ASSESSMENT OF RESIDENTIAL SOLID WASTE MANAGEMENT IN TUNGA AREA MINNA, NIGERIA

BY

ELETU, Mohammed Tajudeen

M.TECH/SSSE/2007/1602

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DECEMBER, 2010.

DECLARATION

I Eletu Mohammed Tajudeen, declared that this thesis was written by me and has not been presented either in whole or part, for the award of any Postgraduate degree any where else. All literature cited have been duly acknowledged in the references.

Eletu Mohammed Tajudeen — Signature & Date 02/02/11

CERTIFICATION

This thesis tittled; Assessment of Residential Solid Waste Management in Tunga area, Minna, Nigeria by: **ELETU, Mohammed Tajudeen (M.Tech/SSSE/2007/1602)** meets the regulations governing the award of the degree of Master of Technology (M.Tech) of the Federal University of Technology, Minna and is approved for its contribution to scientific knowledge and literary presentation.

r. A. S. Abubakar ame of Supervisor	18/08/2014 Signature & Date
r. A. S. Abubakar ame of Head of Department	18/08/2014 Signature & Date
of. M. Galadima ame of Dean, School of Science d Science Education	21/3/2011 Signature & Date
of. S. L. Lamai me of Dean, Postgraduate School	21/3/2011 Signature & Date

DEDICATION

This project is specially dedicated to my lovely Wife.

Mrs. Oluremi Labake Eletu.

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ABSTRACT

For decades, solid waste has been regarded more as a nuisance and private problem rather than as a major public problem requiring critical solution. The world today is becoming more concerned with the control and management of the physical environment. However one area which has not been given adequate attention in most urban areas of developing countries like ours, is detailed information about solid waste generation. Without adequate data on solid waste generation, no meaningful planning can be done towards its disposal. This desire forms the basis of this study. The study examined the existing solid waste management practice and the associated problem in Tunga area of Minna. The study area of this project was divided into three (3) zones for analysis. Questionnaires were administered at random per areas in each of the zone to gather information on socio-economic characteristics of the people. Physical observations of dump sites were also undertaken in other to assess the impact of uncontrolled waste disposal on the environment and man. Domestic waste account for more than 70% of waste generated, while papers and polythene (nylon) account for over 50% of waste constituents in the area. Open dumping is the most commonly used method of disposal. Several factors were found to determine the extent and type of waste generated. These factors include population size & density, cultural habits of the people, there level of affluence and land-use characteristics. High incidence of dysentery, malaria and typhoid fever experience in the study area in recent time, could be attributed to poor waste management practices. These problems can be mitigated through efficient disposal of waste. This work concluded by making some recommendation toward more effective and environmentally friendly methods of waste collection and disposals.

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1.0 INTRODUCTION

1.1 Background Information

Health has been defined as the state of complete physical, mental and social well being. The healthful living of an individual depends on the human environment which can be physical, biological and social in a nature and which has influence on his health. Man through his activities and actions effect man directly and thus pollute the environment through his activities and pre occupations.

The influence of man on the environment has brought about the struggle for survival. In the pre-historic period, little or no problem were imposed on the environment, today the reverse is the case. Man's unguarded development and ineffective waste management especially in urban centers have resulted in degraded environment and outbreaks of epidemics. This problem has progressive worsened judging by the trend.

Populations growth, rising standards of living and rapid pace of urbanization and industrialization pose many environmental challenges for large cities. They contributed to an increase in the amount and type of solid wastes

generated by different human activities. Indiscriminate dumping of these wastes has continued to be a major environmental health and development challenge. Nigerians, particularly those living in the urban area are now having constant memories of huge heaps of garbage in open spaces, especially if they have to cover their noses against all forms of odor when passing by the heaps. There is a general concern that a lot of heterogenous waste is generated and the volume and types have been on the increase in the country.

The need for better environmental management strategies in Nigeria grow with increase urgency of the perceived environmental problems, and the progressive nature of the threats to sustainable development that these problem pose (Olokesusi, 1994). Environmental management is not "management of the environment". It is management of the activities within tolerable constraints imposed by the environment itself and with full consideration of economical factors (Beale, 1980). The worlds attention is now focused on solving environmental problem. Solid wastes been one major pollutants of the environment therefore require proper management.

This study is carefully chosen to examine and analyze the problems associated with the mode of collection and disposal of solid wastes in Tunga area of Minna and to proffer better management.

1.2 Definition of Basic Concept

n the words of Scheinberg (1999). **Wastes** is any item, materials or ubstance derived from human activities or human or domesticated animal odily function which has contrived the purpose for which it was intended nd which does not appear to its owner to be useful for secondary purposes. becomes waste when its owner or their agent chooses to discard it by turning it to a natural medium (Usually water or soil but sometimes also by rning and release of smoke to air) or by releasing it to the responsibility of e community, municipality, or was a collection entity.

olid Waste is material, which is not in liquid form, and has no value to the rson who is responsible for it. Although human or animal excreta often ds up in the solids waste stream, generally the term solid waste does not clude such materials. Synonyms to solid waste are terms such as arbage", "trash", "refuse" and "rubbish".

unicipal Solid Waste (MSW), refers to solid waste from houses, street d public places, shops, offices and hospitals, which are very often the sponsibility of municipal or other governmental authorities. Solid waste

from industrial processes are generally not considered "municipal" however they need to be taken into account when dealing with solid waste as they often end up in the municipal solid waste stream.

Point of Disposal refers to the moment and physical place at which the owner transfers his or her responsibility for the waste to an institution or to a natural medium.

1.3 Statement of the Problems

Man generates waste as a result of his daily activities in a bid to maintain his means of livelihood to enhance and make his life comfortable. Waste generated by man has an adverse effect on the environment and subsequently on man himself. The way these wastes are handled, stored, collected and disposed of, pose risks to the environment and to public health.

Nigerlites, particularly those living in the urban areas, are now having constant memories of huge heaps of garbage in open spaces, especially if they have to cover their noses against all forms of odors emanating from the heap when passing by. It is also not uncommon to find urban wastes blocking streets, roads, drainage and water ways thereby contributing to the problems of flood disaster, breeding of insect and rodent vector and the spread of disease. Typically one to two thirds of the solid waste generated is

not collected, these uncollected wastes are dumped indiscriminately. Colleted wastes, however are often disposed of in uncontrolled dumps ites and/or burnt, polluting air and ground water resources that cause outbreaks of epidemic such as cholera and typhoid. Indiscriminate dumping of solid wastes abuse the tourism potential of any community, as it also negates the aesthetic standard, mental and social well being of man.

While population growth and urbanization in developing countries have ontributed to wealth accumulation, it has also been accompanied by an larming increase in the volume, types and ranges of waste produced. There the justified fear however, that if appropriate measures are not put in space r sustainable waste management,Niger State may be overwhelmed if not nsumed by waste. This study will look into some of these problems and ggest how best they can be minimized.

4 Aim and Objectives

is study is aimed at contributing to the already existing body of owledge about good sanitary environment and aesthetic. The study mined and analyzed the problems associated with waste generation, de of collection and disposal. Within these broad aim, the specific ctives include:

i. To determine the type of waste being generated in the study area.

ii. To determine the frequency and efficiency of refuse clearance in the study area.

iii. To determine the effectiveness of the final disposal method.

iv. To examine the role of Niger State environmental protection agency (NISEPA) as sole body responsible for the municipal solid waste management (MSWM) with a view to identifying area of inefficiency.

v. To make recommendations for better and future plans on environmental waste management for a sustainable development.

1.5 Significance of the Study

Due to rapid urbanization and population growth in developing world, refuse disposal and waste management has become a major problem. Man's activities will always result in the generation of wastes and its associated problems. Effective refuse, disposal and management is very important for a healthier and cleaner environment.

In curbing the menace of refuse and other solid waste, Environmental management comes to be accepted as a nation wide programme. That is why public enlightenment through, Bills, adverts, on radio/television are used by various public agencies to check the proliferous nature of refuse and other

waste materials in our society. The important of clearance of refuse is realised. The different disposal methods determine the efficiency of waste management. This study will in the long run serve as a reference materials to individuals, NGO's and public institutions.

1.6 Scope and Limitation of the Study

The study focused on the problems of the management of solid waste in Tunga area of Minna, as regard refuse generation and waste disposal, and also seek to find a physical planning solution to the issue.

1.7 Background of the Study Area

1.7.1 Location:-

Minna (chanchaga L.G.A) the capital of Niger State of Nigeria lies on latitude 9037' North and longitude 6033' East on a geological base of undifferentiated basement complex of mainly gneiss and magmatite (Maxlock, 1979).

Minna is presently sharing boundaries to the East by Muya local government area, to the west by Bosso local government area, to the south by Paikoro local government area and about 150km away from the federal capital territory, Abuja. The location of Tunga in the context of Minna is shown in the map (fig: 1.1)

Maxlock (1979), estimated the land area of minna to be about 884.0 hectare Tunga area and its environs is located at the south eastern part of Minna town. The area lies on a basement complex rock situated at the base of a hill to the north and East in an undulating plain (lawal, 2000). The study area is estimated to have covered about one-third (1/3) the total land area of Minna.

1.7.2 Climate

Minna experience two distinct seasons, dry and wet. The wet season starts on average between 11th - 20th April and last between 190 and 200 days (maxlock, 1980). The town has a mean annual rainfall of 1334mm taken from an exceptionally long record of 54 years. The highest mean monthly rainfall is in September with almost 300mm (11.7 inches). The mean monthly temperature is highest in March at 30. 5°C (87°F), just before the rains, after which the temperature declines throughout the summer months. The lowest mean monthly temperature is experienced in August the maximum temperature starts to rise, while the minimum continues descending to its annual low in December.

1.7.3 Topography/Land Form

As mentioned earlier, Minna is on a geological base of undifferentiated basement complex of mainly gneiss and magmatite. The area covered by this study is an area of low topography and relief with intermittent hills. The highest points are the western part toward chanchaga with hills of about 250m above sea level and 60-70m above the country rock (Maxlock, 1980). To the north-east of

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on it.

1.7.4 Vegetation and Soil

The whole area lies in a natural vegetation that is characterized by a predominantly woody and grassland scattered here and there, a typical guinea savanna vegetation composed of shrubs, few short trees with grasses between the heights 0.5-2.5m. The trees with an average height of about 10m. However due to the population pressure of this area, human activities have fondly modified the local vegetation. The area has mainly lateritic to sandy soil, except along river channels, which has alluvial deposits. The soil has a fine texture which relatively favours the growth of yams guinea corn, and millet (Niger state regional plan, 1980).

1.7.5 Population/People

According to the National population census exercise conducted in 2006, the population of Chanchaga local government was 202151 One third of these population lives in the study area. (NPC, 2006).

Though the area is mainly Gwari settlement, it has since become heterogenous in terms of people of various and diverse ethnic, religious and cultural background. These Nigerians of diverse origin includes- The Nupes, Hausas, Fulanis, Yorubas, Igbos, Edos among others. Diversity of ethnic composition due to the immigration has impacted on housing type in the

area. The Gwaris who are mainly farmers detest urbanization culturally and hence they build their traditional compound houses at the perithery and in isolated locations outside the high density area. The likes of these locations include Sauka Kahuta, Maje and some part of sango respectively.

The Yorubas and the igbos who are mainly traders, drivers and federal civil servants live in room and palour apartments or modern flat depending on their status. The Nupes and the Hausas who are traders, farmers and civil servants are mainly found in enclosed compound houses with an opening into a common courtyard and one, major entrance commonly referred to as Zaure, in most northern part of the country. The male and the working age group of the people of the area constitute a higher than average proportion of its total population.

As for the religion of the people, almost all the inhabitants are either Muslims or Christians. This could in fact be testified by the ever-increasing number of churches and Mosques in the study area. Although the study area is situated in an agricultural belt, it should be noted that agricultural land use has tremendously reduced, while commercial land use is rapidly developing due to the population up surge in the area. Owing to the serenity nature of

the environment, hospitality business are very much alive. The area also accommodates private firms, state ministries and other government agencies. This explains why majority of the residents are civil servants. Other economic activities in the area include among others carpentry, metal works, poetry and live stock farming, trading and selling of agricultural produce etc. The implication of all these to the physical environment is the increase in refuse generation from these activities, couple with that of the domestic source which usually record the highest tones of waste.

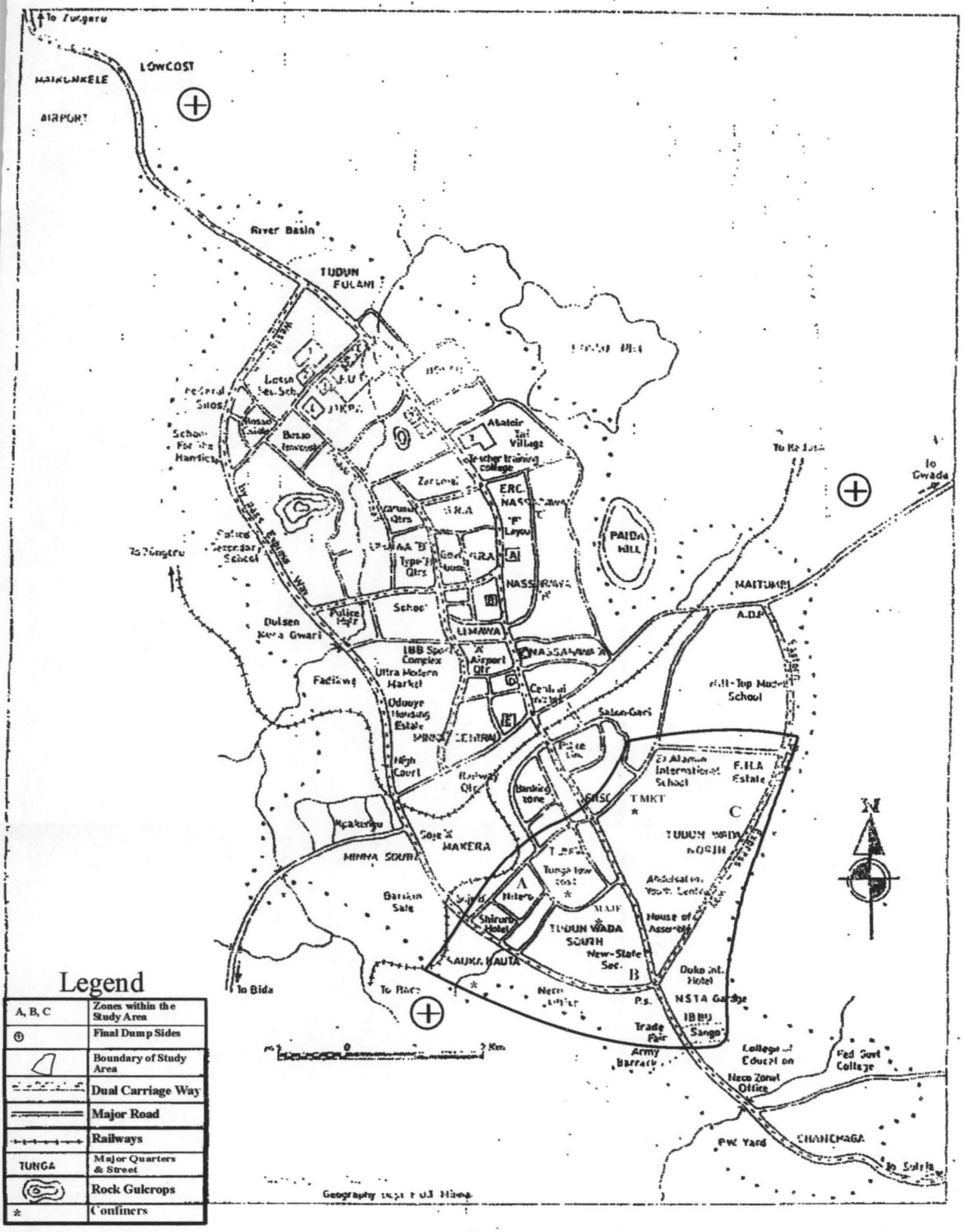


Fig. 1.1 MAP OF MINNA AND ITS ENVIRON SHOWING THE STUDY AREA

1.7.6 Land Uses

Farming and livestock husbandry were the major occupation of the initial settler in the area, this was attributed to the moderate climatic condition of the area and the fertile nature of the soil which makes agriculture productive. Under this land use pattern, flat terrain is use to cultivate, rice, maize, yams, guinea corn etc.

However, due to population growth and rate of urbanization in the area, majority of the vast agricultural land in the area have given way to residential, commercial, public, recreational and educational activities.

1.7.6.1 Residential Land Use:-

Residential land use in Tunga just like any other urban centers in the country covers the greater percentage of the total area and comprises of dilapidated houses at the core area and housing estate, flats, bungalows which are of good condition at the periphery of the study area. The core area needs to be upgraded, because of the lack of motor able access, safety, convenience and general aesthetic of most part of the environment.

1.7.6.2 Commercial Land Use

There are many commercial land uses scattered all over the area. However, the greatest concentration of commercial activities are found at the core area. Few commercial land use within the study area includes market, filling stations, NSTA traffic terminal, motor park (Abdul-salam garage), super market, Business centers, commercial Banks, Clinics, Hotels, etc.

1.7.6.3 Industrial Land Use

The only major productive industrial layout found in the area is in Sauka-Kahuta . The site was chosen because it has a good access (close to bye-pass); it's also close to the National Examination Council (NECO) Headquarter. Despite the location advantages of the site, it is yet to be fully developed. Part of this area are now been use as final disposal sites. However, there are many small scale industries such as Bakery production, Block industries, Auto-mechanic workshop, wood and metal works industries among others that are scattered all over the area.

1.7.6.4 Institutional Land Use

Well over 30% institutional land uses (both public and private) in Minna town are found in the study area. These include primary, secondary and tertiary institutions

Table: 1.1 Land use in Tunga Area Minna

Land	Area (Hectares)	% Coverage
Residential	257.96	59.3
Commercial	15.23	3.5
Institutional (Educational)	53.94	12.4
Recreational/Open space	29.58	6.8
Public & Service	48.71	11.2
Transportation	29.58	6.8
TOTAL	**435**	**100**

Source: Field survey, 2010

The general built up of Tunga area of Minna as of 2006 was about 435 hectares. Table 1.1 above shows the different land uses in the area. Over half of the developed spaces is in the high density core of the area. Outside these, more recent urban expansion has been developed of low density at the periphery of the study area.

1.7.7 Drainage System

As mentioned earlier, the hills to the north and east being steeply sloping rock out crops form the principal physical constraint on the east side of the town.

A major drainage valley flows from the center of the town south-west words with minor drainage channels feeding into it with storm water run-off from the hill to the east. The drainage was reconstructed by Julius Berger Nig. Ltd. It cut across the length and breath of the town. Each household and building along the plane of the multi-million naira drainage has it sub-connection to these bigger drains. However, the drainage is fast becoming dumping sites for refuses and all kinds of domestic waste

1.8 Structure of the Thesis

The thesis is organized into five chapters. Chapter One entails the background information on the research topic, statement of the problems, aims and objectives, scope/limitation of the thesis and also information on the study area, as regard its relief, population, land use etc. Chapter Two of the thesis focus on reviewing relevant literature on solid waste. Materials and methods employed on various Data collection are contained in chapter three of the report. Chapter Four contains the results and various Data obtained from the research. The result obtained in Chapter four were discussed in Chapter Five, alongside with the summary of finding, conclusions and recommendation. The Bibliographic/references and appendixes covering the research work were also included in Chapter Five.

Waste management involves the prevention of the production of waste products, eliminating without danger of a non-recoverable residue and recycling/new use of waste. The appropriated weight, which for example ought to be given to each of the three methods approaches as prevention, elimination, recycling, depends on a comprehensive view technical and economic consideration.

2.1 Solid Waste Management in Developed Countries

The issue of unsanitary environment is as old as human existence. It can be traced back to ancient time when man first started to coverage or congregate into tribes, hamlet, villages and communities. Such waste emanated from the human consumption pattern (Olakesusi, 1994). The situation was terrible in the medieval time as the waste generated led to the breeding of rats and the eventual out break of epidemics, which killed many European in the 14th century.

According to Ahmed (2000), modern technology is extending stress on the environment, breaking some vital link in the web of physical and biotic potential processes that maintain the ecological system in which man lives. This new technology that bring such high productivity and comfort also

destroy man's biological capital such as air, water and other part of the ecosystem that support him and all future generation.

The conditions, issues and problems of urban waste management in the industrialized and developing worlds are different. Though the developed countries generate larger amount of waste, they have developed adequate facilities, competent government institutions and bureaucracies to manage their waste.

2.1.1 The Europe Experience

The more waste we generate, the more we have to dispose of. Some methods of waste disposal release air pollutants and green house gases into the atmosphere. Waste recycling offers one means of reducing the impact of waste disposal on the atmosphere. In UK, the household and the commercial sectors have relatively low recycling rates. This is in comparison to some other waste and sewage sludge.

The government is hoping to increase the amount of household waste that are recycled to 33% by 2015. Some of the materials that are recycled include paper, plastic, metals (such as aluminum cans) and tyres (Daskalopoulos 1998).

Approximately 6 to 8% of UK household waste comprises of glass jars, and bottles. However, the largest producers of waste glass bottles are hotels and pubs,as the vast majority of drinks are bottled. A large proportion of glass is collected in bottle banks and taken to be recycled. There are over 20,000 bottle banks in the UK, and they are mainly found in car parks and at supermarkets. There are usually three bottle banks, on for each colour of glass: clear, green and brown. The UK currently recycle about one third of its glass. This is far behind glass recycling rates in other Europeans countries. Switzerland and the Netherlands for example have recycling rates as high as 80% .

Plastic make up a large amount of waste, since theyare available in numerous forms. There are two main type of plastics: thermoplastics, which are the most common; and thermostats. Thermoplastics melt when heated and can be remolded. This enables it to be recycled easily. In western Europe the largest amount of plastic occur in the form of packaging. About 4.5 million tonnes of plastic waste is produced in the UK per year. Most of which arises from packaging. Plastic recycling rate in UK is only 3%. In Germany the recycling rate for plastic is 70%.

The UK also has a recycling rate of approximately 60% for iron and steel. Most of this waste comes from scrap vehicles, cooker, fridge and other kitchen appliances. It is estimated that the metal content of household waste is between 5 and 10%. Which are mainly made up of aluminum drink cans and tin-plated steel food cans. Cooper, zinc and lead are also recycled in the UK. At present, over one third of aluminum drinks cans are recycled. Some other countries have very high recycling figures for aluminum drink cans. The USA and Australia for example recycle nearly two thirds.

El-fadel (1997), also explained that the most common disposal methods particularly in the UK, are land fill and to a lesser extent incineration. That each year approximately 111 million tonnes of controlled waste (house hold, commercial and industrial waste) are disposed of in landfill sites across UK.

There are over 4000 landfill sites in the UK. As landfill waste decomposes, methane is released in considerable quantities. It is also estimated that over 1.5 million tonnes of methane are released by landfill sites in the UK each year. Methane is a strong green house gas and contribute to global warming. Furthermore, the resulting leachate fluids formed from decomposing waste

can permeate through the underlying and surrounding geological strata, polluting ground water which may be used for drinking water supplies.

Only about 5% of household waste, 7.5% commercial waste, and 2% industrial waste are been disposed of by incineration in the UK. When burning waste, a large amount of energy, carbon dioxide and other potentially hazardous air pollutants is given off. Modern incinerators however make use of these waste energy to generate electricity and hence prevent energy from being wasted. A less common but more sustainable method of waste disposal is the anaerobic digestion. This process is now being encouraged in the UK and other European countries. Usage of the method is forecast to increase, as many other countries already utilize anaerobic digestion to dispose of large amount of waste. Denmark for example, treat 1.1 million tonnes of waste by this method every year (El-Fadel 1997).

2.1.2 The United State of America's Experience

In most part of the world today, there are various ways solid waste are being generated, collected and disposed. A survey conducted in United state revealed that 94% of the land disposed sites were inadequate and many states and municipality have made major strides toward uses of sanitary

landfill or other improved processing and disposal practices (Ricahard. 1985).

About 80% of all community waste in the U.S is disposed of by sanitary landfill and 10% is incinerated (Richard 1985). Other disposal methods such as compositing, salvage and reclamation takes only small portion of the total.

Table: 2.1 Type of Solid waste in U.S.A

S/No	Components	Percentage %
1.	Paper	50.6
2.	Food waste	19.6
3.	Metal	9.9
4.	Glass	10.1
5.	Wood	3.5
6.	Textiles	3.5
7.	Leather	1.7
8.	Plastics	1.4
9.	Miscellaneous	0.2
	TOTAL	**100**

Source: Encyclopedia Americana Vol. 28

There are also other types of waste that because of their large sizes or origin, are usually segregated for separation hauling. These items include automobiles, household appliances, furniture, industrial metal scrap, demolition waste, manure from cattle feed sots, radioactive materials and power plant by fly ash.

In the United State, the percentage capital production of solid waste has increased steadily to a daily rate of over 10 pounds (4.5kg) per person, include both industrial and residential wastes. This is equivalent to a national total of about 360 million tonnes per year. This total include 55 billion cans, 26 billion glass bottle, 30 million tonnes of waste paper, 7 million automobile and 100 million tires. In addition, 2000 million tonnes of waste is produced by agricultural sector and over 1.100 million tonnes are mining and mineral waste (Richard 1985).

2.1.3 The Curitiba Brazil Experience

Each inhabitant of Curitiba produces an average of 0.851kg garbage per day. The composition of this garbage is shown in the table below:

Table : 2.2 Type of solid waste in Curitiba:

S/No	Components	Percentage %
1.	Recyclable (metal, plastic, glass, paper	35
2.	Organic (food, agricultural by-products)	30
3.	Vegetation/Yard chipping (leaves branch, grasses)	12
4.	Inert materials (rubber, woods, cloths, leather	21
5.	Hospital waster	2
	TOTAL	**100**

Source: J. Rabinovitch and J. Leitmann (1993).

Curitiba metropolitan area produces around 1070 tonnes of municipal solid waste. Each day, of which three quarters are generated within the city, with the reminder coming from the thirteen neighbouring municipalities. The department of street cleaning operates within the Curitiba environment department and coordinate public and municipal waste collection. The collection has been contracted since 1984 through a public competition to a private company, LIPATER. The city is divided into 98 waste collection sector that have three pick-ups every week performed by 45 compacting lorries. Two special lorries collected 12 tonnes of waste daily from 180 hospital and health centre. These lorries are staffed by specially protected teams and use tanks to collect contaminated liquids.

In the central city, 28kg are swept manually every day by 415 LIPATER employees. 60km are swept at least once in a week by six mechanical vans working in two slight. Three lorries with water tanks clean curbside, side walks, the municipal public market area, street market area, bus stops and other location. Non-recyclable garbage is taken to the caximba landfill, a 46 hectare area that was inaugurated in 1989. It was originally predicted that this landfill would be used for 15 years but with the implementation will have a much longer life. Hospital waste is buried in controlled septic tanks located in high areas of the Curitiba industrial city.

Limestone powder and a one-meter clay layer in sites that are far from any ground or surface water cover the tanks. However, two innovative approaches to waste management programmes in Curitiba were integrated into their ALL CLEAN project. This include the city wide "Garbage that is not garbage" programme, Which consist of curbside collection and disposal of recyclable garbage previously sorted by households. The "Garbage purchase" programme designed specially fow low-income area normally located along riverine valley. Seek to clean up areas that are difficult for the

convention waste management system (J.Rabinovitch and J. Leitmann, 1993).

2.2 Solid Waste Management in Developing Countries

Municipal solid waste (MSW) disposal is an enormous concern in developing countries across the world, as poverty, population growth and high urbanization rates combine with in effectual and under-funded governments to prevent efficient management of wastes (UNEP 2002, Doan 1998, Cointreau 1982).

There are several factors that set MSW management in developing countries apart from management in industrialized countries. First, the types of materials that compose the majority of the waste are different. In developing countries, there is a much higher proportion of organic, and considerable less plastics (cointreau 1982). The large amount of organic material makes the waste more dense, with greater moisture and smaller particles size (cointreau 1982).

A second difference is that technologies used in industrialized countries are often inappropriate for developing countries. Even garbage trucks are less

effective because of the much heavier, wetter and more corrosive quality of their burden (cointreau 1982). Other technologies such as incinerator, are often far too expensive to be applied in poor nations. Third, developing countries' cities are characterized by unplanned, haphazardly constructed, sprawling slums with narrow roads that are inaccessible to collection vehicles (UNESCO 2003, Daskalopoulos, 1998). Finally, there is often a much smaller stock of environmental and social capital in developing countries. People are unaware or uncaring of cradle-to-grave solid waste management needs, being more concerned with more immediate problems such as disease and hunger.

2.2.1 Solid Waste Management in Nigeria

From an American perspective (Emily warren et al., 2004), the sheer magnitude of the solid waste problem in Nigeria is hard to comprehend. There are no public waste bins, as the amount of trash that accumulates in a matter of hour would be more than waste collectors could haul in a day. Nigeria garbage "dumps" are located on the sides of the high way at the fringe of cities and slums. Since there are no means for containment, trash often spreads into the roads, blocking traffic and drainage. A fair percentage of trash never makes it as far as the informed dumps; when refuse

accumulates, households and business pile it in the median of major roads and burn it (Author's personal experience).

Nigeria is a nation that exemplifies chronic solid waste management problems in conjunction with population growth. It is the most populous country in Africa, with over 120 million residents (world Bank 1996), and over the past 50 years, has had the third largest urban growth rate in the world at 5.51% annually (UMWUP 1999). It is estimated that nearly twenty percent of the population (21 million people) live below the national poverty line (world Bank 1996). Since independence in 1960, Nigeria's government has been controlled by a succession of military dictators. The election in1999 was the beginning of the first true democracy in Nigeria (Economist 2002), however the country is still known to be extremely corrupt.

The federal government has very little control over environment regulations as a whole. The Federal Environment Protection Agency (FEPA) was established in 1988 to control the growing problems of waste management and pollution in Nigeria (Onibokun and Kumuyi 2003). Vision 2010 was FEPA's atempt to address environmental problems in the nation. The report proposed goals to be accomplished by the year 2010 that would lead toward

sustainable development. In regard to solid waste management, the report says the goal is to "achieve not less than 80 percent effective management of the volume of municipal solid waste generated at all sound management" (vision 2010, 2003).

Strategies to achieve this goal include education and awareness programs, developing collaborative approaches to integrative management of MSW, stretchering existing laws and ensuring compliance, and encouraging local and private sector participation. Although this represents a positive, though some what undefined, approach to solid waste management, the reality of poverty and government corruption has prevented effective implementation of these plans. There is little to hold the government or the public accountable to the regulations developed by FEPA and vision 2010 (Bankole 2004).

In Nigeria, it seems as though no organization is willing to take responsibility for regulation of waste management. For example, in Ibadan in the western part of the country, jurisdiction over waste management has changed hands several times since the late 1980s (Onibokun and Kumuyi 2003). Although local governments are intended to found solid waste

disposal, less than a quarter of the necessary money was collected in1994 (Onibokun and Kumuyi 2003). Since state resources are often extremely limited. Private companies will often be contracted for waste disposal.

However, these companies are frequently no more effective than the state - in Ibadan in 1992, there were twenty three (23) registered private waste collector, but only ten (10) were found to be operational (Onibokun 1999).

Lagos, south of Ibadan, demonstrates another obstacles to effective waste management. The city has a population of between 12 and 18 million people, the sixth largest city in the world. Between 20 and 25% of Lagos' budget is allocated to waste management. However, even with proper garbage - collecting trucks, the incredibly dens streets of Lagos make it impossible for the trucks to maneuver through to collect the excessive amounts of trash that are produced a day. In the five other mega -cities of the world (cities with over ten million people). Over forty trips are made per day from the city to the dump site. In Lagos, only two trips are possible each day (UNESCO 2003).

The prevailing situation of refuses collection and disposal in most Nigeria town and cities is still quite unsatisfactory. Household refuse collection is inefficiently organized. A large number of houses have no refuse bins, refuse bins are uncommon and where they are provided, they are often in a state of neglect. Streets are frequently littered with domestic garbage, blocking drainage and water ways. Extensive flooding is often experienced after heavy rains. A typical example is that of the "Ogunpa" disaster that happen in Ibadan on 19th June 1980, which claimed many live and properties. Other cases include that of Minna in September 1986 and the recent Lagos (Victoria Island) episode of June 2004 (Agunwamba 1998).

2.2.2 Historical Development of Solid Waste Disposal in Nigeria

The Origin of environmental planning in Nigeria can be traced by the enactment of town improvement ordinance in 1863 by the colonial government in Lagos. It was to control development and urban sanitation in Lagos (Adedibu 1984). However, the first systematic environmental planning in Nigeria was the township ordinance No 29 of 1917.

Another attempt to control refuse with the establishment of the Lagos planning ordinance of 1928 following the "Bubonic Plague" which broke out in Lagos in 1928, as a result of the unsanitary environment. The Lagos

executive development board (LEDB) was also established for the same purpose of clearing refuses to restore sanity in Lagos. This was later transformed into the Lagos State Development and Property Co-oporation (LSDPC), (Adedibu 1989).

History also traced out that, traditionally in the early 1900s, waste disposal used to be by spraying over farmlands and after long period of fermentation and decay, it will be used as manure. Population increase, urbanization and more economic activities in most town and cities, prompted the use of river and streams as final disposal sites. The thought was of transporting both solid and liquid wastes without having an effect on human health. This assumption was proved wrong because of high incident of water related diseases and illness. Despite the water pollution problems, this primitive means of waste disposal are used in some sparsely populated areas.

Proper refuse collection and disposal has for long been an illusion in this country until in 1975 when an Act tagged "solid waste Act 1975" was passed by the government, for which it assumed the role of solid waste collection, disposal and management. Under the Act, the federal government become responsible for research, training, demonstration of new technology,

technical assistance and grants for state, and their inter-state solid waste programmes. More so, the establishment of ministry for environment and FEPA in both federal and state (Mabogunje 1980). These agencies are to assume a greater role in finding ways to solve our diverse environmental problems.

Chokor (1993) in his submission, said that there were other subsequent Acts, programmes and policies on how sanitation could be attained in Nigeria. For example, in 1984, the environmental sanitation edict was erected.

The aim was to boost the moral of the citizens in the "war against fifth and dirt's. In 1985, a sum of one million naira was ear marked as a price for the cleanest state, in demonstration of government seriousness to salvage the deplorable condition of Nigeria environment.

The promulgation of National policy on environment in 1988, again demonstrate the conviction of government that the environment problem of the country were serious enough to deserve a well focus national policies. According to Baba, J.M (2004), the goal of environmental policy is the enhancement of the human environment, which was to make human living

environment conducive, through proper garbage disposal, good sanitation at home and in public, provision of basic social services such as good drinking water, public toilet, good shelter etc.

2.2.3 Niger State Experience

Although Niger State has not been mentioned prominently as a state with acute waste management problem, there is however a growing evidence that the little that is being generated is not been properly managed. This has raised some concern among planners and decision makers. To further consolidate its efforts in getting rid of solid waste in its urban centres, the government of Niger state sought and obtained the assistance of the United Nation Development Programme (UNDP) to facilitate a process that would lead to the development of a sustainable strategy for solid waste management in the main urban centers of the state. The main objectives of the support was in preparation of a state strategy for waste management. The process followed from the development of the strategy include:

i. Undertaking a survey of waste generation and management in the four most populous cities in the state.
ii. Evaluating the current institutional arrangement for waste management in the state.

iii. Developing a training module on waste management.

(Environmental care project - Minna, 2006).

Despite various efforts, it is becoming clear that present system of waste management have not been able to satisfy community needs for an acceptable clearing level as well as in reducing the general health and environmental impacts of waste. Moreover, national and state efforts have not been able to improve the general aesthetic appearance of city landscape. Evidence of increasing frustration is the indiscriminate and open waste dumping with its attendant high environmental and health risks, and persistent waste accumulation that is evidence in various locations of the main urban centers of the state. These locations are consistently liable to various vectors (rodents and insects) and foci to severe environmental pollution, repulsive and very bad smells and disgusting appearance. When burnt on dump locations, these accumulations have negative environmental and health impacts and implications. Effort were made by the past administrators in the state, in launching war against indiscriminate dumping of waste and giving priority to solid waste management. Adequate funds and logistics were made available. However problem of waste began when the regime elapsed, which result to non-funding of the appropriate organization.

This result to indiscriminate dumping of waste in every nook and crannies of the state.

According to Innocent (1999), besides the serenity and quietness of Minna, the state capital. One of the major attractions especially to first caller to the city used to be its neatness. The city had on several occasions been adjudged one of the neatest in the country. The state has in its fleet many refuse disposal vans managed by local government areas with assistance from state government to embark on constant evacuation of the refuses to a safe dump sites on the outskirts of the city. Today the city is fast losing its past glory, as gradually, this culture of cleanliness and good management of waste is being cast aside. The state capital, has experienced continues increase in volume of wastes accumulation due to increase in population and coupled with uncontrolled and unplanned urbanization which has brought with it environmental degradation.

2.3 Composition and Problems of Waste Generation

2.3.1 Composition and Source of Waste Generation

UNCHS Habitat (1992), observed that refuses from affluent communities contains large proportion of papers, polythene, plastic, metals and glasses.

While the waste in low income communities are predominantly organic in nature. Solid waste are generated from many different sources, they naturally comprises an almost infinite variety of materials, ranging in sizes from a speck of dust to a discarded auto-mobile. The proportion of the constituents of solid waste collected at the disposal sites are virtually constant for a particular town and subject only to seasonal and long term changes, although this could be upset by industrial deliveries (UNCHS,1992).

Adedibu (1983). Confirm that the phenomenon of waste generation is common to all communities and often linked to urbanization process, especially when both the natural and the migratory net gains are relatively large. Thus, man's activities on domestic, commercial and industrial processes produce some undesirable effects, which are pollutant of all categories.

According to Adedibu and Okekunle, (1989). Certain factors determine the rate and characteristic of waste generated. These include the level of economic activities, the pattern of consumption and the income level. To some extent culture, population size and the level of economic development.

However, personal income has been found to have the most significant effect on waste generation, this is due to its impact on individual consumption pattern. Also the rate of solid waste generation per capital increase as the standards of living improves (UNCHS, 1992).

Neal Schubel (1987). In their report say that, without populations there would be no pollution and that pollution is the price of progress".that the spatial variation of socio - economic and demographic characteristic as well as the level of technological development of our environment influence waste generation.

Adedibu (1983). Noted that the economic activity of any community will determine to a great extent the quality and type of waste generated by the people. In an agrarian economy for instant, the common type of waste are usually in the form of leaves, food remnants, harvest wastes among others. In industrial economy, tin cans, plastic packages among other are common. In as much as the generation of waste is inevitable, therefore the need to protect out environment becomes paramount.

Mabogunje (1980). Further argued that the incidence of a population explosion in an area enlarge the size of households, and thus translating into heavy waste generation, that the source of waste generation is a function of many interacting variables.

2.3.2 Waste Collections and Disposal

Economist see waste as that which is cheaper to throw away then to make further use of. This does not mean that waste is valueless; some of it certainly is not. It is in the opinion of Henstock (1986), that unless recycling is possible, disposal is merely a question of relocation or transfer from an inconvenient to a convenient site.

Leorenzen (1986). In their own report, submitted that the most important factor in determining the proper handling methods for solid wastes is the actual characteristic of the waste and method that define the chemical and physical composition of the waste. All these are essential in ensuring that such material are treated, collected and disposed off in a manner that is protective to human health and the environment.

Traditionally, hand picking has long been relied upon as a collection technique to extract from the flow of refuse certain classes of large saleable

items. As household waste disposal is by feeding them to domestic animals, especially where they are composed merely of food items and remnants. Today much interest has been shown in attempt to automate this process because of its health implications. Two important collection methods are now been employed in most Nigeria towns and L.G.A's. These are the house-to-house and the communal deport method.

House-to-house method is practiced in residential layouts and other well planned areas of towns and cities. The collection crew enters each premises, takes out the trash containers and sacks and emptying them into the collection vehicles. The efficiency of this method however, is a function of the price to be paid by the various residents and households in these areas.

Communal depot on the other hand is more convenient and better affordable by vast majority of people. Under this arrangement, households discharge their waste at a designated locations where there are storage facilities (haul containers). Collection vehicles visit these sites at regular intervals to remove the accumulated wastes.

A safe disposal of solid waste is a pre-requisite for sound waste management practice. However, the existing disposal practice in Niger State and Nigeria in general leaves more to be desired. Burning of waste is one method of disposal in most urban centers. This method is said to reduce the amount of waste to between 10-15%. Other sanitary method of disposal includes: landfill, incineration, composting, reclamation and recycling. These methods however, are not been practiced in Nigeria due to lack of financial, technical and institutional capacity to manage and operate them effectively (seo 2004).

2.3.3 Problems Associated with Solid Waste Generation

According to Ahmed (2000), man generated waste as a result of his daily activities in a bid to maintain his means of livelihood to enhance and make his life comfortable. Waste generated by man, however has an adverse effect on the environment and subsequently on man himself. Uncollected waste encourage the breading of flies, cockroaches, mosquitoes, radents e.t.c. These categories of pest easily transmit diseases that can greatly affect human health. Other pathogenic and epidemiological diseases such as cholera, typhoid fever, dysentery and diarrhea etc. can result from improper disposal and management of waste.

Dumpsites are ugly sight; they produce in most cases, bad uncomfortable odour, which leads to discomfort and psychological imbalance to the people residing nearby and the people passing through the area where the wastes is dumped. Uncollected domestic waste is often dumped indiscriminately in our drains and gutters, so contributing to flooding at the onset of rainy season.

Assessing the impacts of municipal solid waste management (MSW) involves consideration of a large number or components. Health impacts include exposure to toxic chemical through air, water and soil media; exposure to infection and biological contaminants; stress related to odor, noise, vermin and visual amenity; risk of fires explosions and subsidence; etc (Dolk 2002). Environmental impacts cam be clustered into: global warning, photochemical-oxidation reaction, abiotic resource-depletion, acidification, eutrophication, and ecotoxicity of water (Seo, 2004).

Landfills are associated with a plethora of health and social effects such as odor nuisance; ozone formation (from reaction of NO_x and non-methane organic compounds with sunlight) that causes pulmonary central nervous system damage; fire and explosion-hazards from build-up of methane; and

increase in the number of vermin (bird, rodents and insects) which act as disease vectors; and ground and air pollution from leachate and landfill gases (Daskalopoutos, 1998). Water contamination by leachate transmit bacteria and diseases. Leachate from landfills can enter ground water system, leading to increase in nutrient levels that causes eutrophication (El-fadel, 1997). Bioaccumulation of toxins and heavy-metals can also occur.

In cineration impacts society by production of odor and in the unsightliness of the facility (Garrod and Willis 1998). There is also the potential for surface water pollution from waste water (used for quenching hot ashes before transport) (EPA 1995). The most important health and environmental impact is from air emissions, which include particulate CO, Co_x, acid gases (Chlorides and sulfides), volatile organics and mercury. These compounds contribute to bioaccumulation of toxics and acid rain (Daskalopouls, 1998, EPA, 1995). Inhalation of particulate matter posses a health danger, as its destroys lung tissues (Neal and Schubel, 1987).

Health and social impacts of composting/Anaerobic Digestion include noise, odor, and unsightliness (Garrod and Willis 1998). Many of the micro-organisms found in compost are known respiratory sensitizers that can cause

a range of respiratory symptoms including allergic rhinitis, asthma, and chronic bronchitic (Swan, 2002). Both composting and anaerobic digestion produce biogases, through less than landfills, composting is aerobic and produces primarily carbon dioxide while anaerobic digestion produces methane. Both gases contribute to global warming.

Recycling also pose health and environmental risks. Sorting facilities contain high concentration of dust bio-aerosols and metals. Workers commonly experience itching eyes, sore throats and respiratory diseases (Gladding 2002). Environmental speaking, recycling uses a large amount of energy resources.

Health and social side effects are equally as important as environmental impacts when considering MSW management. For people in developing countries, bodily well-being is a far more pressing concern than the fact that open burning of garbage contributes to acid rain or global warming. Outrage over health issues of poor waste management could therefore be a motivating factor towards more sustainable environmental practices. Other negative environmental effects of indiscriminate dumping of refuses, is in

the area of social economic aspect of a nation as it affects its tourism potential and its aesthetic standard.

Two approaches were taken. The first approach was searching for published and unpublished materials relevant to the study. The second approach was the administration of questionnaires that comprises of various related question on the research topic for the inhabitants to answer.

3.2 Design of Questionnaires

Questionnaires and personal interviews were the main primary Data used for this research work. The questionnaires were structure in such a way that respondent can easily respond by ticking from the alternative given to each question items, two type of questionnaires were developed, the first for the resident of the study area, while the second was administered to the officials of the body responsible for collection and disposal of solid waste in Minna (NISEPA).

A total number of three hundred and thirty eight (338) questionnaires were administered to various inhabitants living within the study area. The following parameters were strictly followed in the distribution of the questionnaires. Proper identification of the entire zone in the study area. These zones are zone A, that is made up of areas that includes: NITECO, lowcost, and Sauke-Kahuta. Zone B, includes: farm center, Aero-park, and Maje area. While zone C , is made up of area that include: NSTA-GARAGE. Top-medical and Abdul-Salami garage and its environs.

Listening and numbering of identified buildings in those zones. For each zone the number were arranged in ascending order and 10% was taken for each and every area. The corresponding number of questionnaires were administered, though not all were recovered.

Table, 3:1 Shows the summary of the sampling used for the zones.

Zone	Areas	No. of House	No. of Quest	No. of Retrieved
A.	Niteco	1056	106	93
	Low cost	522	52	52
	Sauka-Kahuta	217	22	14
B	Farm Centre	229	23	23
	Maje	189	19	09
	Aero-Park	388	39	34
C.	NSTA Garage	403	40	31
	Top Medical	201	20	17
	Abdulsalam Garage	169	17	13
	TOTAL	**3374**	**338**	**286**

Source: Field survey, 2010

3.3 Sample Selection

It is impractical if not impossible, within the limit time and finance to take on research work of this magnitude covering the whole Tunga area of Minna. A deliberate selection of representative areas was done based on the zones earlier mention for the purpose of this research, it was also done with respect to peculiar antecedent of waste generations in such areas.

Based on this premise, some area: like low cost, farm centre, Niteco and some part of Aero-park where chosen as settlement that compose of affluent member of the society. Their waste generation and management system is expected to follow the same pattern. Other areas like Sauka-Kahuta, Maje and Tunga extreme, owing to their dense nature and limited access road where termed low income residences. There waste management and the general attitude of the residents towards waste is expected to be the same. The sample and households used for this research were picked at random and added to the 10% target frame. Problems were identified, significant conclusion drawn regarding people attitude to waste the location, income distribution and emerging trend on waste management in the areas.

3.4 Method of Data Analysis Presentation

The Presentation of Data is very necessary in any research work, as it aid adequate explanation of the entire project. Data presentation in this particular work were in the forms of Tabular and Graphical/vestal Display form. The tabular representation involved arrangement of data in frequency distribution showing number of time with which an item or events occurred in certain frequency interval and the percentage different. Each table of the data has the following for its arithmetic:

i. Title

ii. Tabular number

iii. Column heading

iv. Source of data

v. Date of compilation and the implication of the date.

Graphical display of data is the presentation of data or the tabular forms into graphs, pie chart, histogram, bar chart, line graph and so on. Finally, pictures and photographs (plates) were also used to depicts situation encounter in the field during the cause of this research work.

4.1.2. Types of houses in the study area.

The reconnaissance survey carryout reveal that most of the houses in the study area are in bungalow forms.

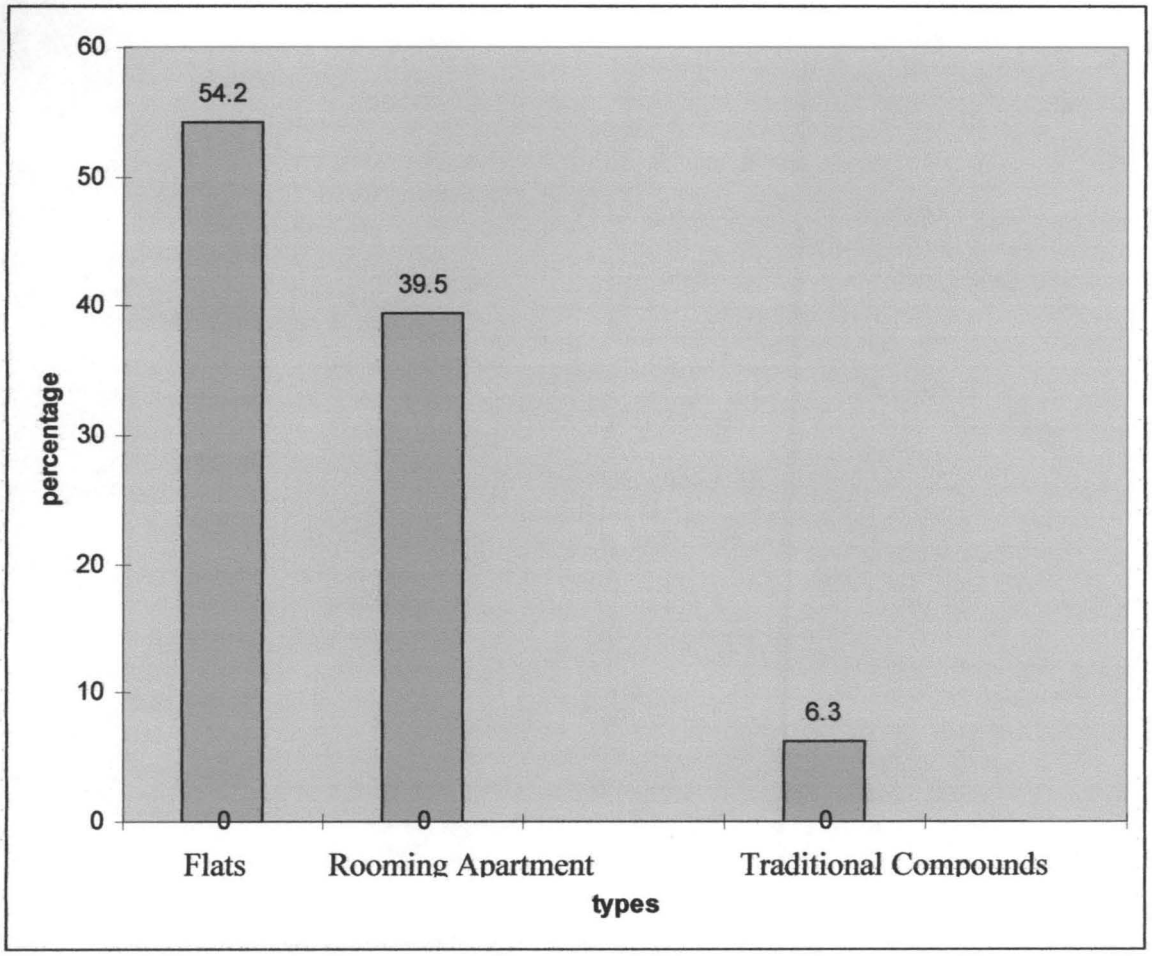


Fig 4.1 Types of houses

Source: Field Survey, 2010.

4.1.3. Number of household in the houses

Investigation reveals that, clustering of householders in some houses within the study area influenced waste generation.

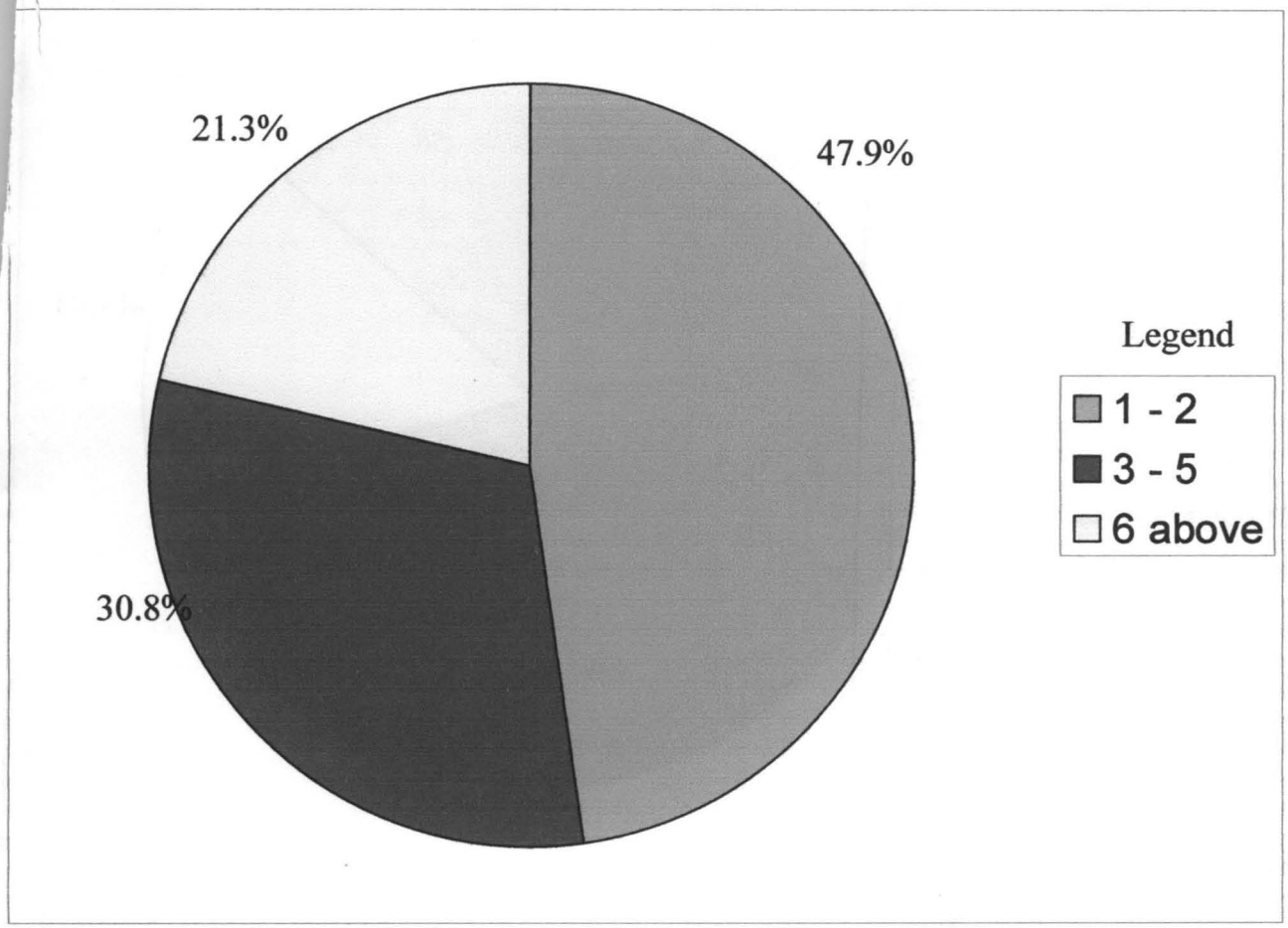


Figure 4.2: Number of Household Per Compound

Source: Filed survey 2010.

4.1.5. Occupational Distribution

Majority of the respondents in the study area are civil servants, others include artisan, traders, farmers etc.

Table 4.2 Respondents by occupation

Occupation	Frequency	Percentage %
Civil Servant	147	51.4
Artisans	52	18.2
Trading	77	26.9
Farming	6	2.1
Others	4	1.4
Total	**286**	**100**

Source: Field Survey, 2010

4.1.6. Educational Status of respondents

The statistic shows that the respondents are enlightened and should appreciate the essence of good sanitary environment.

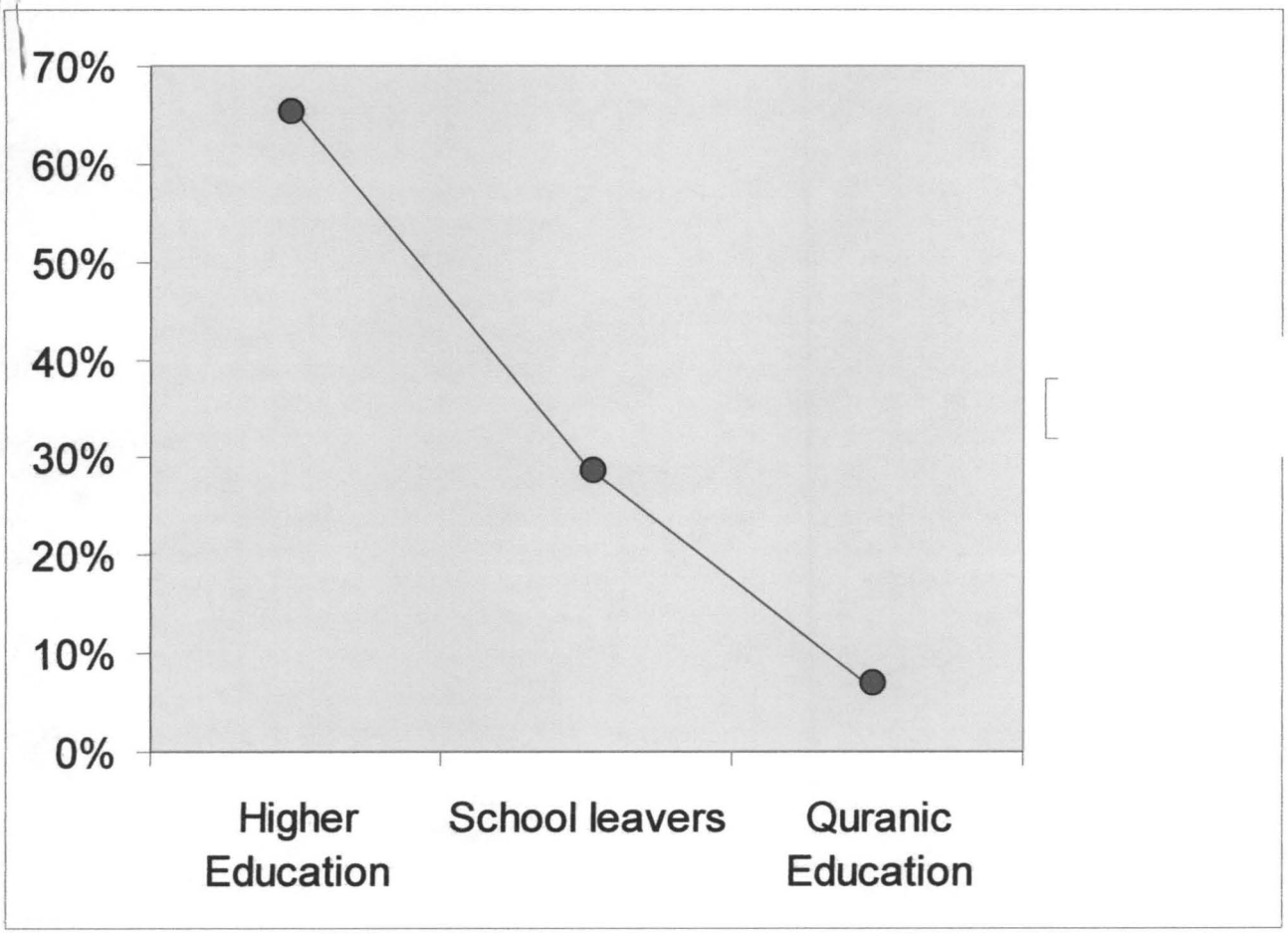


Figure 4.4: Educational Status of Respondents

Source: Filed survey 2010.

4.1.7. Household income Distribution

Tunga area residents are low and middle-income earners. These could be attributed to the social behaviour of the people and high food content wastes in the area.

Table 4.3 Monthly Income Level

Income per month	Frequency	Percentage %
5000 – 10,000	21	7.3
10,001 – 15,000	62	21.7
15,001 – 20,000	54	18.9
20,001 – 25,000	44	15.4
> 25,000	105	36.7
Total	**286**	**100**

Source: Field Survey, 2010

4.2 Solid Wastes in Tunga

4.2.1 Type of waste generated in the Areas

Wastes in Tunga, constitutes some of the following items; Leaves & food reminants, paper & polythenes, plastics, bottles, ceramics & metalscraps etc.

Table 4.4 Type of waste in Tunga

Waste generated	No. of respondent	Percentage %
Leaves & food remnants	79	27.6
Paper & polythene	147	51.4
Plastics	36	12.6
Ceramics/metal scraps & bottles	11	3.8
Ashes & dusts	13	4.6
Total	**286**	**100**

Source: Field Survey, 2010

4.2.2 Source of Solid waste Generated

The bulk of the wastes in the area comes from the household kitchens. Some other sources includes; Restaurants, markets & stores, offices, passerby etc.

Table 4.5 Source of waste in the area

Waste	General Composition	Sources
Garbage	Waste from cooking (food remnant), spoil fruit and vegetables etc.	Kitchen, Restaurants, shops & market,
Rubbish	Combustible papers, polythene/ nylons & rags etc.	Offices, household and markets
Ashes & Dusts	Residue from fire used in cooking and carpentry works etc	Restaurants, stores, markets etc.
Street Trash	Leaf, litters, can, cobs, fruits peel etc.	Food vendors, passerby, store & restaurant.
Abandoned vehicles	Unwanted cars, motorcycles, bicycle parts, other metals scraps etc.	Road side mechanics etc.

Source: Field Survey, 2010

4.2.3 Characteristics of Urban Solid Waste

Table 4.6 Characteristics and Composition of Urban Solid waste in Niger State (From 3 Social Classes)

Characteristics/Waste Generation Rate	Volume/Density Type		
	Low	**Medium**	**High**
Paper	12.6	33.7	81.3
Leaves	13.2	11.3	2.5
Garbage	65.3	41.6	8.2
Tin	4.6	6.2	3.4
Glass	2.1	2.5	0.1
Rag	1.6	3.4	4.3
Dust	0.6	1.3	0.2
Density	256kg/m^3	256kg/m^3	296kg/m^3
Moisture Content	64.4%	61.4%	49.7%

Source: Adopted from Niger state waste management strategies, 2006.

4.3 Waste Management in Tunga

4.3.1 Households method of storage

Catoons, baskets, drums, sacks and cellophene bags, are some of the waste storage facilities use in stores and residential buildings. Hauled containers and big vessels are used in publics and commercial facilities.

Table 4.7 Waste Storage facilities in Tunga

Types	Frequency	Percentage %
Basket/Catoons/Buckets	74	28.1
Sacks/Cellophone Bags	48	18.3
Drum	36	13.7
Pile on Floor	105	39.9
Total	**286**	**100**

Source: Field Survey, 2010.

4.3.2 Household method of Disposal

Open dumping is the most common way of disposing refuses by different households in Tunga. At this point, the responsibility of waste management is left in the hands of the authorities.

Table 4.8 Waste Disposal method in Tunga

Method	No. of respondent	Percentage %
Packing & Burring	39	14.7
Open dumping	111	41.7
Drainage dumping	33	12.4
Others (eg NISEPA)	83	31.2
Total	**266**	**100**

Source: Field Survey, 2010

4.3.3 Waste collection in the Areas

Block system and the communal deport are the two major methods of waste collection adopted by the Niger State Environmental Protection Agency (NISEPA).

Table 4.9 Preferred collection method

Method	**No. of respondent**	**Percentage %**
Communal deport	173	60.5
Block collection system (House to house)	113	39.5
Total	**286**	**100**

4.3.3 Source: Field Survey, 2010

4.3.4 Dumpsites location

Some of the official dumpsites allocated by the local authority have been ignored due to their location. Any available open space (plot of lands) owned by individual is now been used as dumps.

Table 4.10 Various dumps (confiners) in the study area

Location	Categories
Maje Market	Unofficial
Abdulsalam Garage	Official
Behind Tunga Market	Official
Government Day Secondary School Tunga	Official
Kolawale	Unofficial
School of Midwifery	Unofficial
El-Alamin Int' School	Official
Sauka Kahuta	Unofficial

Source: Field Survey, 2010

Table 4.11 Staff strength of N.I.S.E.P.A

S/No	Category of Staff	Capacity	Number (No)
1.	Special grade	Chief Executive	1
2.	Grade above -12	Senior Executive Officer	6
3.	Grade 07 – 09	Principal Environmental Officers	27
4.	Grade 04 – 06	Health Attendants	48
5.	Below – 03	Road cleaners, drivers etc	130.
	TOTAL		**212**

Source: Field Survey, 2010

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

Refuse/waste generation, disposal and public health have been tropical environmental issues that have generated a lot of interest among environmental experts in developing countries of the world. The six months survey, observation, interviewing and administration of questionnaires on the topic: Assessment of Residential Solid Waste Management in Tunga Area Minna, Niger State, Nigeria, has broading and further enlighten the researcher on the various ways in which refuse are generated, collected and disposed off in Tunga area.

The followings therefore form the summary of research findings based on a thorough understanding of the problems and prospects in the area.

5.1.1 Analysis/Interpretation of Data on the Socio-Economic Characteristic of the Respondents.

A total of 3,374 houses were found in the study area, with an average size of 50 by 100m2 compound (Table 4.1). The type of houses that characterise the study area are flats, rooming apartments, and traditional compound houses.

(Fig 4.4). This statistics however, show that the respondent are enlightened and should appreciate the essence of good sanitary environment and aesthetic. From the table 4.2 it is evident, that mojarity of the respondent are civil servants (more than 50% of the responses). The survey also reveals that artisants and traders ae more clustered in and around Maje, Sauke – Kahuta, Aero –park and NSTA garage areas than other places. This could also be an evidence of the amount and types of waste coming out of these areas. The income distribution on table 4.3 shows that the respondents are regular income earners. The implication is that higher income affects life style and eating habits of the respondents, which attract more waste generation and also influence the types and composition of waste generated.

5.1.2 Analysis of Data on Solid Wastes in Tunga.

Information about waste types, source and composition is very critical as they help in planning for integrated waste management system. The result from the findings based on the survey carry out, reveals that 27.6% of the refuse generated in the study areas are made up of leaves and food remnants, paper and polythene, recorded 51.4% of waste generated, plastics 12.6% ceramic/metal scraps/bottles 3.8% while Ashes and dusts represents the remaining 4.6% (Table 4.4). Several factors determine the extent and types of waste generated. These factors include population size and density,

cultural habits of the people, their level of affluence and land use characteristic. More than 70% of the total waste generated in Tunga area comes from the Domestic sources. The levels of income of the resident usually affect composition of the waste. Tunga residents can be termed as low and middle income earners. Because of the social behaviors of the people, waste in these areas contains high organic and moisture contents. The high moisture content of the waste is because of the high percentage of the food waste and also because they are often stored on open ground waiting collection (Table 4.6).

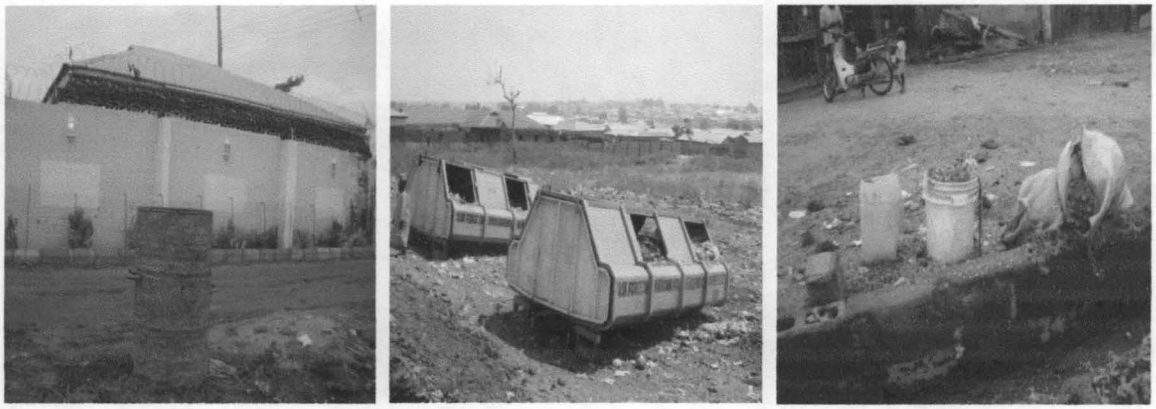
i ii iii

Plate I (i, ii, iii) type of wastes generated in the area

5.1.3 Analysis of Data on Waste Management in Tunga.

Table 4.7 reveales that within the compounds, baskets, metals of plastic drums, and sacks / cellophane bags are used for direct storage of wastes. Contrary to expectation, about 40% of the total respondents dump their

refuse on the floor, most especially residents of high density and low – income area like Maje and Sauke – Kahuta. The survey also revealed that the containers used to store the wastes are smaller in size to contain all the refuses and lot of them are without lids. (Not covered). Hauled containers placed in public and commercial facilities where a lot waste is expected to be generated are grossly inadequate, and few available were unhygienically exposed to the environment (see plates).



i ii iii

Plate II (i, ii, iii) different storage containers used for waste

Waste is generally seen as that which is cheaper to throw away than to make further use of. Table 4.8, clearly shows that open dumping is the most common way of disposing refuses by different household in the study area. It is at this point that the households expect that management is done by the authorities.

House to house (block system) and the communal deport are the two major methods of waste collection used in the study areas (Table 4.9). The block system is practice in residential layout and other well planned areas such as low-cost, farm center, Niteco and few other areas. The collection crew enters each premise, takes out the trash containers and sacks, emptying them into the collection vehicle. Over 60% of the responses favour the communal deport. Under this arrangement, householders discharge their waste at designated location (storage confiners) that are strategically located in the areas. This method, eliminate the need of moving from house to house, which is tedious, exhaustive and a time consuming process. This means less time would be spent at each waste collection point and crew size would be reduced as well. The survey also reveals that the efficiency of Block collection system is a function of the price to be paid by the residents, as households need to be informed of time of the day for collection. Only two collection vehicles are servicing the areas as at the time of writing this report. This has limited the number of times and frequency with which refuse are evacuated from the deports and various residences. 80% of the respondents also indicate that once the refuse is taken out of the households to a dumpsite, it becomes the responsibility of the authorities. They further

affirmed that it is a social service expected to be provided by the government to the community.

i ii iii

Plate III (i, ii, iii) NISEPA Waste Collection Vehicles at work

Disposal strategies are the most sensitive aspect of this research. It involves the collection of waste from the deports and containers, transportation of the waste to final disposal points along a major highway. Most of these collection points are illegal (unofficial). From the result of location of dumps (confiners) on table 4.10, it is obvious that the dumpsites are few when compared to the size of the areas. The limited number of dumpsites contributed to the indiscriminate littering and dumping of refuse all over the place. The few dumpsites provided are sited very close to the residential buildings and drainages. Owing to the location of some of these sites, they are very difficult to access by hauling vehicle. There is also a high rate of vandalism by animal and unauthorized recyclist (scavengers) in some of

these collection points. It was also observed that uncollected waste encourages the breeding of flies, cockroaches, rodents etc. these categories of pest easily transmit disease that can greatly affects human health and pollute the ground water resource in the areas. Although, reliable statistics is hard to come by, the increased incidences of malaria, typhoid and diarrhea in the areas over the last 3 years according to respondents is an evidence of poor disposal of wastes in the areas. Most of the dumpsites constitute eyesores and produce bad odour.

i ii iii

Plate IV (i, ii, iii) Dumpsites along streets and major road in the area

5.1.4 Minna Municipal Solid Waste Management.

Generally, the responsibility of waste management rest largely on municipal authorities. Much emphasis by the authorities has been on getting rid of the waste at minimal cost. Only a few proportions of house holds in the town has access to regular waste collection. Thus there are low waste collections

efficiencies, such low collection efficiencies result in left over accumulations that are either removed on regular basis, or burnt on site.

Waste management in Minna is highly dependent on an active informal network. This sector consists of waste pickers, intinerant, waste dealers and whole sellers and small recycling enterprises. There is poor performance of the formal sector which is basically restricted to sweeping and curbside collection, transportation by hand – carts to large or collection point which often than not are open dumps, and transportation by vehicle to the disposal sites. Waste collected by formal and informal sectors are disposed off in an environmentally unsound open or semi – controlled unlined dumps with no ground water protection or treatment system. Here, waste displaced within an area without compression or covering with earth. This dumping in an open field is extremely hazardous to both the environment and health. It was also observed that the management program does not include land filling sites and incinerators due to the to the cost. The approach has not given much attention to key economic goals of waste management such as waste reduction, source segregation, and recycling. In a similar vein social goals such as litter avoidance and the care for a health and sustainable environment are not properly reflected in the current approach.

i ii iii

Plate V (i, ii, iii) Conditions of Drainages in the area

5.1.5 Problem of Waste Management in Minna

Waste manager faces a number of problems in Minna ranging from system failure in which there are poor policy frameworks for waste management and shortage of tools, poor capability, under funding, increasing cost of transportation and disposal due to the growing distance to disposal sites, lack of delineate are site and increasing value of land close to the city center, to mention but few. These problems are multidimensional and can be summarized as follows.

1. These are weakness in the Niger State public health law (amendment) edict No 2 of 1984 that backed up the bodies responsible for solid waste management in Mina. Investigation reveals that there are lapses in the implementation of the provision of the law. Economic reasons have weakened the implementation of the provision of the section I of this effort

as many house holds cannot refuse bins for the collection of waste. In section II and III the fine contained there in are too meager to make any impact on the offenders

2. The rapid rate of urban development has placed a greater burden on environmental sanitation management. The small size of the task force has been stretched to the limit in its effort to maintain a clean environment. Despite the efficient and effective functions of the NISEPA and the sanitation unit of the municipal council, there is still inadequacies in the execution of there functions. Some of this lapses include, lack of proper routine inspection by the officers to assert the state of the dumps, improper inspection of the households in relation to refuse storage and disposal in the areas. There are also laxities as a result of administrative bureaucracy where officer find it difficult to challenge and report other officers weakness in the performance of their duties.

3. The role of a sound financial base is a pre-requisite for any organization to survive and carry out its functions in order to realize its objectives. Money is needed to pay and maintain workers, purchases of specialized equipment in sufficient number needed for effective waste management. The agencies annual budget has also been drastically cut down over the years.

4. The number of trained environmental officers whose responsibility is to ensure effective co-ordination of management system and general inspection of areas is grossly inadequate (Table 4.1). As at the time of writing this report, the agency had a total number of 212 staffs, out of which about 45 were posted to sanitation department of the municipal council. Based on the analysis carried out on the volume of waste generated, vis -a-vis the increased population of people living within the area of the study. More lands are needed to carry out the demanding exercise effectively.

5. in addition to other practical problems mentioned is inadequate poorly maintained, out of date equipments with limited available spare parts; and inappropriate of equipment for local conditions. Many areas of the municipality still suffer inaccessibility to collection vehicles. Few collection points available in the area are not strategically located. Above all there is general failure of people to acquire the right attitude toward waste management and disposal, instead they throw them around their residential houses.

5.2 Conclusion

The problems of waste generation, collection, disposal and management have underscored the need for re – evaluating the basis for delivering modern services efficiently in urban centers. It is the believe of all that

everybody has an important part to undertake in this re – evaluation. To avert this disaster is to avoid disaster, therefore careful planning and management of the expending life support system in most of the urban centers is crucial if the environmental crisis is to be ameliorated.

The most important factors in determining the proper handling methods for solid waste is the actual characteristic of the waste. Method that defines the chemical composition and physical characteristics of a waste is also essential in ensuring that such materials are treated or disposed off in a manner that protects human health and the environment.

The finding of the research also agreed with Mabogunje's (1985) observation, that we must not under estimate the role of habit and attitude of people toward the environment. To this end. The researcher is of the view that ignorance, habit and attitude of the people account for the cans, plastics polythene / nylons, papers and food ruminants that litter the environment. Other factor include socio – cultural background of the inhabitants, hence the need for awareness. It is therefore the submission of this study that information gotten from this work will in no small way help in solid waste evacuation and disposal. Lastly, living in a healthier and cleaner

environment would bring about sustainability of life and the environment in general.

5.3 Recommendations

Having had an in-depth study of the problems of solid waste management within Tunga area of Minna, ranging from its generation, collection and subsequent disposal and after a careful consideration of the options available to individuals and government. The following measures have been suggested as a panacea to the problem of waste menaces that parade most Nigerian cities.

1. Waste collection and management authorities in the state should be properly reorganized. Part of their responsibilities should include the creation of dumping sites for different categories of waste such as biodegradable and non-biodegradable. This type of development will allow waste that can be recycled, to be observed, monitored, and used as new sets of raw materials. This will also go a long way in encouraging companies that depend on the recycled materials.

2. Agencies involved in the management of solid waste should effectively be equipped with tools and machineries. There should be involvement pf private organization participation.

Enough funds should be made available for these agencies to effectively carry out their function adequately. In addition there should be enough manpower with technical and otherwise staff welfare should be given by the government because this is a job most Nigerians would not do earn a living especially the labour aspect. Improved welfare scheme would attract people to the job.

3. Government should buy refuse bins (oil drums) and sell at subsidized rate to the residents of the areas for onward storage and collection of their wastes, to complement the existing small aluminum containers distributed by NISEPA per households. Block system of collection of refuse should be intensified on the daily basis to avoid or reduce indiscriminate dumping and uncleared heap of wastes. A neighborhood collection centre points, that will serve as a waste depot should be provided in especially high dense and low-income areas of the study area.. Here the refuse collection period should be al least thrice a week. However, the whole exerc should be sustainable as it is now (free of charges), to encourage resident to send refuse to approved places.

4. Massive enlightenment campaign to re-awake the sanitation consciousness of the people is to be worked upon jointly by all the relevant agencies that are involved in management. This can assume the form of mass media such as radio, Newspapers, Magazines, workshop and seminars e.t.c. A dime this is to float on environment

educational programmes with a focus on the dangers of fitly environment and general waste management. Environment sanitation should be re-introduced on monthly basis and should be adequately funded and enforced by the local government and Health department respectively. All these will enable the public to appreciate the need for clean environment, for cleanliness they say is next to Godliness.

5. There should be renewed and conducive working relationship between the local community arm and the state arm of agencies responsible for solid waste management as well as other related organization (e.g NGO's). Further more, Geography, Planners, Engineers and other workers in the area of health should be encouraged so as to provide workable methods. For effective and efficient waste management and formulating laws.

6. There is also need for environmental control standards as an abating measure. Such standard imply that the community is willing ti bear certain costs or to enforce those cost on others to maintain its surrounding at a given level of quality. Alternatively, a committee should be put in place and charged with the responsibility of creating refuse dump sites, monitoring the behaviours of refuse disposal and impose sanctions on defaulters of these regulations. Generally, these measures are bound to succeed if the entire community complied with the suggestion. Also if the entire populace equally make themselves amendable to future changes on environmental laws and

regulations. Appropriate recommendation have been made which if implemented will solve the problem of wastes in the long runs.

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APPENDIX I
SCHOOL OF POST GRADUATE
DEPARTMENT OF GEOGRAPHY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

Questionnaires: For the body responsible for collection and disposal of refuse in Minna.

Organization: _____ Date: _____

Researcher Topic: ASSESSMENT OF RESIDENTIAL SOLID WASTE MANAGEMENT IN TUNGA AREA MINNA, NIGERIA

A research work is proposed to be done on the above topic in pursuit of Degree of Master of Technology (M.Tech).

The aim of this preliminary survey is to obtain useful information needed for the success of the research. Therefore, your candid response to the inquiries is highly solicited for, as well as your co-operation for the next stage of the study. All information obtained would be treated with utmost confidentiality and respect for this research work only.

INTRODUCTION: Fill in the blank spaces or tick were necessary.

1. COLLECTION POINTS

1.1 How many collection point do you have in Tunga Area of Minna?
_____

1.2 What is the nature of the collection point?
(a) Enclose ( ) (b) Open ( ) (c) Walled ( )
(d) Others (specify) _____

1.3 Where are the collection points located?
(a) Along the street/road ( ) (b) Within planned space ( )
(c) Within accidental open space ( ) (other (specify) _____

1.4 What type of collection method do you ployed in the area
_____

1.5 What problems do you encountered in setting of collection point
_____

2. VEHICLES

2.1 How many vehicles do you have for refuse collection? _____

2.2 What type of van or refuse vehicles do you have? _____
(a) Trucks ( ) (b) Tipper ( )
(c) Tractors ( ) (d) others (specify) _____

2.3 What is the carrying capacity of each van? _____

2.4 How often do you go out for refuse collection?
(a) Daily ( ) (b) Weekly ( ) (c) Monthly ( )
(d) Other_____

2.5 What are the problems encountered during collection?
_____

3. DISPOSAL SITE

3.1 How do you finally dispose refuse after collection?
(a) Landfill ( ) (b) Ordinary Dumping ( )
(c) Composing ( )(d) others (specify) _____

3.2 How many disposal sites do you have in Minna? _____

3.3 What are the criteria for choosing these sites? _____

3.4 What are the problems you encounter during disposal? _____

4. OTHER MATTERS

4.1 What major problems is the body facing in collection, transportation and disposal of refuse?

(a) Level of finance ( )
(b) Low level of staff strength ( )
(c) Inadequate equipment ( )
(d) Lack of access to collection ( )
(e) Other (specify)

4.2 What steps are being taken to solve these problem?

_____

4.3 What is the source of finance to the body?

_____

APPENDIX II
SCHOOL OF POST GRADUATE
DEPARTMENT OF GEOGRAPHY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

2. **Questionnaire:** For people living in the area of study.

The questions below are in respect to the topic above. Please thick/fill in appropriate answers.

Date: _____ Houses No: _____ Street: _____

Instruction: Fill in the blank spaces or tick were necessary. To be completed by a Head of the family or entrusted representative only.

Section A

1. Type of House of abode:
   (a) Flat ( ) (b) Rooming apartment ( )
   (c) Traditional compound house ( ) (d) Others ( )

2. Educational Status
   (a) Higher Education ( )
   (b) School leaver ( )
   (c) Qu'ranic education ( )

3. **Occupation**
   (a) Civil servant ( ) (b) Trading ( ) (c) Artisans ( )
   (d) Farmer ( ) (e) Others ( )

4. **Size of the Household**
   (a) 1 - 5 ( ) (b) 6 - 10 ( ) (c) 11 - 15 (d) 16 and above ( )

5. **Income per month**
   (a) #5,000 - 10, 000 ( ) (b) 10, 001 - 15, 000
   (c) 15, 001 - 20, 000 ( ) (d) 20, 001 - 25, 000 ( )
   (e) Above 25, 000 ( ).

Section B.

1. What are the sources of your refuse?
   (a) Household activities ( ) (b) Commercial activities ( )
   (c) Industrial activities ( ) (d) other (specify)

   _____

2. Type of refuse (waste) generated?
(a) Food and leave materials ( ) (b) Polythene and paper ( )
(c) Ashes & dust ( ) (d) Plastic ( ) (e) ceramics & metal scraps ( )
(e) Other (specify) _____

3. Do you have a dust bin in or outside your compound? (a) Yes ( )
(b) No ( )

4. Do your dustbin have a lid cover? (a) Yes ( ) (b) No ( )

5. Where do you store your waste before disposal?
(a) sacks ( ) (b) Drum ( ) (c) Bucket / Basket ( )
(e) pile on floor ( ) (d) other (specify) _____

6. How frequent do you empty your dustbin at your house.
(a) Daily ( ) (b) every 3 days ( ) (c) weekly ( )
(d) Monthly ( ) (e) Not at all ( )

7. What type of collection point in your house/Area?
(a) Hauled container ( ) (b) Commercial depot ( )
(c) Illegal dumpsite ( ) (d) other (specify) _____

8. How do you dispose your waste?
(a)Burning ( ) (b) Drainage dumping ( )
(c) neighborhood/open dumping ( ) (d) Rain – wash ( )
(e) Other (specify) _____

9. What collection method do you preferred
(a) House to house ( ) (b). Communal deport ( )

10. In your opinion who should be responsible for the refuse in your area?
(a). Government ( ) (b). Community ( ) (c). Individual ( )
(d) Private firm ( ) (e). Other (specify) _____

11. What establishment or agency is responsible for the collection of refuse in your Area?
(a) Local Gov't ( ) (b) State Gov't ( ) (c) Private firm ( )
(d) Community ( ) (e) Other (specify) _____

12. If method of disposal is open dumping, are you satisfied with the location? Yes ( ) / No ( )

13. If no, what do you feel should be the best alternative?
(a) Provide incinerator ( ) (b) provisions of land fill facilities ( )
(c) Other (specify) _____

14. Do you pay in respect to the collection of your waste?
Yes ( ) / No ( ).

15. If yes how much? _____

16. If no, are you willing to pay? Yes ( ) / No ( )

17. What problems do you encounter with the body responsible for waste/refuse disposal in your area?

_____

_____

18. Are you aware of any relationship between waste management and public health? (a) Yes ( ) (b). No ( )

19. How often do you or any member of your family suffer from malaria, diarrhea, typhoid fever, others (please specify)
(a). Very often ( ) (b). Periodically ( ) (c). Rarely ( )
(d). Never ( )

20. What possible suggestion do you have to improve on the collection and Disposal of waste in your area?

_____

_____

21. Does this refuse dump affect you in any way? Yes ( ) / No ( )

22. If yes, how does it affect you?

_____

Eletu M.T
M.TECH/SSSE/O7/1602