DISSERTATION

ON

SOLID WASTE MANAGEMENT
(A CASE STUDY OF MINNA)

SUBMITTED TO THE
DEPARTMENT OF GEOGRAPHY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
NIGER STATE, NIGERIA.

BY

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IN PARTIAL FULFILMENT FOR THE AWARD OF POST GRADUATE DIPLOMA IN ENVIRONMENTAL MANAGEMENT, DEPARTMENT OF GEOGRAPHY, SCHOOL OF SCIENCE AND SCIENCE EDUCATION,
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DECLARATION

I hereby declare that this work has been written by me as a record of my research work. It has not been presented in any previous application for any level of post Graduate Programme in Environmental Management. All quotations are indicated and the sources of information are duly acknowledged.

.....

MOHAMMED SHEHU GULU

DEDICATION

This project work is dedicated to all the World's champions of environmental purity and conservation.

ACKNOWLEDGEMENT

I must first of all express my profound gratitude and continuous total submission to my creator, ALLAH (S. W. T.) for giving me the physical and financial abilities with which I successfully passed through the rigours of the course.

My sincere thanks and appreciation go to Dr. Peter S. Akinyeye for all the guidance, corrections and advice he rendered at various critical stages of this project. Infact, without his preparedness to help this project work would not have been seen the light of the day. Once again, I thank him.

I must also not forget to express my thanks to Dr. M. T. Usman, Dr. Abubakar Saduki, Professor J. M. Baba, Alhaji Dauda Hussaini of the defunct NEPA, Dr. G. N. Nsofor, Dr. A. Apolloniah, Dr. Umoh T. Umoh and Mrs. Odafen for their patience in instilling the knowledge I have acquired in me. May God reward them all.

ABSTRACT

The continuos increases in human population in the past of few years (as indicated by the 1991 population census result) has given rise to a similar increases in urbanization. These increases have also jointly led to increases in industrial, agricultural and commercial activities. As a result of the above scenario, complex problems affecting several areas of human endeavours have continued to emerge.

One of the problems is the increasing generation of solid wastes. Solid wastes generation has increased both in nature and in volume over the years. This phenomenon no doubt constitutes a disturbing threat to both human and environmental well being.

There is therefore the need for a concerted efforts to be made towards the identification of the nature, sources and volumes of the solid wastes generated. There is also a need for a proper understanding of the effects of the wastes on human health and on the environment. With regard to the study area of this project, questionnaires have been used and the resulting data analysed.

Finally, efforts and studies should be made towards the identification of the best methods of solid wastes management that have the capabilities of curbing the effects of solid wastes for now and into the future. This has been touched in my recommendations in the last chapter of this project.

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CHAPTER ONE

1.0 INTRODUCTION

In the whole of the Universe the Earth is the only place in which man can conveniently live. The other areas of the Universe are either too cold or too hot to sustain human life.

The Earth, which is unavoidably the dwelling place for man is made up of the Atmosphere, Lithosphere, Biosphere and Hydrosphere all of which should always be in such acceptable levels of purity to be able to sustain life. Any fall from the standard acceptable levels of purity may occur naturally or artificially through human activities.

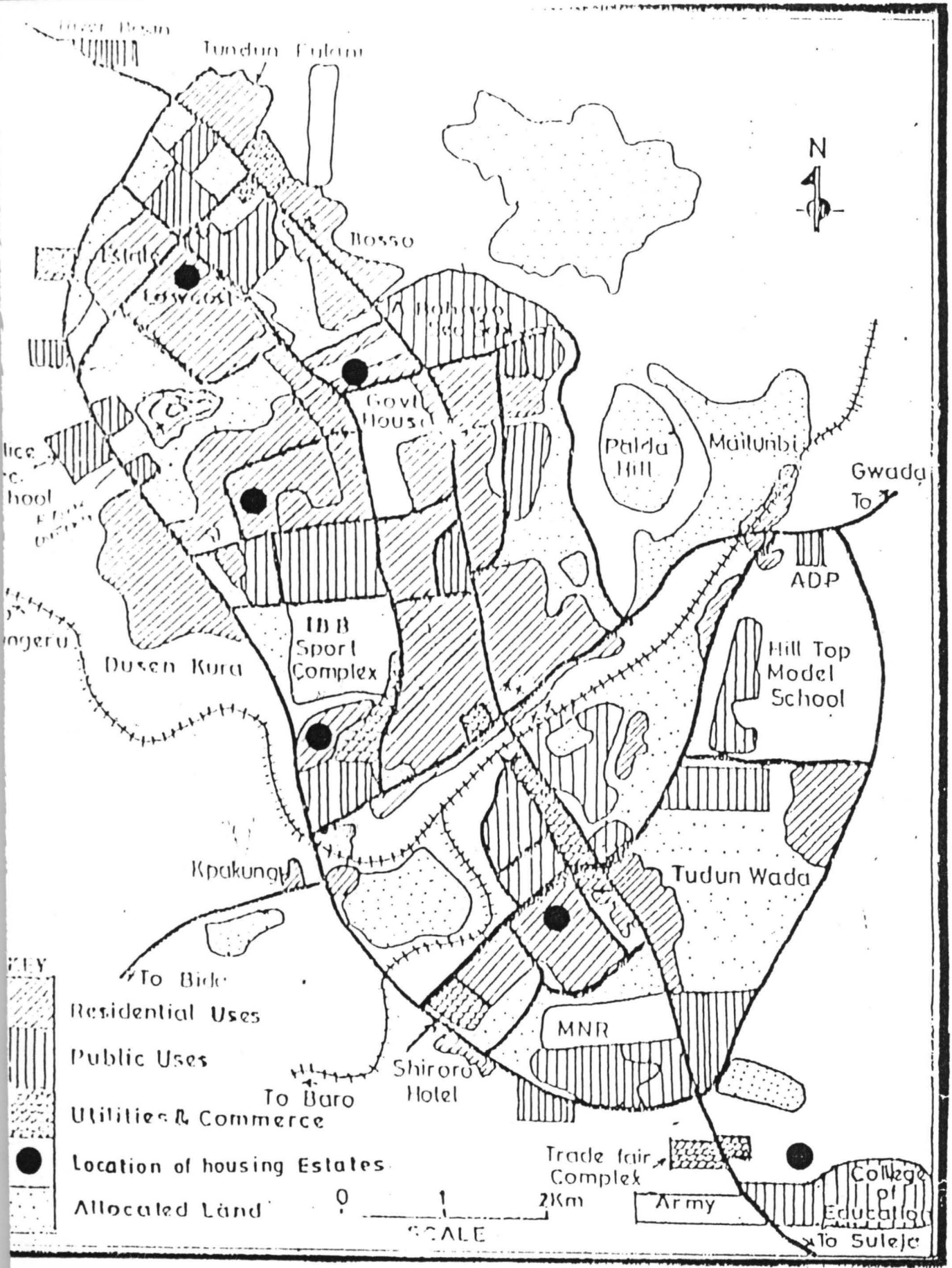
The immediate earth surface, the Lithosphere, is the part of the environment that concerns man the more because it is his immediate environment and almost all his activities from birth to death take place on it. Human activities like building, cooking, farming, recreation, movement etc all take place over the lithosphere. In every human society therefore, no matter how primitive or developed, the inhabitants have some knowledge of certain aspects of their immediate earth surface because it is part and percele of their lives.

Several years back the management of solid wastes within our environment was not a source of headache to man because considerably little manageable

volumes of solid wastes were generated through industrial, agricultural and domestic activities.

With increasing human population over the years however, more industries are built to produce more products to meet the growing needs of the population. Agricultural activities have similarly grown in size in response to the increasing population. The increase in industrial and agricultural activities together with increase in domestic activities have all resulted in the generation of more solid wastes in volumes over the years.

Instead of properly disposing off the increasing volumes of solid wastes generated in such a way as to avert the resultant harmful effects on man, lower animals and the environment, every available space in our towns and cities are indiscriminately used for dumping heaps of solid wastes leading to the appearance of massive problems having direct impacts on man, lower animals and the environment in general.



Source : Survey Department, Minna With Modification

The Map of Minna showing some locations of dumping sites.

1.2 BACKGROUND INFORMATION

Minna, the focus of this project work is the capital of Niger State. Minna was about two decades ago, one of the small human settlements in the Niger Province of the defunct North Western State.

Minna was still in a status of a rural setup when, in 1976, the then Military Government of the Late General Murtala Muhammad created Niger State with Minna as its capital. This exercise marked the beginning of the departure of Minna from a rural settlement to a growing urban settlement.

The eventual status of Minna as a State capital soon started to witness the influx of people both from the rural areas of the young State and from other parts of the country. The influx of people in large numbers provoked a massive physical expansion of the town in order to make accommodation available for the people coming in. As increasing population led to the physical expansion of Minna, business, agricultural and domestic activities were also expanding.

In the early years of Minna being the State capital, problems of solid wastes management were not noticeable. Now that the physical and human growth have reached high levels, disturbing problems of solid waste management have become glaringly noticeable almost every where.

1.3 STATEMENT OF PROBLEMS

The growing indiscriminate accumulation of solid wastes has led to the obstruction to free movement of vehicles, pedestrians and animals. Solid wastes contribute to the blockage of drainage thereby preventing the free flow of rain water and waste water from domestic uses. The practice of burning solid wastes creates smoke nuisance and also causes fire outbreaks in residential buildings. Strong winds blow away solid wastes littering a wide area thereby making the environment untidy. In rainy season and in humid weather some solid wastes decompose thereby emitting strong smell to the people passing by.

The above are some of the peculiar problem presently existing in the study area. It is therefore the intention of this study to find a lasting solution to the problems.

1.4 AIMS AND OBJECTIVES

The aim of this work is to study the current solid waste disposal techniques. Within this general aims, the specific objectives are:- Identification of the nature and composition of solid waste with a view to determining the best

Way to dispose them off. Identify the sources of the various types of solid wastes with a view to attempting control measures. Identify the shortcomings on the part of individuals and the government leading to the growing heaps of solid wastes.

Identify easy, reliable and cost effective ways of disposing off solid wastes in order to realise the removal of the hazards.

1.5 SCOPE AND LIMITATION

The project work is to be centred on Minna municipality. The study will deal with issues affecting the types, sources, generation, collection and disposal of solid wastes including the associated hazards.

1.6 JUSTIFICATION

This research work is intended to be used to identify the nature and sources of solid wastes including the current management strategies. The study is also expected to open up new ideas on better management strategies aimed at ensuring a minimum level of environmental hazards. The study will also promote awareness to the people on how harmful indiscriminate solid waste dumps can be to the health of the inhabitants.

1.7.0 STUDY AREA

1.7.1 LAND FORM

The total landmass of Minna is underlain by hard rocks. There is also the threat of increased rocky nature of the landmass if erosion and deforestation activities are not checked. The water table in Minna is usually quite high and wells are sunk to a comparatively shallow depth before water is struck. If solid wastes are not properly managed therefore, there is the risk of contamination of wells.

1.8.0 CLIMATE

Like the rest of the west African Sub-region, the climate of Minna is influenced largely by two dominant air masses affecting the sub-region. They are the dry and dusty tropical continental air masses and the warm moist tropical moisture air masses. There is dynamism in the climatic condition which determines the nature of the rainfall regimes, the temperature and the wind.

1.8.1 RAINFALL

The rainy season is usually from the month of April to October. In some years however, the first two weeks of the month of November also witness some rain fall. Although the beginning of rainfall is recorded in the month of April, the rain becomes steady between the months of June and July and the highest rainfall

is recorded between the months of August and September. Excess rainfall could cause a lot of damages if solid waste are not properly managed.

1.8.2 TEMPERATURE

In Minna, the highest level of atmospheric humidity is between the months of March, April and May before the onset of the rainy season. During this period the atmospheric temperature rises up to 38c°. The lowest temperature is recorded from the end of December to the end of February. The rise in atmospheric temperature during the period can be linked to the highest amount of sunshine experienced during the period. Temperature may facilitate air pollution, if solid wastes are left untreated. Thus temperature may cause a threat to the health of individuals if refuse are left to decompose in the study area.

1.8.3 WIND

There is the occurrence of heavy destructive wind that accompanies the early rain storms, usually in the months of April and May. Another similar wind comes again towards the end of October signaling the end of the rainy season. During the months of January and February, strong harmattan winds are also experienced which terminates with the beginning of high temperature. The wind in the study

area could pick up refuse and dump or scatter it else where if refuse is not properly managed.

1.9 DRAINAGE

Before the devastating floods of September, 1986 in Minna, there were poor drainage systems. Most of the then existing drainage network prior to the floods of 1986 were either inadequate or non functional. The construction of large multi million naira modern drainage systems across Minna has reduced, to the bearest minimum, the incidence of flooding in Minna. It is therefore necessary to manage solid waste in order to prevent the blockage of drainages that could lead to flooding.

1.10 LAND USE

The land in Minna is essentially used for agricultural purposes. Within Minna township crops like Maize, Melon and Ground nuts are produced. Vegetable gardens are also maintained near some households. The largest percentage of the land is used to build residential houses to accommodate the rising population. Considerable percentage of land is also used for building both government and private office blocks. A reasonable percentage of land area is also used to build township roads for ease of movement. The hygienic nature of the

land is however not preserved since there is indiscriminate defaecation and dumping of all sorts of wastes everywhere.

1.11 VEGETATION

The vegetation of Minna belongs to the Guinea Savannah vegetation. The vegetation is characterized by tall grasses with scattered trees like Locust bean, Sheabutter and Mango trees e.t.c. Several years of repeated cultivation has rendered the land almost bare. Instead of tall, fresh grasses we now have short, scanty and miserable looking grasses with almost all the tall trees cut down for use as fuel food. Vegetation of the study area will not pose a threat to solid waste management.

1.12 SOIL

The surface soil in Minna is generally loamy sand. The soil is well drained and has high water infiltration rate. Soils of Minna are derived from basement complex rocks. They range from shallow to very, deep soils overlying weathered geneisses and magmatities. Some are underlain by iron pan at varying depths. They are strong brown to red sandy clay or clay with often gravely loamy sand or sandy surface layer.

CHAPTER TWO

2.0 LITERATURE REVIEW

There is an increasing accumulation of solid waste all over our environment. This is linked to the growing human population. There is also a rising concern for the hazards posed by he increasing volumes of solid wastes.

A waste material is any thing that has outlived its primary usefulness and should be thrown away. Ademiluyi, (1986), pointed out that "a waste is the discharge of any material (gaseous, liquid or solid) which can cause a negative impact on the environment either routinely during normal operations, or accidentally due to process up sets".

Having seen the general concept of wastes, what then is a solid waste? As the name implies, solid waste can best be defined as any useless material which is neither in a liquid nor in a gaseous form. According to Umar, (1999), "Solid wastes include garbage, rubbish, food waste, ashes, papers etc.". Solid wastes include all forms of agricultural wastes from grains, vegetable and fruits. Industrial activities also lead to the production of solid wastes like machinery and automobile scraps, polythene bags etc. A wide area of environment especially here in the north is littered with Mango seeds between the month of April and June when there is an abundance of Mango fruits. Wastes from Maize also litter our environment

between the months of July and November when it is in abundance. Polythene bags also form the largest bulk of solid wastes especially during the dry season.

Since solid waste generation is a result of man's activities, the problem of solid wastes dates back to the time when urbanization started and from that time, there has been an increasing rate of solid waste generation and its associated problems. Umar, (1999) pointed out that "the principal hazards associated with insanitary disposal of solid wastes in general have been well documented. These include air pollution, land, surface and ground water contamination, fire outbreaks and serious health hazards".

It is stated by O'meara, (1999), that "like water borne waste, solid waste profoundly affects human health, and it too was a target for reformers in industrial cities of the nineteenth century. Today, such hazards are most pronounced in the developing world where between one third and one half of city trash goes uncollected". Solid wastes involving food wastes and human faeces are potential breeding spots for vectors of pathogenic organisms. House flies are known to alight on human faeces and transmit the micro-organisms causing diseases like dysentery,, cholera, typhoid fever etc. They also can emit offensive smell.

O'meara, (1999), noted that "increased generation and accumulation of solid wastes are beginning to produce social, economical and environmental problems of significant proportions. These problems are particularly acute in regions where

intensive urban population concentration have increased solid waste and decreased the availability of lands suitable for disposal".

Solid wastes involving metal scraps constitute a lot of danger since they are capable of causing physical bodily injury to man. They can also block water channels. This prevents free flow of water causing flooding. Road paths can effectively be blocked obstructing free movement for man and vehicles. Combustible solid wastes can be carelessly handled resulting in fire outbreaks leading to the possible destruction of life and property. Umar, (1999), stated that "there has been reported cases of fire outbreaks consequent upon setting fire on dumps, especially in cases where dumping sites are located amidst houses and this results in loss of lives and property". Fire from dumping sites can also give rise to heavy smoke nuisance covering a wide area. This smoke nuisance interferes with respiratory and eye functions. Continuous exposure to this smoke can lead to respiratory and eye diseases.

This fact is supported by Umar, (1999), when he indicated that "this act of burning sometimes causes air pollution in the form of smoke, fly-ashes and repugnant odour. Sufficient evidence is available to indicate that atmospheric pollution of varying degrees does affect health, especially as it relates to chronic respiratory disease".

PLATE 1: A typical solid wastes dumping site in Minna. The growing heap of solid wastes is not only threatening to completely block the passage over the bridge but also could block the drainage system below it.

Wind can blow light solid wastes from dumping areas which will cover a wide area away from dumping sites. This creates an environment that always look dirty. Infact, in Northern States, one of the main solid wastes constituting the greatest menace between the months of December and February is polythene bags. Since almost every thing is sold in a polythene bag, they are thrown every where after use. The harmattan wind blows them several kilometers apart making every where filthy. On this, Umar, (1999), added that "in addition large heaps of wastes in most cities of Northern Nigeria constitute serious aesthetic problem in these cities".

Considering the harmful effects of the various types of solid wastes, attention needs to be focused on the best ways of management. The solid wastes, after generation have to be stored. The storage can take place at different places using different methods. Storage facilities like large dust-bins serving a large area of a community or small dust-bin serving individual house holds can be provided by individuals or by an agency dealing with solid wastes management. Whatever is used as a dust-bin for storage and in whatever size, one important thing is that there should be a properly fitted cover. This should be done to prevent offensive smell from the contents of the bin and also prevent flies from gaining access to the contents of the bin. Whatever is used as dustbin should also have strong handles for easier lifting mechanically or manually.

In situations where no bins are available, open spaces are used to store solid wastes. After the solid wastes are stored in whatever manner practicable, the next stage is their collection to various destinations in the management procedures. Awaisu, at al, (97/98), stated that "it is an integral part of the urban solid wastes management system. It is labour intensive and affects people when it ceases to function effectively". Whatever method that is used for collection, it should be reliable, effective, cheap and durable. The collection of wastes is one of the problematic aspects of solid waste management. In most states all over Nigeria, whether dustbins are used or open dumping sites are used collecting the wastes for disposal becomes a big problem. The cause of failure in this vital aspect of solid wastes management is due to he inadequate availability of vehicles. Either the vehicles are not available in reasonable numbers or the few available ones cannot be maintained. Ashiru, (1999), pointed out that "collection of refuse in urban areas is difficult and complex because the generation of residential and industrial refuse is a diffuse process that takes place in every house, every industry as well as in the streets and vacant land. In the villages refuse generated are promptly collected and disposed off either through burning or other ideal methods. While most slum areas have further complicated the collection task because of lack of access roads".

Still on the collection of solid wastes, Lucas, & Gilles, (1981), pointed out that "collection of solid wastes should be frequent, systematic and reliable, and bin

points maintained by government or municipal cleaning services". Specially designed vehicles for the collection of solid wastes have been developed in recent years and improvements have continued to be made in the construction of the vehicles. The transport system used for collection should be strong enough to withhold the weight of the wastes. It should also be so designed as to be able to hold in position all the wastes without escaping during movement. If open tipper lorries are used the wastes should be firmly covered by tarpaulin. The vehicle should also be designed in such a way that minimum human labour is used to put the wastes on board the vehicle.

After the collection of the solid wastes is completed they are transported to the areas of disposal. The followings are the variety of solid wastes disposal vehicles:-

Open top truck tippers

The closed top non-compacting truck

The closed compacting truck

The pulverizing truck

Awaisu, at al, (1998), pointed out "transportation of solid wastes should be planned in order to achieve maximum positive results. It might be necessary to arrange for collection transportation in the night to remove the effects of traffic hold up on the efficiency of operation".

It is possible to retrieve some of the solid wastes and process them in to some useful materials before the final disposal. In other words, some parts of the wastes can be recycled and products made from them put to various uses. In recent time some young men are seen scavenging the waste dumping sites to pick old rubber and metal materials. Some times they ask the members of various households to exchange old materials for boxes of matches or any other useful material. These old materials collected are taken to various industries and reprocessed into new products.

Oluboru, (1999), in emphasing the benefits of recycling pointed out that "solid wastes recycling refer to he process of using the solid waste as raw material again for the same or a different purpose. Examples of solid waste that have been recycled include tin cans, scrap metal, glass, plastics and paper".

O'meara, (1999), emphasised that "throwing way items instead of reusing or recycling them increases the demand for new resources obtained by environmentally destructive mining and logging".

After the collection of the wastes the next stage is the final disposal. This is no doubt another difficult aspect of refuse disposal. It is so because adequate efforts must be made to pick a type of disposal that will agree with the environment and the nature of wastes involved. Also to be considered is the season

in which to handle the solid wastes. Oluwande, (1983), pointed out that "the process of refuse disposal may be divided into four principal groups:-

Those involving removal of solid wastes from immediate human environment,

Those involving hiding the solid wastes from human immediate environment.

Those involving stabilizing the refuse. Those involving physical conversion of refuse into other forms".

The following are some of the methods waste disposal:-

2.1 LAND FILLING OR RECLAMATION

This is a process of waste disposal in which refuse and sand are used to fill up a ditch or an excavation. A layer of refuse carefully spread in the ditch followed by a layer of earth. This procedure continues one after the other until the ditch is filled up. Davey and Light body's, (1971), pointed out that "the method is not entirely without nuisance from flies and smell, so a tip should always be situated to leeward of a village and some distance from the nearest house. The site should also be chosen with due regard to ease of access and availability of soil for covering purposes".

Another problem here is how to get enough sand to cover layers of refuse continuously until the end of the exercise without having to create more ditches.

At the end of the exercise the building cannot be constructed over the site but can be used for agriculture, gardening or recreational activities.

Olubori, (1999), pointed out that "most of the problems associated with the open dump method are eliminated in sanitary land filling method. Cases of proliferation of disease bearing insects, rodents and fire outbreaks are removed while the odour problem is minimal. Sanitary land fill system while better than the open dumps is fraught with certain shortcomings. For instance, ground water contamination by seepage of rain water through the wastes and formation of gas (methane) during anaerobic breakdown of the waste".

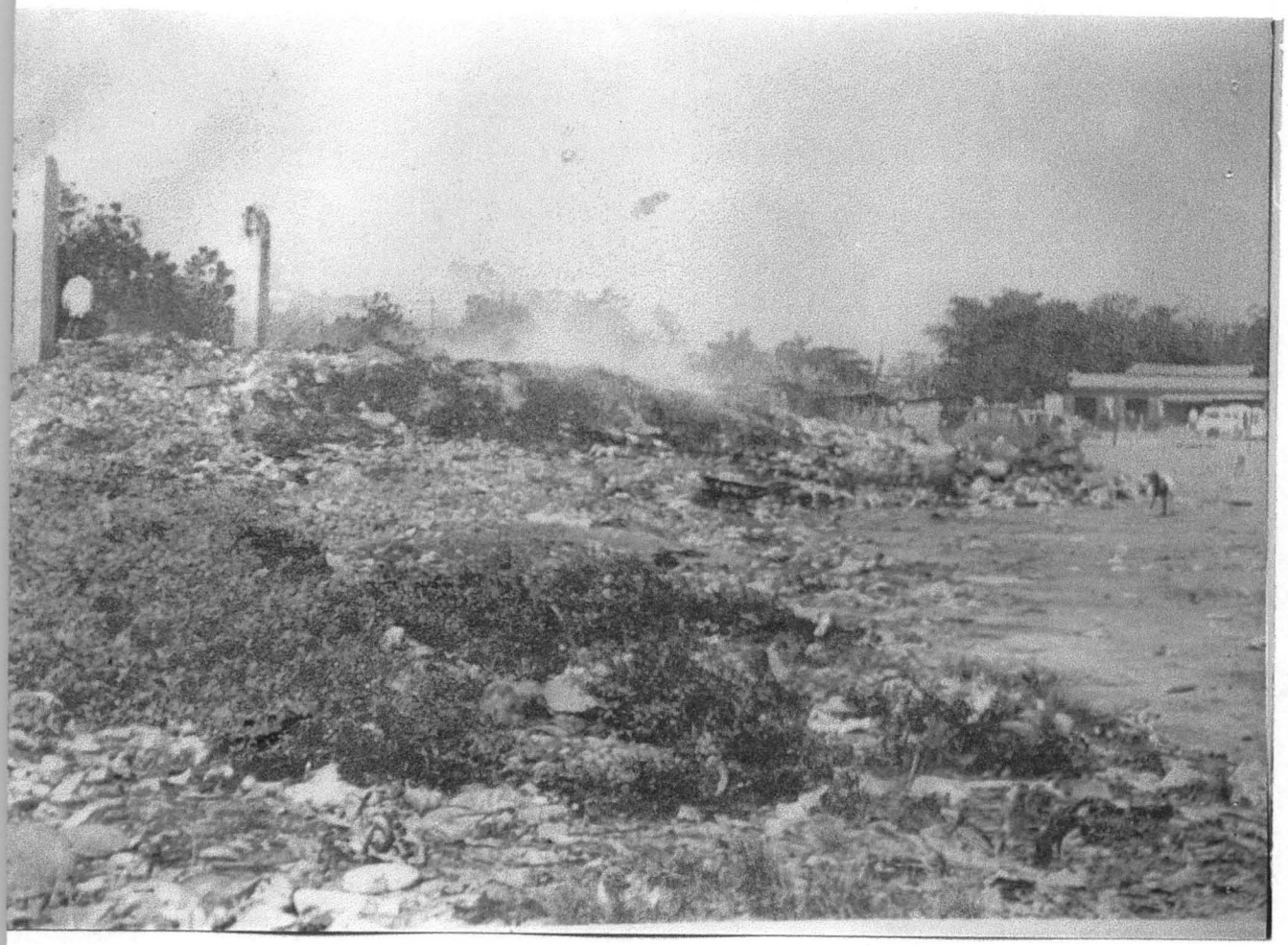


PLATE 2: This is another solid wastes dumping site in Minna. The wastes are scattered all over the area. Smoke nuisance is also visible due to the burning of the wastes. Goats are also seen here eating from the food wastes.

2.2 OPEN DUMPING

This is practised in poor local communities in the tropics. A space of land is simply used for dumping solid wastes. This is a practice that is prevalent in countries with high poverty and illiteracy levels. The condition of the dumping sites is always an eye sore. There is offensive smell and also attracts files, rodents, dogs etc. If open dumping will be practised at all it must be very far away from human settlements and also far enough to make access by animals impossible. Lucas and Gilles, (1981), pointed out that "this is cheap, it requires little planning and is therefore unfortunately too frequently found in tropical countries. It provides ideal breeding places for rats, flies and mosquitoes".

Avoiding this practice is the best way to eliminate problems associated with it. This is necessary because whatever measures that are taken to control the problems will be open to abuses. Olubori, (1999), advised that "this method of waste disposal should be discouraged in view of the dangers associated with its practise. Open dumps are breeding grounds for house flies and rodents which are vectors of a number of human diseases such as cholera and plague. They are also sources of offensive and obnoxious odour from rotting garbage".

2.3 BURNING

Combustible parts of solid wastes can be subjected to burning process of disposal. This process is however associated with the risk of atmospheric pollution and fire outbreaks. If the dumping sites are located in various areas within a town large volumes of smoke is produced into the immediate atmosphere making visibility very difficult and increasing the risk of some medical related conditions.

Burning can also be carried out by means of incineration. This is a method by which a structure made of mud or cement blocks is built and divided into two compartments-the ground compartment and the upper compartments. The space between the ground compartment and the upper compartment is demarcated by a strong sheet of wire gauze on which combustible solid waste is deposited through an opening. The wire gauze prevents the wastes from dropping down to the ground compartment. When fire is set on the wastes and it starts burning the resulting ashes drop down to the ground compartment through the wire gauze. A vertical opening is made on the upper compartment to allow the escape of smoke. This method is efficient but rain can mess up the wastes if the upper opening is not well protected. This process of solid waste management is almost impossible to practise during the rainy season because the bulk of the wastes are always in a state of wetness. There is also the agony of having to pick only the combustible part of volumes of wastes. There may also be smoke nuisance especially when there is an

unfavourable change of wind direction towards human settlements. Only a little quantity of wastes can be dealt with in this method of disposal.

On the advantages of incineration, Olubori, (1999), pointed out that "Incineration is better than the open dumping because high temperature of the process kills disease vectors (flies and rats) and other pathogenic organisms. Incineration is compact and does not require much space. Incineration is better than sanitary land fill because it does not endanger ground water quality".

2.4 COMPOSTING

This is the process of mixing refuse with night soil (human faeces) together. Aerobic bacterial activities break down the materials through very complex and hazardous procedures into little humus particles. The resulting humus from this process can be used for agricultural purposes. This method needs a lot of care from whoever will practise it in order to avoid self contamination with human faeces. One can contaminate one's hands and result in disease causation. All the food and related places have to be properly taken care of to avoid flies having access to them. Infact, it has to be practised far away from human settlements.

2.5 DUMPING INTO THE SEA OR RIVER

Volumes of wastes can be dumped into the sea or river particularly in places close to coastal and riverine areas. This practise is ecologically bad because it poses a lot of danger to the aquatic lives in these river and sea. This practice can also be a threat to human life because of contamination of other sources of water supply other than the sea and rivers. Lucas & Gilles, (1981), pointed out that "it results in littering of shorelines with refuse and becomes a health as well as an accident hazard".

2.6 BURRYING

Waste can be collected up and buried under the ground and covered up. This will not be easy when one has to handle large volumes of wastes. The risk of contamination of sub-surface water is also possible. This practice also reduces the availability of land for agricultural and other human uses.

No matter what method of disposal that is employed problems are still encountered in the process. The greatest problem facing urban environmental management in Nigeria is inadequate organizational and administrative structures. While the environmental problems or solid wastes are increasingly exacerbated by the tremendous increase in urban population, expansion of industrial and commercial activities, (particularly the increase in the number of urban markets),

there has not been comparative growth in the strength of the organizations or institutions for solid waste and other environmental management. The much that exist in the nature of institutional or organizational frame work for environmental (solid waste) management is still in a state of flux. In addition, they do seldom have clear cut terms of references, jurisdiction,

operational flexibility or strong political and financial resources support to deal with or strong political and financial resources support to deal with the kinds of environmental problems that increasingly manifest themselves.

PLATE 3. An incinerator where controlled burning of combustible solid wastes takes place.

Although it is a constitutional function for local councils to deal with solid waste management in our towns and cities all over the states, the local councils have glaringly been exhibiting inefficiencies in this aspect of constitutional responsibility. The excuses always put forward are inadequate funding and paucity of technical facilities and expertise. Several states have tried using semi-autonomous and state-wide refuse disposal boards t hat are mostly made independent of the local councils. Although no outright remarkable success has been made some degree of success have been recorded.

In some states, where the state and local council authorities are not in logger-head with each other over solid waste management responsibilities, there are in existence institutions of similar nature with resembling responsibilities. The reference state here is Niger State. There has been in existence Niger State Environmental Protection Agency (NISEPA) carrying out, as one of its functions, disposal of solid wastes. A few years later another institution with resemblance in name and functions to NISEPA was again established. The new institution was named Niger State Urban Development Board (NUDB). This is really counter productive and a waste of funds and manpower. A section of whatever NUDB was established to do should have been established under the umbrella of NISEPA and the required manpower put in place for the section. The situation now is that either

the two institutions are working below capacity or one of them has been crippled and doing nothing.

There is the need for a sound administrative network in order to ensure proper solid waste management. Men and equipment have to be adequately and strategically placed to ensure visible success. The issue of equipment needs a lot of emphasis. Most of the equipment used now are either obsolete or can no longer deal with huge volumes of wastes. The open tippers used cannot serve the purpose of refuse collection until pay-loaders are made available. The tippers are too high from the ground for the labourers to conveniently be able to load refuse into them.

Legislation that is effective is always absent in the wastes management activities. This is the reason why people do whatever they want regarding environmental degradation. In places where legislation exists, they are only there in name but never implemented as a result of some political, administrative, corrupt and ethnic reasons. The provisions of such laws should also be stiff in terms of fines or imprisonment.

Sitting of disposal places is another problem in the disposal of refuse. Disposal sites should be as much as possible be far away from official and residential settlements. It should also be far away from sources of water supply. The situation now is that you see a disposal site right in front of a residential house and close to a source of water supply. Awaisu, at al, (1998), observed that

"unsatisfactory provision for final disposal sites constitutes a problem. Even in places that has already been designated as disposal sites at times safety is not considered ..... Consequently some of the tipped refuse is blown into the village and contaminates the wells, which are the only sources of domestic water supply to the villagers.

Lack of household bins and public bins constitute a big problem to waste management. This leads to the situation in which every available space is used as disposal site. Even in situations where bins are in adequate supply transportation becomes a major problem in the solid waste collection from the various dustbins before the final disposal.

Manpower which is capable in solid waste management needs to be available. Unfortunately, particularly in the third world countries, there is the absence of required manpower both in number and in training. Personnel policies also have not yet recognised the peculiarities of the solid waste management functions, particularly as regards remuneration and career opportunities. Considering the hard and hazardous nature of solid waste

PLATE 4. A section of modern drainage system in Minna. Note the presence of refuse on both sides of the embankment. The refuse is also seen falling into the drainage. Also to be noted is the accumulation of wastes and the growth of weeds inside the drainage fertilized by the falling wastes.

management, operatives need to be motivated to put in their best. Besides, the level of personnel put incharge of waste management are generally not high enough to press for more resources for this function. The personnel in charge of waste management in most of the major cities are generally of the principal and high superintendent levels in most of states in Nigeria. In the words of Awaisu, at al, (1998), "if we are to take analysis on the staff strength of the public health department in each state, in respect to the estimated population of 1991 census, we may find out that the staff strength is not capable to take care of such population".

Since the major components of solid waste generated are mostly from industries, households, commercial and agricultural activities, an effectively vibrant agency needs to be put in place to check the rate of solid wastes generated and ensure effective, feasible and harmless methods of disposal.

CHAPTER THREE

3.0 METHODOLOGY

The method of investigation in this project work will be by the use of prepared questionnaires which will be distributed among the population of Minna, the study area. All the responses received for the questionnaires will form the basis of the data. Apart from the questionnaire, the ground truth assessment of the study area will add to the information required by the project work.

3.1 SOURCES OF THE DATA

Data are collected from the responses received from people who filled and returned their questionnaire forms and the ground truth assessment made of various places within the study area.

3.2 POPULATION AND SAMPLING

The questionnaires were distributed to people living in Kwangila, Limawa, Tunga, Sabon gari and Bosso using random sampling of the population. The scattered populations were chosen because closer information need to be received on the situation of waste management in majority of the study area. (A sample of the Questionnaire is shown in Appendix 1).

3.3 DATA ANALYSIS

The data collected were analysed through the use of percentages and tables. The data from the questionnaires will be tabulated. This data will then be used for various discussion on the result.

CHAPTER FOUR

4.0 DISCUSSION OF RESULT

A total of 96 questionnaires were sent out to respondents and 74 completed questionnaires were returned, representing 77% of the total number of questionnaires sent out. The responses are as follows:- Question 1: Which of the following wastes are more generated in your house?

Table 1: RESPONSE

Response	Figure	Percentage
Papers	19	25.6%
Food particles	20	27.0%
Polythene bags	20	47.2%

Of all the wastes generated in the study area, Polythene bags constituted the largest. The Polythene bags were mostly from pure water, Sobo drinks and other commodities sold in polythene bags. Polythene bags constitute about 47% of the total wastes generated. This is followed by food particles of different categories like oranges, cassava, yam mango etc.

Question 2: How do you handle household wastes?

Table 2:

Response	Figure	Percentage
By throwing them away	64	86.4%
By storing them in dustbins	10	13.5%

Waste generated from the study area are largely thrown away instead of being stored before removal. About 86.4% of the total wastes generated are simply thrown away. This also indicates that the use of dustbins is not in practise. Only 13.5% of the respondents store their wastes before they are collected for disposal.

Question 3: How regular are wastes removed from dumping sites?

Table 3:

Response	Figure	Percentage
Immediately wastes are dumped	11	14.8%
Not removed at all	10	13.5%
Removed after several weeks	63	85.1%

Table 3 above indicates that the bulk of the wastes dumped at the various dumping sites within the study area are abandoned for several weeks without removal. 85.1% respondent indicated that wastes are abandoned at the dumping sites for a long time before removal. This indicates that the wastes removal is not effectively regular.

Question 4: When do you observe wastes increases in Minna?

Table 4:

Response	Figure	Percentage
Rainy season	57	17%
Dry season	17	22.9%

Of the whole wastes generated within the study area 77% is in the rainy season. This may be due to the additional agricultural wastes that are abundant during the period. There is only about 22% increase in wastes generation during the dry season.

Question 5: People do not use dustbin due to

Table 5:

Response	Figure	Percentage
Poverty	27	36.4%
Ignorance	14	18.9%
Not provided by government	33	44.5%

Majority of people in the study area constituting 44% of the respondents have indicated that people do not use dustbin because they are not provided by the government. This is followed by 36.4% of the respondents who attribute the lack

of usage of dustbin to be due to poverty. The remaining 18.9% of the respondents attribute the reason to ignorance.

Question 6: People can assist in proper waste management by:-

Table 6:

Response	Figure	Percentage
Throwing the wastes every where	25	33.7%
Storing in dustbins	49	66.2%

About 66.2% of the respondents have shown that the use of dustbins is the best way to help in wastes management. About 33.7% of the respondents however indicates that throwing the wastes way is the best way to deal with the solid wastes. This indicates that majority of people will use the dustbins if provided by the government or if they can afford to provide for themselves dustbin that can be regularly evacuated.

Question 7: How can the government improve waste management?

Table 7:

Response	Figure	Percentage
Early removal of wastes	62	83.7%
Increasing public awareness	12	16.2%

Table 7 above indicates that about 83% of the respondents in the study area have indicated that the government can improve the waste management by quick removal of solid wastes from the dumping sites. This has also shown the level of disturbance heaps of refuse constitutes to the people in the study areas. The 16.2% response means that people do not see public awareness as important as immediate removal of wastes from dumping sites.

Question 8: Which is the best way to dispose off solid wastes?

Table 8:

Response	Figure	Percentage
Burning	10	13.5%
Dumping into the bush	41	55.4%
Dumping within the town	23	31.1%

About 55% of the respondents in table 8 above have indicated that dumping the solid wastes inside the bush is the best way to dispose off solid wastes. This is an indication that more people are aware of the dangers of having large heaps of wastes around them. About 31% of the respondents have shown that dumping within town is still the way to improve solid waste while the remaining 13.5% of the respondents are in support of burning the wastes.

Question 9: Which of the following hazards is more disturbing at dumping sites?

Table 9:

Response	Figure	Percentage
Physical injury	13	17.5%
Offensive smell	25	33.7%
Smoke nuisance	36	48.6%

In table 9, 48.6% of the respondents believed that smoke nuisance at dumping sites is more injurious. This is because every household near dumping sites are uncomfortable due to the smoke nuisance. 33.7% of the respondents are of the view that offensive smell from the dumping sites is more disturbing while only 17.5% of the respondents have pointed to physical injury to be the most disturbing hazard at dumping sites.

Question 10: Which of the following is a more disturbing effect of smoke nuisance?

Table 10:

Response	Figure	Percentage
Reduced visibility	12	16.2%
Breathing difficulty	14	18.9%
Eye irritation	48	64.8%

The largest number of respondents constituting 64.8% see eye irritation to be the most disturbing effects of smoke nuisance from dumping sites. Breathing difficulty comes next with 18.9% of the respondents in support while reduced visibility comes last as the most disturbing effect of smoke nuisance and supported by 16.2% of the respondents.

Question 11: Which of the following acts causes the blockage of drainage?

Table 11:

Response	Figure	Percentage
Solid wastes falling into drainage		
From dumping sites	9	12.1%
Wind blowing wastes into drainage	19	25.6%
People directly dumping wastes into		
Drainage	46	62.1%

62.1% of the respondents in table 11 believed that drainage in Minna are blocked by refuse directly thrown into them by the people while 25.6% believed that the wastes in drainage are blown in by the agent of wind. Only 12.1% of respondents see the blockage to be due to direct falling of wastes into the drainage from dumping sites thereby resulting in blockage.

Question 12: Which of the following may happen due to the blockage of the drainage?

Table 12.

Response	Figure	Percentage
Offensive smell	24	32.4%
Flooding of surrounding areas	49	66.2%

Out of 74 respondents in table 11, 49 people representing 66.2% consider the effect of the blockage to drainage to be flooding of the surrounding areas while the remaining 25 people representing 33.7% see offensive smell to be what is likely to happen due to drainage blockage.

4.1 GROUND ASSESSMENT

On the ground assessment of the study area indicated that the whole environment had scattered presence of one type of solid waste or the other. There were however limited quantity of wastes in the streets due to the hard work of the men of Niger State Urban Development Board who are always seen sweeping the streets, particularly the main street (Bosso Road) that runs through Minna.

The solid wastes dumping sites are located in some strategic locations in Tunga, Kwangila, Limawa, Sabon gari, Bosso etc. Most of the dumping sites have grown into heaps of solid wastes. The height of the wastes has kept on growing because of non collection of wastes as soon as they are dumped. It is possible to have some parts of the wastes that has been dumped for several weeks without collection.

The composition of the wastes is largely polythene bags. Some have been dumped for several months while some are freshly dumped. Apart from the polythene bags raw and cooked food wastes were also noticed in large quantities.

There were also little scattered presence of metal and rubber wastes around the dumping sites.

All the dumping sites visited were in a terrible state of offensive smell emanating from the rotten garbage and other rotten materials. The solid wastes from all the dumping sites are threatening to or have completely blocked the access road running across the sites. Where the dumping sites are close enough to drainage systems the wastes are seen falling inside the drainage system.

Some wastes are also set on fire because of irregular collection. The fire produces huge smoke nuisance that spread over a wide area surrounding the dumping site. Animals like Goats, Chicken, Dogs e.t.c are seen mouth-probing into the wastes looking for some food. These animals contribute in scattering the wastes all over the dumping sites. Looking along the ultra modern drainage system in Minna, there are areas that are blocked by the solid wastes.

CHAPTER FIVE

5.0 FINDING

The outcome of the data analysis and the general assessment of the study area have shown that the bulk of the solid wastes generated are mainly domestic in nature (see table 1). The fact that industrial growth is still low within the study area, industrial wastes are not yet a disturbing phenomenon. It is however disturbing that dustbins are not in use (see table 2) neither by the households nor centrally by the community. This reason contributes to the general filthy condition of study area. If all wastes are carefully stored in dustbins whether household or community based and the wastes are subsequently collected and disposed off solid wastes will not have littered every where as it is now. Apart from the reason given in (table 5) which is non provision of dustbins by government, the issue of poverty is also strongly part of the cause of non usage of dustbins by the people.

The dumping sites within the study area were hygienically in a miserable states. Infact, the dumping sites are eye sores. Wastes are continuously dumped but are not regularly collected. It is even difficult for people who come to dump their refuse to reach the central point of dumping so the refuse is deposited anywhere near the dumping site.

Apart from the unsightly nature of these dumping sites there is also the problem of offensive smell from the rotten materials concealed in the heaps of wastes. The smell even increases during intensive heat when decomposition rate heightens. The smell makes life seriously uncomfortable for the inhabitants of the areas with dumping sites.

Most pedestrian paths close to the dumping sites (see plate 1) are completely blocked. People who normally should pass through the blocked road path are forced to take alternative route. The drainage system close to the sites are also threatened with blockage (see plates 1 & 4). There are areas along the large drainage systems in Minna where solid wastes have accumulated to the extent that some parts have started blocking. Th closeness of some dumping sites to the drainage system may result in some wastes falling inside the drainage system but people also throw wastes directly (see table 11) into the drainage system.

A very disturbing phenomenon in connection to the dumping sites is the smoke nuisance. Most of the dumping sites are always on fire (see plate 2) producing clouds of smoke nuisance into the atmosphere. Apart from the effects of this smoke in climate change it makes the whole environment uncomfortable for living. The smoke causes eye disturbances (see table 10) which may lead to more serious eye problems if exposure continues.

Domestic animals (see plate 2) are always found around the dumping sites. Since the life of these animals are related in one way or the other to the life of human beings there is the fear of disease transmission from one type of animal to man. Animals like Goats can get poisoned from dumping sites and die. If such a Goat is unknowingly eaten it may have some effects on man. Rats are known to transmit disease known as plague to man. The continuos access to dumping sites by rats therefore poses some danger to man.

Drainage that are constructed to enhance water flow may result in flooding. Several parts of the drainage system (see plate 4) are gradually growing weeds whose growth is encouraged by the fertility of the wastes washed into the drainage or deposited into them. If this situation persists in the next few years there may be flooding as indicated in (table 12).

The irregular collection of wastes from the dumping sites is no doubt contributing to the hopeless situation of the areas. The Niger State Government lacks adequate equipment for wastes management. There are a few open tipper lorries which, compared with the volumes of refuse generated, are inadequate. The newly established Niger State Urban development Board no doubt has a reasonable number of Junior level personnel but lacks adequate modern equipment especially heavy vehicles like lorries and Payloaders that are capable of collecting and disposing off large volumes of refuse. Non Governmental Organisations like Julius

Berger usually assist the State government with vehicles whenever a cleaning exercise is conducted at various sites.

There is clearly no presence of legislation that checks the activities and conducts of people towards the environmental protection. What the state uses as environmental sanitation laws are a set of laws that are decades old and can no longer stand the test of time and circumstances. The public health edict in existence is a product of Military Government of 1984. The edict is inadequate to be able to address the present environmental complexities and its punitive provisions are watery. Human beings no matter how mindful about environmental purity should have a set of laws by their side as a reminder.

5.1 CONCLUSION

It clearly appears that the State government and Minna local council have not done enough in terms of the provision of effective and adequate manpower and equipment to deal with the issue of solid waste management. The people on their own part appear to be either ignorant of or socially disabled to provide dustbins for use. This turns every available space of land a potential dumping site.

Finally, the absence of effective and comprehensive legislation against acts that promote environmental degradation is a contributive factor in the filthy state of the environment in Minna.

5.2 RECOMMENDATIONS

The existence of dumping sites in the state capital is not acceptable and should be stopped. All the wastes collected should be taken to the bush far away from the town and dumped. This becomes necessary as an interim measure because there is no local technology that will reduce the wastes into some useful materials and all the other methods of disposal earlier discussed will not be able to cope with the volumes of refuse generated. The wastes, after a long time can be used by farmers as manure. As for the polythene bags, it is impossible to stop their usage and they do not decay like other types of wates. In the absence of a technology that will reprocess them, they have to be taken outside the town like other types of solid wastes.

For the above recommendation to be reasonable there should be the provision of dustbins of smaller size for households to store all the refuse generated. A bigger size dustbins should be provided at particular locations to serve a number of household. This should be accompanied by the provision of adequate and effective manpower and equipment that will collect the wastes from various points at regular intervals. The government or the solid waste management agency can charge some fees from people who use the dustbins. This will go along way in supplementing the cost of wastes management.

A strong public awareness campaign regarding the dangers of depositing wastes every where and the advantages of using dustbins should be established and every measure taken to keep it alive for as long as necessary.

Finally, a set of legislation should be promulgated to check the activities and conducts of the people towards maintaining a clean environment. The legislations should be strong enough to deal with any one, no matter his social position, who contravenes any of the environmental protection law.

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APPENDIX

QUESTIONNAIR ON SOLID WASTES MANAGEMENT IN MINNA

DEAR SIR/MADAM,

This questionnaire is designed to obtain some information on the solid wastes management in Minna. You are to answer the questions below. I wish to assure you that this is simply an academic exercise and all information given will be treated confidentially.

You are to tick the correct answer from the following questions:-

1. Which of the following wastes are more generated in your house?
   (a) Papers
   (b) Food particles
   (c) Polythene bags
2. How do you handle household wastes?
   (a) By throwing them away
   (b) By storing them in dustbins
3. How regular are wastes removed from dumping sites?
   (a) immediately wastes are deposited
   (b) Not removed at all
   (c) Removed after several weeks

4. When do you observe wastes increases in Minna?

   (a) During rainy season

   (b) During dry season

5. People do not use dustbins due to

   (a) Poverty

   (b) Ignorance

   (c) They are not provided by government

6. People can assist in proper waste management by

   (a) Throwing the wastes anywhere

   (b) Storing in dustbins

7. The government can improve waste management by

   (a) Early removal of wastes

   (b) Increasing public awareness

8. Which is the best way to dispose off solid wastes?

   (a) Burning

   (b) Dumping into the bush

   (c) Dumping at sites within the town

9. Which of the following hazards is more disturbing at dumping sites?

   (a) Physical injury

   (b) Offensive smell

(c) Smoke nuisance

10. Which of the following is more disturbing effect of smoke nuisance:

(a) Solid wastes falling into drainage from dumping sites

(b) Wind blowing wastes into drainage

(c) People directly dumping wastes into drainage.

12. Which of the following may happen due to the blockage of the drainage?

(a) Offensive smell

(b) Flooding of surrounding areas.