was constructed around each of the illegal dumpsites. Table 4.3 shows the proportion of buffer of illegal dumpsites that fell within and outside 200m. The result showed that 77% of the dumps fell within 200m away from residences, while 23% fell outside 200m from the residence. The result of those that fell within 200m buffer is presented in Fig.4.3. The distances of dumpsites can be termed either suitable or unsuitable from residential areas. A distance can be said to be unsuitable if the solid waste dumpsite is too close to theresidential buildings.

Table 4.3: Proportion of Buffer of Illegal Dumpsite that fell within 200m and outside 200m

Neighbourhood	Number of dumpsites	Illegal dump that fell outside200m	Proportion of Illegal dump that fell outside 200m (%)	Illegal dump that that fell within 200m	Proportion of Illegal dump that fell within 200m (%)
Makera	1			1	1.0
Sango	3			3	3.0
Minna Central	1			1	1.0
Sabon Gari					
Sauka Kahuta	6			6	7.0
Bosso Estate	1			1	1.0
Barkin Sale	10			10	11.0
Bosso Extension					
Kpakungu	7			7	8.0
Bosson Town	43	21	78.0	22	25.0
Tudun Fulani	2			2	2.0
Tayi Village	4	2	7.0	2	2.0
Tunga					
Maitumbi	4			4	5.0
Nassarawa	5			5	6.0
F-Layout	1			1	1.0
Nigeria Army Barrack					
Fadipe	5			5	6.0
Duten Kura	6			6	7.0
Hausa					
Dutsen Kura	4			4	3.0
Gwari					
Tudun wada North	5	3.0	11.0	2	2.0
Tudun wada South	4	1.0	4.0	3	3.0
G.R.A	5			5	6.0
Chanchaga	3			3	3.0
Total	**116**	**27(23%)**	**100**	**89(77%)**	**100**

Source: Author's Analysis,2016

Table 4.3 shows that there are 77% of illegal dumpsites that fell within 200m, while 23% fell outside 200m distance from the residential buildings. The results shows that the residential buildings that fell within 200m are exposed to serious health and environmental hazards due to the proximity of the dumpsites to the buildings; this is in agreement with the findings of Salam Abul (2010)on the health impact of solid waste management among residents around the Mangwaneni Dumpsite in Swaziland and found out the negative relationship between the distance of residential apartments from dumpsite and being affected by the dumpsite pollution.

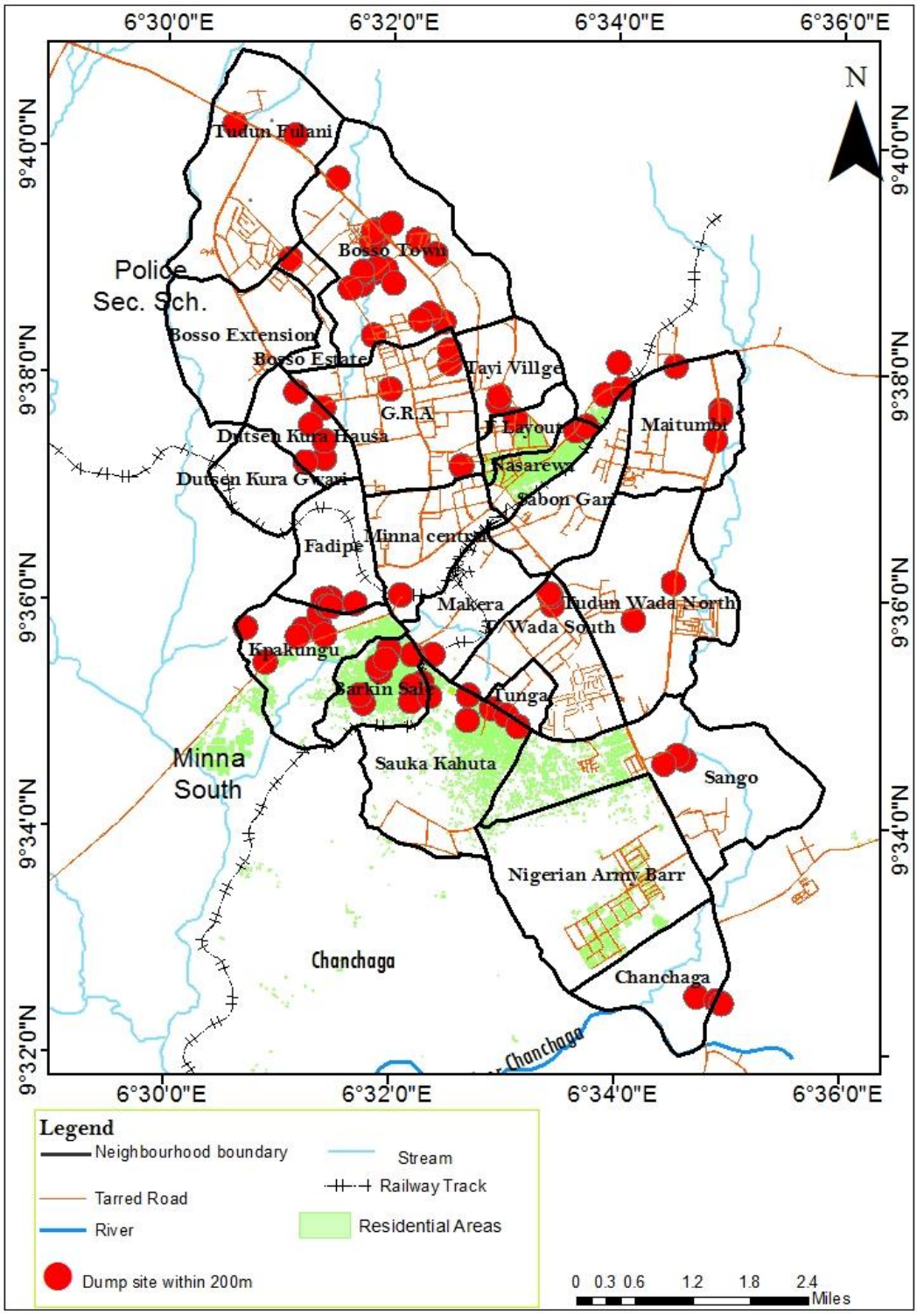


Figure 4.3: Proximity of dumpsites to residence (within 200m)

Source: Author's Analysis, (2016).

From Figure 4.3 it shows that most of the residences around the solid waste dumpsite fell within 200 metres to the dumpsite. This shows that the residences within 200m buffers are exposed to air pollution, bad odour, proliferation of insects, disease outbreak and dirty street. The proportion of dumpsites that fell within 200m buffer are Bosso town (37.1%), Shango (3.1%), Sauka Kahuta (5.1%), Barkin Sale (9%), Kpakungu (6%), Minna Central (1.1%), Tudun Fulani(2.1%), Chanchaga (3.1%), Bosso Estate (1.1%), Tayi Village (3%), Tudun Wada North (4%), Tudun Wada South (3%), Makera (1.1%),Maitumbi (3%), Nassarawa (4%), F-Layout (1.1%), Fadipe, (4%), GRA (4%), Dutsen Kura Hausa (5.1%), with the total number of 89 dumpsites. Buffer of illegal dumpsites that fell outside 200m away from the residence is presented in Fig.4.4.

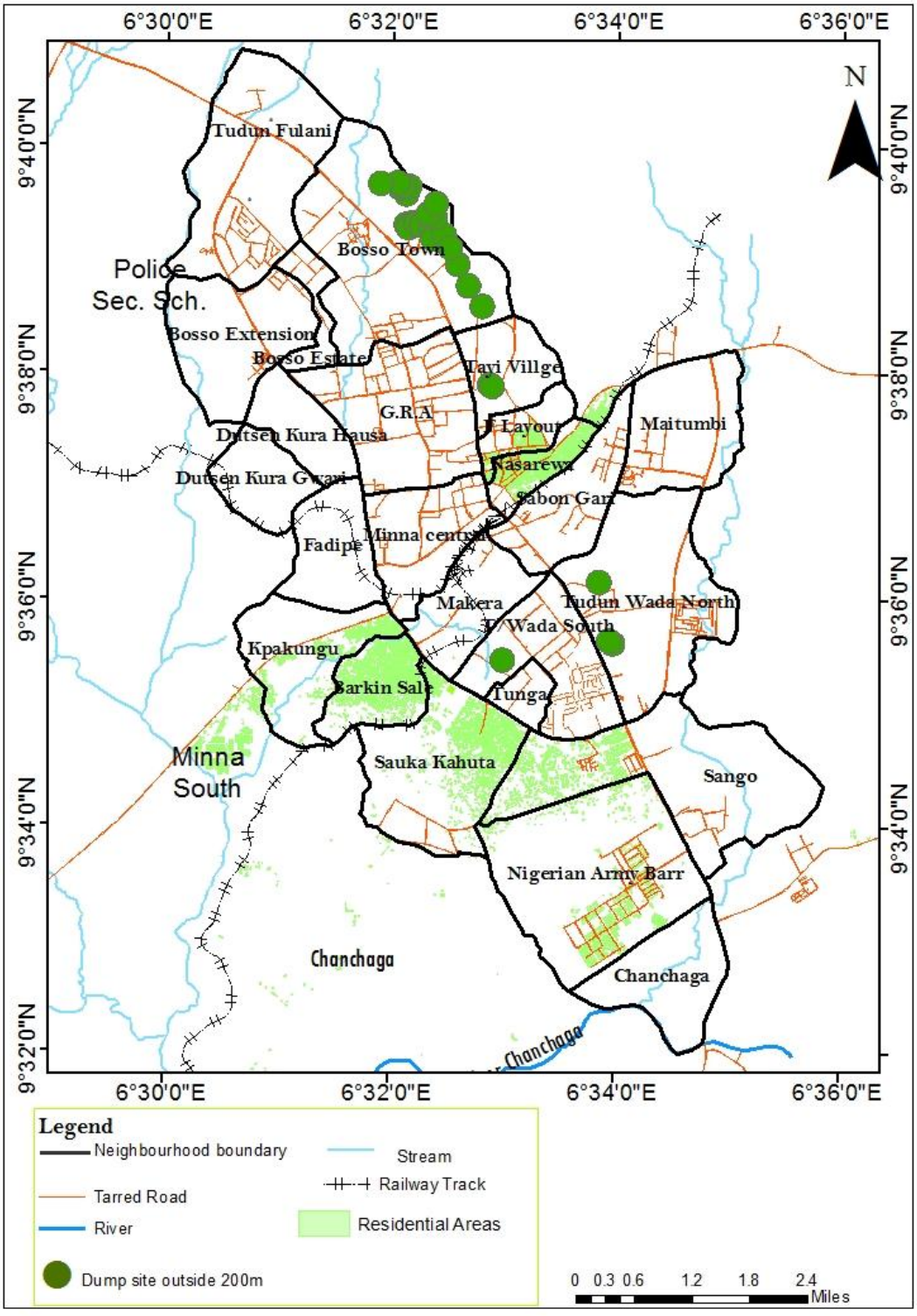


Figure 4.4: Proximity of Dumpsites to residence (outside 200m)

Source: Author's Analysis, 2016.

Figure 4.4 it was noted that the residents whose houses fell 200 meters outside the dumpsite are affected by bad odour and air pollution from the dumpsite, but mainly when wind is blown in their direction. These areas include Bosso town (37.1%), Tayi Village (3%), Tudun Wada North (4%) and Tudun Wada South (3%) with the total of 27 dumpsites.

4.5PERCIEVED RISKS POSED BY THE ILLEGAL DUMPSITES TO THE RESIDENTS

A total number of 374 out of the 384 distributed questionnaires were found useable and were used for the data analysis. The questionnaire were analysed by section.

4.5.1 Socio-demographic Characteristic of Respondents

Data from the demographic section yielded information about respondent demographic characteristicand it is presented below.

Thedemographic characteristic ofthe respondents, consist of sex, age, marital status, number per household, occupation and educational qualification are presented in Table 4.4

Table 4.4:Socio-demographic characteristic of Respondents

Sex		**Frequency**	**%**
	Female	205	55.0
	Male	169	45.0
	Total	**374**	**100**
Age	Less than 19	53	14.0
	21-30	125	33.0
	31-40	95	25.0
	41-50	69	19 .0
	Above 50	32	9.0
	Total	**374**	**100**
Marital Status			
	Single	96	26.0
	Married	182	49.0
	Divorced	66	17.0
	Separated	30	8.0
	Total	**374**	**100**
Number per Household			
	1-2	58	16.0
	3-4	112	29.0
	5-6	88	24.0
	7-8	77	21.0
	9-10	26	7.0
	11 Above	13	3.0
	Total	**374**	**100**
Educational Qualification			
	Quranic	62	17.0
	Primary	60	16.0
	Secondary	114	30.0
	Tertiary	130	35.0
	Others	8	2.0
	Total	**374**	**100**
Occupation			
	Farming	69	18.0
	Business/Trading	152	41.0
	Civil Service	145	38.7
	Artisan	7	2.0
	Others	1	0.3
	Total	**374**	**100**

Source: Author's Field Survey, 2016

Data from the demographic section yielded information of the respondents demographic characteristics. Table 4.4 shows that majority of the respondents were female (55%) while (45%) were male. This implies that a reasonable number of waste managers at the household levels are female. It has been hypotheses that women demonstrate grater enthusiasm in environmental issues than men (Gifford, Hay and Boros 1982 and Thampel, Boldero and Holdsworth 1996).

Majority of the respondents were in the age range of 21-30 (33%) and 31-40 (25). Invariably, that may be why many of the respondents were married. This means that majority of the respondents were young female who are engaged in reasonable waste management at the household levels as stated with regard to culturally inherited gender stereo types. This correspond with Ahmad (2002), this finding revealed that women who are more severally restricted to their homes differ from those other part of the country that are more liberal in their tendency to waste sorting and sanitation at large.

Most of the respondents were married with two to three children; therefore it results to increase in population and more generation of waste. Those between 3-4 per household were (29%), 5-6 were (24%), 7-8 were (21%), 1-2 were (16%), 9-10 were (7%) while above 10 were (3%). This means that majority of the respondents were more than 9-10 per household, as a result of this there will be more generation of waste in the households.

Most of the respondents were business/traders (41%), civil servant (38.7%), and farmers (18%), Artisan (2%) while others are (0. 3%).Those with secondary education constitute (30%), (35%) had tertiary, (17%) had Quranic education, (16%) had primary education, while others were (2%). This means that a lot of the household respondents were aware of solid waste management issues and understand the risk that improperly managed waste pose to human health and the environment.

4.5.2 Waste Management

Data from the waste management section is presented below.

4.5.2.1 Waste disposal and method of waste disposal

Responses on waste disposal and the method of waste disposalby the respondents are presented in Table 4.5.

Table 4.5:Frequency of Waste Disposed and the Method of Waste Disposal used by the Residents

Times of disposal of waste		**Frequency**	**Percentage**
	Every day	142	38.0
	2-3 times a week	131	35.0
	Once a week	95	25.0
	Others	6	2.0
	Total	**374**	**100**
Disposal Methods			
	Burning	90	24.0
	Dumping Along water body	12	3.0
	Dumping in Drainage	35	9.0
	Illegal Dumps	132	35.0
	Legal Dumps	46	12.0
	Collection by Agency	33	9.0
	Bury	26	8.0
	Total	**374**	**100**

Source: Author's Field Survey, 2016.

Table 4.5 shows that 38% dispose there waste every day, 35% 2-3 times a week and 25% once a week while others were 2%. This means that more waste is damped every day and less waste management is done. This is in agreement with previous studies like,Babayemi and Dauda (2009) found out that Abeokuta has a high rate of waste generation without a corresponding efficient technology to manage the wastes.Abel and Afolabi, (2007) also found out that Nigerian cities and towns are currently facing serious environmental problem arising from poor solid

waste management. In this research i found out that Minna has problem with waste disposal and management which is of great concern to the people there.

The table also shows that 35% of the generated wastes are disposed on illegal dumps, 24% were burning the waste, 12% legal dumps, 9% drainage, 9% collection by agencies, 7% by burying, and 3% along water bodies. Majority of the respondents dump on illegal dumps, this particular method of waste tends to pollute the environment and poses danger to ecological receptors; this correspond with Aguoru and Alu (2015) who studies on solid waste disposal and management methods in Makurdi and Environs, in the findings level and methods of solid waste disposal and management in Makurdi and Environs is not ideal. Waste is poorly collected and dumped at the dump sites irrespective of its composition.

4.5.2.2 Method of waste sorting

Those that sort their waste use to separate the plastic bottle from other materials this is because the bottles are used for other purposes; this does not correspond with Pothimamaka (2008) researched on community learning process: a model of solid waste reduction and separation in Bang Sue District, Bangkok Metropolis. The study found out that the best practice of solid waste management in developed countries is reduction of waste generated at the source by sorting.

4.5.2.3 Sorting of waste

Figure 4.5 shows that 97% of the residents do not sort waste in Minna while 3% do sort. It is clear that most of the residents do not sort. As a result of this waste litters the environment in different form and recycling is not done; this is in agreement withAdekunle et al (2012) assessed

population perception impact on value-added solid waste disposal in developing countries using Port Harcourt as a Nigeria case study. The author's finding was that no participant really sorted waste materials at source; rather, an overwhelming majority (81%) mixed or mingled their wastes together in a given waste bin and 19% practiced indiscriminate disposal.

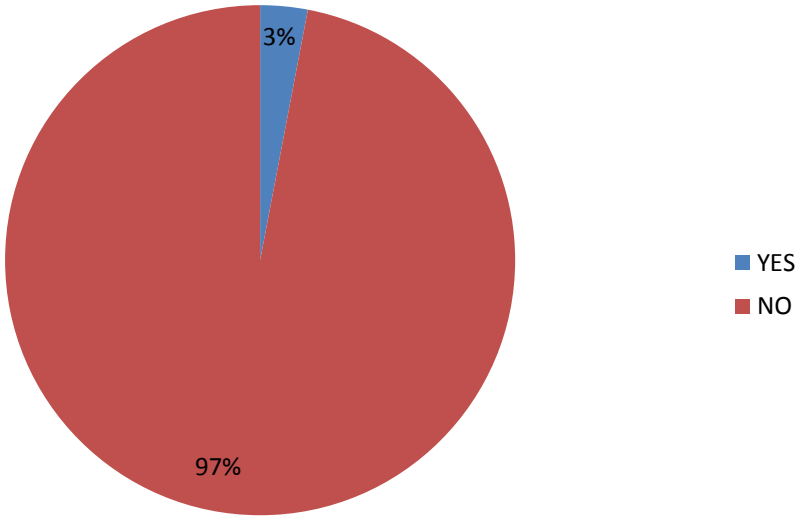


Fig 4.5: Percentile ofwaste sorting by the respondents

4.5.2.4Agencies responsible for waste collection

The Agency responsible for waste collection is given in Table 4.6.

Table 4.6 Agencies Responsible for Collection of Waste

Agency	Frequency	Percentage
Local Government Authority	49	13.0
State Government	67	18.0
Private Organization	258	69.0
Total	374	100

Source: Author's Field Survey, 2016

Table 4.6 shows that collection of waste around Minna and her environs is carried out by some agencies. From various respondents it was observed that 13% agreed waste is carried away by Local Government Authority, 18% said by state government while 69% opined that it is by private organization. This shows that the private organization collect more of these waste with the use of wheel barrow and truck which result to indiscriminate dumping of waste in illegal sites; this is in agreement with. Ukoje (2011) analyzed the participation of stakeholders in solid waste management in Zaria, Nigeria. The study revealed that there is lack of recognition and cooperation with non-public institution stakeholders in the solid waste management framework in Zaria.

4.5.2.5Payment of fees for waste collection

Figure 4.6 shows the response on the payment of fees for waste collection. This shows that 55% of residence pays fees in respect to waste collection while 45% do not pay. Fees are collected from the residence by the private organization that collects these wastes with the use of truck and wheel barrows. This results into indiscriminate dumping of waste on open space and drainage system causing proliferation of insect, dirty street, bad odour and air pollution.

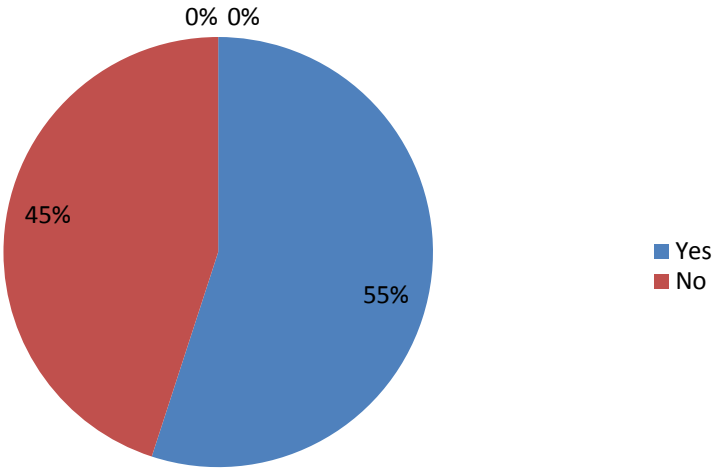


Figure 4.6: Percentile distribution of payment of fee in respect to collection of waste

4.5.2.6 Distance between residence and collection point

The result of the analysis of the distance between residence and collection point is presented in Table 4.7.

Table 4.7: Distance between the Collection Point and the Residence

S/N	Distance	Frequency	Percentage
1	10m-20m	43	11.0
2	21m-40m	78	21.0
3	41m-60m	103	28.0
4	61 – above	150	40.0
	Total	**374**	**100**

Source: Author's Field Survey, 2016

Table 4.7shows distances between collection points of waste and residence. About 11% of the respondents have their disposal point located at a distance of 10-20m, 21% at a distance of 21-40m, 28% at a distance of 41-60m while 40% at a distance of 61m or further. The table shows that the dumpsites are far away from most of the residents and this result into payment of the private organization and indiscriminate dumping.

4.5.2.7 Satisfaction with existing solid wastemanagement

Figure 4.7 below shows the satisfaction of resident with the existing solid waste management.It shows that 37% of the respondents were satisfied with the existing solid waste managementservice and 63% were not satisfied. The respondent are not satisfy with solid waste management due to the fact that the dumpsites causes bad odour, dirty street, air pollution and proliferation of insects which leads to different diseases. This shows that waste management in Minna is very poor, and needs more improvement. About 26.7% were of the view that more legal dumps should be created, while 40.1% were of the view that state government should make solid waste management more effective and 33.2% were of the view that state government should be in collaboration with private organization in solid waste management. This research is in agreement with the opinion that says state government should be in collaboration with private organization, this should be done so as to reduce the illegal waste disposal by wheel barrow and truck operators.

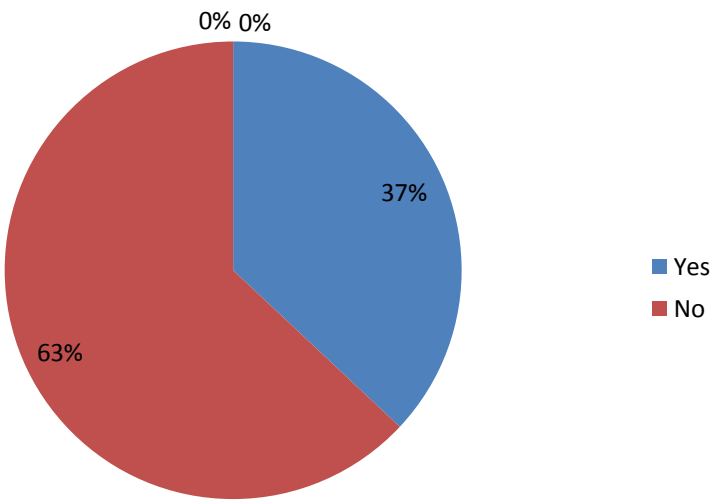


Fig 4.7: Satisfaction of respondents with the present solid waste management in Minna

4.5.3 Risks of illegal Dumpsites on the residence

This section presents the perceptualview of the respondents on the effect of dumpsites on the residential area**.**

4.5.3.1 The perceived risks of illegal dumps by the respondents

The perceivedrisk of dumpsites by the residents is presented in Table 4.8.

Neighbourhoods were requested to award scores to risks posed by the dumps. The result are shown in table 4.8.

Table 4.8: Types of risk Posed by dumpsites to the residents

Item	Flood		Bad odour		Fire outbreak		Water Pollution		Proliferation of insects		Injury		Dirty street		Air pollution		Disease outbreak	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Very serious	5	56.0	128	91.0	2	29.0	1	25.0	57	73.0	1	10.0	62	84.0	27	66.0	5	83.0
Serious			7	5.0					16	21.0	1	10.0	6	8.0	2	5.0	1	17.0
Moderate	4	44.0	5	4.0	3	42.0	2	50.0	5	6.0	7	70.0	6	8.0	12	29.0		
Not serious					2	29.0	1	25.0			1	10.0						
Not serious at all																		
Total	9	100	140	100	7	100	4	100	78	100	10	100	74	100	41	100	6	100

Source: Author's Field Survey, 2016

Table 4.8 showed that four (Bad odour, proliferation of insects, dirty street and air pollution) of the nine items of risks posed from the dump solid waste dumps to the residence are seen to be very serious. The highest score is obtain from bad odour (91%). Proliferation of insects (73%) and dirty street (84) and others are seen to be moderate to the residence in the neighbourhoods. The overall picture is that the people feel that the presence of the solid waste dumpsites in their neighbourhoods has a lot of risks on the residents.

All the nine items of risks posed by the dumpsite to the residents in the neighbourhood were scored by the resident who has experienced the risk posed by the dump site to the residents in one way or the other.

4.5.3.2: Reasons for illegal dumps site

The respondents' response to this question was very low. About 5% answered while about 95% did not. Those thatanswered said the legal dumps were too far from them and those that make

use of wheel barrow and truck has made it easier for the residence to dispose off there wastes easily without so much stress.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This Chapter provides the summary of the findings.It also provides conclusions, recommendations and suggestions for further studies.

5.2 SUMMARY OF THE FINDINGS

This research analyszed thespatial distribution and perception of the effect of illegal solid waste dumpsites in Minnausing Remote Sensing and Geographic Information System. The study identified and mapped the major illegal solid waste dumpsites in the area and also analyzed the pattern, the proximity and the effect of the dumps to residences in the area using questionnaire.

Hundred and sixteen (116) illegal solid waste dumpsites were identify in the area. During the survey the locations of the dumps show that there are serious negative implications of the dumps on residence in the area. Some of the dumps were inside drainages thereby obstructing the free flow of water and this could lead to flooding which is common during rainy season. A good number of dumps were within and adjacent to residential structures. The one that is on plate I is located at Makera and it is in contact with the wall of the residential houses of the people while the one in chanchaga in a drainage system (Plate II). The finding shows that the pattern of distribution of solid waste in the study area are significantly clustered.

Buffer of 200m was constructed around the illegal dumpsites and found out that the proportion of those dumps that fell within 200m from the residence is 77.0%, and they are affected by proliferation of insects, bad odour, dirty street, and air pollution. While that of residence whose houses fell outside 200 meters away from the residents is 23.0% and are also

affected by the air pollution and bad odour from the dumpsite, but mainly when wind is blown in their direction.

The findings from the demographic respondent showed that55.0% were female, 33% of the respondent were under the age group of 21-40, secondary education is 30.0% and tertiary had 35%, business/trading 41.0% and civil service had 38.7%. This indicates that the respondents were young and can engage reasonable in waste management and they understand the risk posed on human if not well managed.The highest number per household is 3-4 (29.0%), 5-6 (24.0%) and 7-8 (21.0%), this indicates that there will be more waste generation. The findings from waste management shows that about 38.0% dispose there waste every day, 35% 2-3 times a week and 25% once a week while others were 2%. This means that more waste is dumped every day and less waste management is done.Waste disposal shows that 35% of the generated wastes are disposed on illegal dumps, 24% were burning the waste, 12% legal dumps, 9% drainage, 9% collection by agencies, 8% by burying, and 3% along water bodies. The findings shows that the respondents dump on illegal dumps, this particular method of waste dumping tends to pollute the environment and poses danger to ecological receptors, it shows that the respondents are not satisfy with the existing solid waste management. Findings on waste sorting shows that 90% of the residents do not sort waste in Minna while 10% do sort. It is clear that most of the residents do not sort. As a result of this waste litters the environment in different form and recycling is not done. Findings showed that private organization is responsible for collection of waste from the residence (69.0%), which results in indiscriminate dumping of waste on illegal dumpsites. The distance of the dumpsites to the residents also contributes to indiscriminate waste dumping

Findings from the perception of the respondents showedthat four (Bad odour, proliferation of insects, dirty street and air pollution) out of the nine items of risks posed by the

solid waste dumps to the residence are seen to be very serious. The highest score is obtained from bad odour (91%). Proliferation of insects (73%) and dirty street (84) and others are seen to be moderate to the residence in the neighbourhoods. The overall picture is that the people feel that the presence of the solid waste dumpsites in their neighbourhoods has a lot of risks on the residents.

5.3 CONCLUSION

The result of the study found about 116 illegal dumpsites in Minna. It was noted that both residents that fell within and outside200metres buffer from the residents were affected by the location of the illegal dumpsite. Results obtained proved that as one moves away from the dumpsite the impact is not as severely felt as those who are closer to the dumpsite. It was also discovered that residents(GRA, Tudun Fulani, Dutsen Kura Hausa, among others) located within 200 metres from the dumpsite are affected by the dumpsite; they are affected by proliferation of insect, bad odour, air pollution and dirty street. However, it was also noted that residents(Tayi village, tudun wada North, Tudun wada South and Bosso Town) located outside 200 metersfrom the dumpsite are also affected by bad smells from the dumpsite, mainly when wind is blowing in their direction. As a result of these factors the residence complains of health hazard which leads to the spread of infectious diseases. The pattern of distribution of solid waste in the study area is clustered in the neighbourhood. The demographic of the respondents showed that female were more, and respondent were under the age group of 21-40, secondary education and tertiary had the highest response while business/trading and civil service also had the highest. The highest number per household is 3-8. Response from the waste management showed that waste are dispose every day, 2-3 times a week and once a week. Waste disposal showed that the generated

wastes are disposed in illegal dumps, are burnt, are dumped in legal dumps, drainage, are collected by agencies, buried, and dumped along water bodies. Majority of the residents do not sort waste in Minna while 10% do sort. Private organization is responsible for collection of waste from the residence. The distance of the dumpsites to the residents also contributes to indiscriminate waste dumping

Findings from the perception of the respondents showed that four (Bad odour, proliferation of insects, dirty street and air pollution) out of the nine items of risks posed by the solid waste dumps to the residence are seen to be very serious. The highest score is obtained from bad odour (91%). Proliferation of insects (73%) and dirty street (84) and others are seen to be moderate to the residence in the neighbourhoods. The overall picture is that the people feel that the presence of the solid waste dumpsites in their neighbourhoods has a lot of risks on the residents.

5.4 RECOMMENDATIONS

i. Neighbourhoods should open dumpsites on remote areas with no residents closer to them to avoid the effect of the dumpsite on the nearby residents and monitor the dumpsite properly.

ii. Neighbourhood should control the litter and monitor their volumeof waste.

iii. The neighbourhoodsneed to be educated on the risks of dumpsites on their health. This will limit the indiscriminate emergenceof the dumpsite in the areas.

iv. The study recommends that dumpsites should be located above 200 metres away from resident so as to minimize its effects on the environment.

v. State government should make solid waste management more effective and state government should be in collaboration with private organization in solid waste management.

vi. Institution and businesses that could buy up discarded materials should be facilitated to Enhance recycling and reuse.

5.5 SUGGESTIONS FOR FURTHER STUDIES

1. Similar studies could be carried out in Bida metropolis in Niger State.
2. It is needful to carry out the studies every year so as to be able to monitor solid waste management in Niger State.
3. Similar studies could also be carried out on facilities and techniques of solid waste management in Niger State.

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APPENDICES

QUESTIONNAIRE

Dear Sir/Ma,

I am a Postgraduate student of Geography Department in Ahmadu Bello University, Zaria, carrying out a research on "Analysis of Spatial Distribution and perceptual implication of illegal Municipal Solid Waste Dumpsites on the environment in Minna, Niger State.

Please kindly answer the questions below as well as information supplied would be used mainly for academic purposes and shall be treated as highly confidential.

Thank you.

SECTION A: Demographic Characteristic

1. **Sex:** (a) Female ☐ ☐ (b) Male

2. **Age:** (a) Less than 19 ☐ (b) 21 – 30 ☐ (c) 31 – 40 ☐ (d) 41 – 50 ☐

   (e) Above 51 ☐

3. **Marital Status:** (a) Single ☐ (b)Married ☐ (c) Divorced ☐ (d) Separated ☐

4. **Education Qualification:** (a) Quranic ☐ (b) Primary ☐ (c) Secondary ☐

   (d) Tertiary ☐ (e) Others, (specify): _____

5. **Occupation :**(a) Farming ☐) Business/trading (c) ☐ Service ☐

   (d) Artisan ☐ others (specify): _____

6. **Number per Household:** (a) 1 – 2 ☐ (b) 3 – 4 ☐ (c) 5 – 6 ☐

   (d) 7 – 8 ☐ (e) 9 - 10 ☐ (f) 11 above ☐

SECTION B: Waste Management

7. How often do you dispose waste? (a) Everyday ☐ (b) 2 – 3 Times a Week ☐

   (c) Once a Week ☐ (d) others (specify): _____

8. Do you sort your waste before disposal? (a) Yes ☐ (b) No ☐

9. How do you sort your waste_____

10. How do you dispose your Waste? (a) Burning ☐ (b) Along water body ☐

(c) Drainages ☐ (d) Illegal dumps ☐ (e) Legal dumps ☐

(f) Collection by Agencies ☐ (g) Bury

11. What Agency is responsible for the Collection of Waste in your area

(a) Local Government Authority ☐ (b) State Government ☐

(c) Private Organization ☐

12. Do you Pay Fee in Respect to the Collection of Waste in your House?

(a) Yes ☐ (b) No ☐

13. What is the Distance between the Collection Point and your House?

(a) 10m – 20m ☐ (b) 21m – 40m ☐ (c) 41m – 60m ☐ (d) 61 above ☐

14. Are you satisfied with the Existing Solid Waste Service in your Area?

(a) Yes ☐ (b) No ☐

SECTION C: Effect of Dumpsites

15. What are the risks Posed by these Dumpsites to your Environment?

	1	2	3	4	5
	Very serious	Serious	Moderate	Not serious	Not serious at al
Types of risk					
Flooding					
Bad odour					
Fire outbreak					
Water pollution					
Proliferation of insect					
Injury					
Dirty street					
Air pollution					
Disease outbreak					

16. What is the Reason for Dumping in Illegal Dumps?

_____

APPENDIX II

Table 4.1: Coordinates of Illegal Dumpsites in Minna.

Points	Locations	Easting	Nothing
1	Tudun Fulani	227709	1069633
2		226721	1069808
3	Bosso Town	228395	1068928
4		228594	1067141
5		228783	1067200
6		228796	1067214
7		228796	1067370
8		228793	1067408
9		229172	1067451
10		229026	1067404
11		229030	106466
12		229300	1067223
13		228951	1067855
14		229062	1067989
15		228941	1067907
16		229031	1068098
17		228968	1068058
18		229226	1068191
19		230115	1066591
20		229885	1066726
21		229734	1066623
22		229691	1067934

23		229987	1067693
24		230353	1067514
25		230527	1067163
26		230754	1066828
27		229770	1068152
28		229932	1068083
29		229947	1067929
30		230134	1067993
31		230235	1067783
32		229519	1068167
33		229618	1068187
34		229554	1068115
35		229679	1068180
36		229984	1068276
37		229879	1068340
38		230005	1068500
39		229524	1068695
40		229412	1068765
41		229574	1068765
42		229482	1068796
43		229382	1068844
44		229382	1068834
45		228975	1066372
46	GRA	230400	1064250
47		230403	1064240

48		229246	1065496
49		230216	1065913
50		230214	1066137
51	Tayi Village	230999	1065266
52		231019	1065383
53		230871	1065554
54		230913	1065524
55	Nassarawa	232256	1065863
56		232732	1065405
57		233023	1065504
58		232960	1065922
59		2324030	1064890
60	Maitumbi	233886	1065863
61		234610	1065154
62		234611	1065080
63		224529	1064660
64	Dutsen K Hausa	227710	1065451
65	228160	1065188	
66		227952	1064918
67		228173	1064370
68	228173	1064653	
69		227862	1064310
70	Minna Central	229412	1062148
71	Fadipe	228672	1062008
72		228269	1062090

73		228150	1062074
74		228210	1061966
75		228274	1061954
76	Kpakugu	228080	1061681
77		227829	1061594
78		228085	1061826
79		228173	1061496
80		227731	1061471
81		227213	1061055
82		226887	1061616
83	Barkin Sale	229759	1060716
84		229598	1060655
85		229079	1060899
86		229035	1060983
87		228805	1060385
88		229575	1060412
89		229602	1061173
90		228746	1060520
91		229221	1061257
92		229170	1061681
93	Sauka Kahuta	230889	1060296
94		231128	1060183
95		230512	1060512
96		230497	1060103
97		231318	1060000

98		229881	1060494
99	Tudun wada south	321880	1061977
100		231859	1062121
101		231825	1062164
102		231076	1061065
103	Tudun wada North	233847	1062338
104		233197	1061730
105		232868	1061331
106		232806	1061378
107	232646	1062331	
108	Shango	233693	1059391
109		2344026	1059462
110		233906	1059529
111	F-Layout	231281	1065009
112	Bosso Easte	227622	1067622
113	Chanchaga	234213	1055604
114		234540	1055540
115		234623	1055491
116	Makera	229937	1061175

Source: Author's Field Survey, 2016