ASSESSMENT OF THE EFFECTIVENESS OF SOLID WASTE MANAGEMENT IN MINNA METROPOLIS AND ITS ENVIRONS
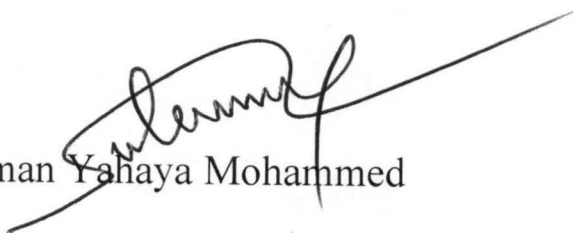
BY

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Submitted to

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CERTIFICATION

This thesis entitled Assessment of the Effectiveness of Solid Waste Management in Minna Metropolis and its Environs by Sulaiman, Zakariyau Liman meets the regulations governing the award of the Post Graduate Diploma (Environmental Management) of Federal University of Technology, Minna and is approved for contribution to knowledge and literary presentation.

Suleiman Yahaya Mohammed   Date 18th June, 2020.

Supervisor

Dr. A.S. Sadauki   Date ------------------------------

Head of Department

Prof. S. L. Lamai   Date ------------------------------

Dean, Post Graduate School

DECLARATION

I hereby declare that this thesis entitled "Assessment of the Effectiveness of Solid Waste Management in Minna Metropolis and its Environs" is a record of my own research undertaken in the Department of Geography, School of Science and Science Education, Federal University of Technology, Minna, under the supervision of Suleiman Yahaya Mohammed.

In the course of the research numerous literatures have been consulted and the information derived from these literatures has been duly acknowledged in the text and a list of references provided.

Sulaiman, Zakariya'u Liman.

June, 2010

DEDICATION

In memory of my late parents, Alhaji Sulaiman Liman and Hajiya Zainabu

and Hajiyah Hawahu. May Allah grant them eternal bliss (amen).

ACKNOWLEDGEMENT

I wish to express my profound gratitude to my supervisor, Suleiman Yahaya Mohammed for his immeasurable guidance and contributions towards the successful completion of the research work.

My appreciation goes to Dr. A.S. Sadauki (Head of Department) and the entire lecturers of the Geography Department for assisting with some reference materials. Similar appreciation is extended to the members of PGD class of 2008/2009 session for their supports and courage during the years of study at Federal University of Technology, Minna.

Finally, my sincere gratitude must be extended to the entire family of the late Alhaji Suleiman Liman and Alhaji Hassan Lemu for the great role they have played in my life.

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ABSTRACT

Many years ago, man's non-degrdable waste materials have generally been hauled along with the degradable wastes for disposal in open gullies or abandoned pits. This type of disposal has led to a deterioration of the local environment around the dumping sites because the waste attracts insects and vermin, produce unpleasant odour and sometimes causes bush wild fire. As a result of growing population and their consumption rates, coupled with the level of corruption within the government circle and the masses, most sanitation programmes are targeted towards revenue generation without considering the welfare (social and economic) of the people. This allows the local environment to be highly deteriorated in both developed and developing nations, thereby creating an avalanche of waste generated. The environmental quality problems facing Minna have been that of refuse generation and disposal method. The efforts by the government and its agencies towards solving the refuse problems have to some extent failed to yield significant result. This study was carried out in Minna Metropolis to assess the effectiveness of waste (solid waste) management system in the area, in order to evolve solution to any possible problems that may arise from the findings. In carrying out this research, a total of 450 questionnaires were administered and about 71.3% (321) of these were appropriately and correctly completed and returned to the researcher. It was discovered that Minna such problems as poor waste management in some part of the town arises from the lapses or inefficiency of the agency responsible for waste management. Proposals and recommendations were made on how to manage the waste in the area appropriately which include enforcement of sanitation laws, massive public enlightenment campaign on solid waste disposal, good incentive for workers, and compilation of up-to-date and necessary date on waste generation in metropolis.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background

In recent times environmental pollution has been giving mo.
attention. Water and air pollution have been examined and significant
legislation and control have been passed for the prevention of water
and air pollution. The pollution of land surface in Nigeria consist of
disposal termed solid waste, which is one of the waste product in
Nigeria not already subjected to scientific analysis. (Obi, 1989).

The public is still not conscious of the waste products in spite of
the piles of rotten vegetables and food around the environment, this
could be because of inadequacy of awareness, labour, equipment,
technology and expertise or no appropriate protection and more so
the waste contents were not separated before the final disposal.

Minna like most other Nigerian and world urban centres is now
saddled with the high volume of wastes, high court of solid waste
management, disposal technologies and methodologies. The impacts
of solid wastes on the locality and indeed the global environment
cannot be over emphasized. The problems have equaliy provide

challenges and opportunities for the suburbs to find solutions. Some of the solutions have in certain places been solved in diverse ways involving the community and the private sector relating to innovative technologies and disposal methods connecting behavioural changes and awareness.

In particular, the disposal method, whether it is incineration, compositing, recycling or sanitary handfill, depends in large extent on the physical and chemical composition or characteristics of the refuse generated. More so, the overall management of the developed system for collection and disposal of refuse will depend largely on preliminary data concerning the quantities and character of the refuse.

Currently, the Niger Environmental Protection Agency has the responsibility for refuse collection and disposal in Minna.

Individual houses or group of houses have refuse bins and litter baskets positioned strategically within the town and around their houses. Though, some of the refuse is being evacuated periodically from the collection points and transported to the disposal site which

is located about some kilometers away from the city centre. Th method of disposal in use presently is the sanitary landfills.

The other problems associated with the present disposal system in the metropolis are that the refuse bins are in short supply due to rapid growing population of the suburbs, and also the irregularity of collection results in a "backlog" of refuse to l collected and littering the entire place.

Apart from being unaesthetic in sight, the accumulated refuse cause odour problems and proliferation of vermin and disease vectors. These disposal sites appear to be undermanned, the operating equipment is also in short supply and the landfill is n properly managed. As such this study is intended to examine other methods of waste disposal in other to proffers better methods of disposal.

1.2.0 Statement of Problems

This research will therefore look at the problem associated wi. solid waste generation. Collection and as well as the disposal of Minna metropolis.

Also to examine the problem relating to the establishment of institutions responsible for waste management and the lack of consistency and continuity in the functions of there agencies or board with regard to solid waste management system.

In addition to interagency conflict and competition, the problems of personnel have further obscured the problems of solid waste management. The government agencies or local governments lack adequate and skilled personnel in the field. The lacks of expertise and skilled manpower have led to lack of proper focus tackling the problems of solid waste.

Other problems relating to solid waste management system are lack of funds, problems of equipment and machinery, the uncontrolled population increase in the area, have reduced the level of efficiency and effectiveness of the available equipment and manpower for solids waste management.

Since the rate at which the refuse or waste is generated is more than the rate at which they are being collected and disposed, this accumulation of waste usually results in mountains or heaps of refuse constituting nuisance in many parts of the study area.

1.3 Aim and Objectives of the Study

The study is aimed at assessing the effectiveness of solid waste management system in Minna metropolis with a view of makii ɔ possible suggestion for the improvement and further management of solid waste in the study area.

1.3.1 Objectives of the Study

i. To identify and analyze the sources, types, characteristics and the existing problems of solid waste management in the area.

ii. To assess the mode of operation and effectiveness of the agency or agencies charged with the responsibilities of solid waste management in the area.

iii. To suggest a framework that would provide effective facilities and improve the efficiency of the collection and disposal system in the area.

1.4 Scope and Limitations of the Study

The study would concentrate on the assessment of the existing solid waste management system in the area (i.e. public agency parastatals, and how it affects the qualities and aesthetic values of the area). The factors responsible for the increasing volume of solid

waste in the area. Also the study would be limited to Minn Metropolis.

This study would not give equal attention to other factors that cause environmental degradation.

This study is not without problems. The major problem encountered during the period of collecting the primary data was the low response of people as a result of suspicion despite disclosing one identity as a university student undergoing a research work in the chosen topic. The acquisition or data was a difficult task. The people do not understand the purpose of the data and its use so there was wide spread ignorance. A lot of persuasion, explanation and commitment have to be used to get the people to answer questions to fill the questionnaire. It took repeated calls to get response as most tenants would rather refer to one to their landlords who could not be traced. Most people especially the illiterates refused to cooperate because they thought the researcher is a health office inspecting their environment in order to arrest environmental sanitation violators.

The responses of the environmental sanitation institutions and health institutions in the study area were not encouraging. It took repeated calls before the researcher was able to get the responses he used for this analysis. Most or the health institutions do not keep adequate statistical records of the number of patients treated recent past years and as such they found it difficult to supply the researcher with the needed information. Some private hospitals refused to cooperate because they believed that the researcher is in search of unregistered hospitals that are practicing. Furthermore, there was the problem of getting individual populations of the variou communities and the number of households within each community used for the study which were not available at the National Population Commission (NPC) office in Minna.

1.5 Justification of the Study

With growing need for solid waste management, the study would help the public and interested parties, researchers, non-governmental organizations, to have a better appreciation of solid waste management problems and practices especially in the urban areas.

This research would also help in bringing about positive changes and improvements in the use of materials that is capable of producing waste to reduce volume of waste generated.

The study of the operations and techniques used by the agency responsible would help to improve the current performance of the agency and suggest or recommend better method that would guarantee optimal performance based on the existing facilities. The suggestions used in this report are capable of being adopted another location.

Truly speaking, planning law arose from the need to improve the physical quality of our environment (Utuama, 1990). Our early planning statutes, like their English counterparts, were aimed primarily at protecting the environment against wide spread abuse. From the Lagos Improvement Act, 1863 and Swamp Improvement Act, 1877 to the Public Health Act 1917, the thrust had been to improve out towns with broad streets, "cleans" the environment of filth, remove and reclaim swamp lands or clear bushes from our urban surroundings (Utuama, 1990). Although the modern equivalent of these provisions are now to be seen in Environmental Edicts or

Laws, Town and Country Planning Laws have not been indifferent towards a decent environment. Therefore, a clear understanding of the attributes of a good environment is of immense importance for urban environmental quality improvement to planners and policy makers. Thus a good environment must be healthy i.e. with adequate clean water supply, good drainage system, good sanitary condition, etc. Also , it must be free of pollution experienced from industrie.., vehicles, water, noise, etc and free or diseases. Furthermore, a good environment must be clean, peaceful and be provided with habitable dwelling units.

Environmental issues have gained global attention particularly after the 1992 Earth Summit in Rio Dde Janeiro. Urban and Regional Planning is more of an environmental science despite its electric nature Central to this area of study is the area called Environmental Planning and Management. These researches which focus on the environmental sanitation and the Health of the people is therefore significant to this area of this study. Also this research work purports that an investment in the environmental sanitation standard of a city with a view to sustain it as a system will contribute to the upliftment

of the living condition of the inhabitants, improve their health status and the quality of the environment at large.

1.6 **The Study Area**

- Minna lies on latitude 9^{o36}.22"N and longitude $6^{o}33'$ 15" east on a geographical base of undifferentiated basement complex of man gneiss and magnetic the town enjoys a climate typical of the middle belt zone. The rainy season last between 190-200 days, means annual rainfall is 1334mm (52- inches) with September recording the highest rain of 300mm (11.1 inches) the mean monthly temperature is highest in March at 30.5c (85f) and lowest in August at 22.3° (72f)s.

1.6.1 **Topography**

Minna is on a geological base of undifferentiated basement complex of mainly gneiss and magnetic. To the north – east of the town a more or less continuous steep outcrop of granite occurs. The cut crop from the principal physical development constraint on the east side of the town. A major drainage valley flows the centre of the centre south-west wards with many minor drainage channels feeding into it with storm water run-off from the hills to the east. In

place, there streams from large area of flood land. To the south, the land offers reasonable development possibilities, but is curtailed by the Chancahga River. On the eastside, there is a series of hills, one of the which was built on as the old GRA making use of the excelle... breeze that wall over the escarpment, and also has the town water storage built on it.

1.6.2 Population

Minna has a total population of approximately 201,429 people out of the total population of Niger State, which is 3,950249 with an annual growth rate of 2.3% (NPC, 2006).

1.6.3 Occupation

The main occupation of the indigenes of Minna is farming. This is a predominant occupation that takes place all year round. All manners of crops are cultivated by the people. Since the colonial period, Minna has become a cosmopolitan city with most of residents engaging in white kola jobs. As a state capital, majority of the inhabitants are civil servants.

1.7 Definition of Terms

Pollution: Pollution, contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems (living organism and their physical surroundings). Although some environmental pollution is a result of natural causes such as volcanic eruptions, most is caused by human activities.

Waste: Waste, rubbish or materials that are not needed and are economically unusable without further processing. It may be in liquid, gas, or solid form and originate from a wide range of human operations, such as industry, commerce, transport, agriculture, medicine, and domestic activities. Waste may be classified in many different ways, such as according to its origin (for example, domestic, industrial, clinical, construction, nuclear, agricultural) or its properties (for example, inert, toxic, inflammable).

Solid Waste: Solid wastes typically may by classified as follows:

Household Waste Production: A city dweller living in an industrialized, wealthy nation may produce as much as 875 kg (more

than 1,900 ib) of domestic waste in one year. Household waste is often a mix of potentially reusable or recyclable items (such as newspapers and cans) and largely non-recyclable material (such as broken or worn out domestic appliances and plastic packaging). Due to dwindling space for landfills, many cities have adopted widespread recycling programmes in which people separate out the valuable components of their refuse before the remainder is transported to a local dump. Garbage: decomposable wastes from food.

Rubbish: Non-decomposable wastes, either combustible (such as paper, wood, and cloth) or noncombustible (such as metal, glass, and ceramics).

Ashes: Residues of the combustion of solid fuels.

Large Waste: Demolition and construction debris and trees. Dead animals sewage-treatment solids. Material retained on sewage-treatment screens, settled solids, and biomass sludge.

Industrial Wastes: Such materials as chemicals, paints, and sand Mining wastes. Slag heaps and coal refuse piles.

Agricultural Wastes: Farm animal manure and crop residues

Source Reduction: Waste prevention, also known as source reduction, is the practice of designing, manufacturing, purchasing, or using materials (such as products and packaging) in ways that reduce the amount or toxicity of trash created.

Solid Waste Disposal: Solid Waste Disposal, disposal of normally solid or semi-solid materials, resulting from human and animal activities, which are useless, unwanted, or hazardous.

Open Dumping: An open dumping is an area where refuse is deposited and allowed to remain exposed to the atmosphere. It is th most common refuse disposal method used in most Nigeria urban centres (Oluwande, 1991).

Incineration: In incinerators of conventional design, refuse is burned on moving grates in refractory – line chambers, combustible gases and the solids they carry are burned in secondary chamber Combustion is 85 to 90 percent complete for the combustible materials. In addition to heat, the products of incineration include the normal primary products of combustion – carbon dioxide and water as well as oxides of sulphur and nitrogen and other gaseous

pollutants, nongaseous products are fly ash and unburned solid residue.

Compositing: Compositing operations of solid wastes includ᠆ preparing refuse and degrading organic matter aerobic micro-organisms. Refuse is presorted, to remove materials that might have salvage value or cannot be composted, and is ground up to improve the efficiency of the decomposition process. The refuse is placed in long piles on the ground or deposited in mechanical systems, whei ᠆ it is degraded biologically to a humus with a total nitrogen, phosphorous, and potassium content of 1 to 3 percent, depending on the material being composted.

Recycling: Another method of recovery is the wet pulping process: Incoming refuse is mixed with water and ground into a slurry in the wet pulper, which resembles a large kitchen disposal unit. Large pieces of metal and other non-pulpable materials are pulled out by a magnetic device before the slurry from the pulper is loaded into a centrifuge called a liquid cyclone. Microsoft ® Encarta ® Encyclopedia 2005 © 1993 – 2004 Microsoft Corporation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept of Solid Waste and Literature Review

Pollution can kill or sicken plants, animals, and people. Pollution can change the environment. Things that cause pollution are called pollutants. Soil pollution can come from chemicals used on farms t kill insects and other pests. Pollutants can also seep from garbage dumps into the nearby soil and water. Think of all the things you throw away: juice bottles, soda cans, candy wrappers. It adds up.

Solid waste in the broad sense includes all the discarded materials from municipal, industrial, and agricultural activitie However for the purpose of the assignment, solid waste will refer only to those solid wastes that are the responsibility of, and usually collected by a municipality. Residential and commercial areas, together with some industrial operations, are the sources of these "non-hazardous" municipal wastes.

Municipal solid waste is difficult to characterize in the sense that the diversity of its components, many of which should not be "wasted". The objectives of solid waste management are to control,

collect, process, utilize, and dispose of solid wastes in the most economical way consistent with the protection of public health and the natural environment and the wishes of those served by the system.

Municipal solid waste which is one of the major components environmental degradation has been a recurrent issue of concern of human being in particular and societies in general in biblical times. There is a definite instruction to the people of Isrealite on how to dispose off their wastes. This is contained in Deuteronomy 23:12 -13.

> *"Let there be a place outside the tent-circle of which you may go; And have among your arms a spade; and when you have been to that place, let that which comes from you be covered up with earth".*

In recent times, various thoughts, writings, researches, ideas, and practices have been generated on waste management.

According to Tchobanoglous et al (1977), the municipal portic of the total solid waste generated represents only 50/0 but receives the most attention because of the effect of its improper disposal can have on public health and on water supplies from both surface and ground water sources.

The primary focus of solid waste management objectives is on management of solid residues in a manner which utilizes the residues as a resources, protects public health and utilizes management system which can be operated and maintained at reasonable cost and with semi-skilled or unskilled staff.

Solid waste management therefore requires the advancement of our major functions: collection, transportation, processing or treatment and disposal. The basic considerations required for the definitions of these functions include: waste generation rates, types of collection points, composition of solid waste stream, types of locations and accessibility of collection points, frequency of collection, types of transportation equipment, processing techniques and method of disposal.

There are various literatures of texts in general solid waste management system. The idea of solid waste management is no longer new in the developed world; much emphasis should be in the situation in the developing countries where waste management posed a serious threat on the environment and health of the people.

The most comprehensive and far reaching document published in solid waste management in Nigeria is the research work titled "The State of Solid Waste Management in Nigeria", Federal Ministry of Housing and Environment (FMHE). The report was carried out by P.A.I. Associate International, which was commissioned by the defunct FMHE in 1981. The work was the results of the investigation on the problems associated with solid waste collection, disposal and environmental sanitation of selected cities and urban areas in Nigeria.

The report suggested that urbanization was responsible for solid waste generation both in quantity and quality. The quality aspect is in two parts; aggregate and per capita. It is expected that as the population of a particular city grows, the overall volume of solid waste generated will increase. The relationship between the increase in waste volume and population growth depends on per capita of the different social classes of the society. It has been found in the case of USA, solid was generation varies by social class; that those with higher incomes tend to generate more solid waste because of their greater consumption of heavily packaged materials and goods.

In Nigeria, the awareness of solid waste management is relatively new, it is only within the past two decades that became aware of it Oluwande (1981) attested to this statement in his work "the idea of systematic collection, transportation and disposal is relatively new in Nigeria.

A significant attempt onwards solving the problem was pointed out in Abuja, the new capital city, "that in order to achieve optimum resource allocation, it is helpful to look at the basic functions, management needs, and a conceptual basis for solid waste management, so that adequate land area may be reserved for th. requisite facilities, so that environmental compatibility is maintained (Obi, 1989). His report recommended the method of sanitary land fill as disposal method for the capital city of Nigeria.

Adedibu (1983), in his work on effective solid waste management for the city suggested that "there is need to have a we. known disposal method to enable the authority to control the collection, transportation and disposal of refuse, legislation on solid waste disposal must be enforced to have a clean environment more equipment need to be purchased and more people have to be trained

as environmental sanitary officers, that boards should be formed to relieve the ministry of the responsibility of solid waste management etc".

Ofaigbe (1983), recognized other causes of refuse manageme problem such as the low standard of urban planning and design, absence of appropriate technology, rapid rate of income – waste generation relationship. For example, a Columbia (USA) study finds that a percentage increase in income results in 0.7% increase in waste (Okpala, 1986).

Some researchers have looked into the administrative frame work of solid waste management in Nigeria. They concluded that the functions of refuse collection and disposal should be left with the Local Government (Bello – Imam, 1983, Okpala, 1986, Onuwa, (1983). However, Egunjobi, 1983 affirms categorically that the loc.. governments that are traditionally saddled with this responsibility have neither the equipment nor the finance and personnel to perform the functions effectively. Several researchers have attempted to provide a classification of solid waste. These were sustained by the belief of researcher in proper understanding of the composition of

solid waste, which are necessary for achievement of an efficient management and disposal.

In view of this, Saba, (1977) recognized eight types of solid waste, which are: abandoned vehicles, industrial waste, municipal solid waste, agricultural waste, hazardous waste and sewage treatment residues.

Egunjobi, (1983) addressed himself to those aspects of soli' wastes. Services that delay or hinder effective collection, transportation and disposal of waste in Nigeria, he identified fragmentation and instability of agencies responsible for solid waste management as major ingredients of inefficient management. He buttressed his proposal by saying that "it is possible for the privat: contractor to keep cost down as a result of competitive bidding".

Filani and Abumere, (1983) in their contribution argued that to provide meaningful solution to solid waste problem in Nigeria cities, it is absolutely essential that we do not only know the magnitude of the problem now, but the magnitude in the foreseeable future. Fro·· their study, they postulated that there is inter and intra city variation in the amount of solid waste generated that southern Nigeria towns

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have a greater waste generation rate than their northe. ₁ counterparts because of the use of leave in food packaging. As distances from the city centre, the volume of solid waste was observed or found to decrease.

They rounded up the research by agglomerating factors affecting waste generation rate, such factors as population size, tl ₌ growth rate, the eating habits of the people, the seasons, the sanitation and cultural habits of the people and the land use characteristics.

Okpala, (1983) studied solid waste problem, in Ibadan and recommended sanitary landfill for disposing the city's refuse. Adeni ₍₁ (1979) on his part feels that sanitary landfill an compositing, if efficiently operated could handle any amount of waste produced in Lagos metropolis up to (1990) and beyond.

Okpala (1983) insisted that solid waste management institutions need to evolved and substantially7 strengtheneu. According to him, four approaches are possible, provide waste management department at the local government level, creation of autonomous single – purpose waste management agency

establishment of an autonomous government department for environmental matters private firms collection services.

Several studies on waste management have been carried out in different countries, which are mostly important to the landmar development at the international level. In the review of environmental protection in Australia, the Federal Press Service, 1914 concluded that the management of waste problem in Australia as in elsewhere is without doubt the most challenging aspect of present day environmental policies. The solid waste management system most advanced nations has tended towards re-cycling of wastes. This is the modern trend and practice. Different nations have through various experiences on this issue – which resulted in taking advantages of the strong points and improvements in the pitfalls of these policies. For example, in Germany, compulsory collection recyclable waste have reduced packaging waste and increased recycling rates.

This system however, distorts markets for recyclable materials and often harms recycling industries in other countries.

Belgium and Denmark have instituted "ecotaxes" on some material so as to help pay for recycling, while in the United States, encouragement of recycling in the city of Long Beach has create 1000 manufacturing jobs.

2.2 Sources and Characteristics of Solid Waste

The sources and characteristics of solid waste are in general related to the land use. The sources can be grouped in the following categories:

i.   Residential

ii.   Commercial

iii.   Industrial

iv.   Agricultural

v.   Open area recreational centres.

Any of the sources above can produce solid wastes of the following characteristics. Solid wastes could be in form of the putrescible (biodegradable) food wastes, called garbage and the nonputrescible solid wastes, referred to as rubbish. Rubbish can include a variety of materials, which may be combustible (paper, plastic, textiles, etc) or noncombustible (glass, metal, masonry, etc).

Most of these kinds of waste are discarded on a regular basis from specific locations. However, there are wastes, sometimes called special wastes, such as construction debris, leaves and street litter, abandoned automobiles, and old appliances, that are collected at sporadic intervals from different place.

2.3 Environmental Problems

The species Homo sapiens-that is, human being-appeared late in the Earth's history, but was ultimately able to modify the Earth's environment by its activities. Although human beings apparently first appeared in Africa, they quickly spread throughout the world. Because of their unique mental and physical capabilities, huma beings were able to escape the environmental constraints that limited other species and to change the environment to meet their needs.

Although early human beings undoubtedly lived in some harmony with the environment, as did other animals, their retreat from the wilderness began with the first, prehistoric agricultur revolution. The ability to control and use fire allowed then to modify or eliminate natural vegetation, and the domestication and herding of grazing animals eventually resulted in overgrazing and soil erosion.

The domestication of plants also led to the destruction of natural vegetation to make room for corps, and the demand for wood for fuel denuded mountains and depleted forests .Wild animals were slaughtered for food and destroyed as pests and predators.

While human populations remained small and humar technology modest, their impact on the environment was localized. As populations increased and technology improved and expanded, however, more significant and widespread problems arose. Rapid technological advances after the middle ages culminated in the Industrial Revolution, which involved the discovery, use, ar exploitation of fossil fuels, as well as the extensive exploitation of the Earth's mineral resources. With the Industrial Revolution, humans began in earnest to exchange the face of the Earth, the nature of its atmosphere, and the quality of its water. Today, unprecedented demands on the environment from a rapidly expanding humar population and from advancing technology and causing a communing and accelerating decline in the quality of the environment and its ability to sustain life.

Sanitary nuisance and health hazards are some of the effect of solid waste. According to Olude, (1984), "most diseases that people suffer from in the country can be prevented by a clean environment. The piling of refuse breeds such household pests as mosquitoes and cockroaches which in turn contaminate food in homes and bring about diseases". Waste accommodate and serve as a source of food for rats, small rodents, and vectors of diseases, which include residents which includes residents and buildings and causes a lot of damage and reduces the social standard of the environment.

In general terms, solid waste (sometimes called refuse) can be defined as waste not transported by water, which has been rejected for further use. For municipal solid wastes, more specific terms are applied to the putrescible (biodegradable) food wastes, called garbage and the nonputrescible solid wastes, referred to as rubbish. Rubbish can include a variety of materials, which may be combustible (paper, plastic, textiles, etc) or noncombustible (glass, metal, masonry, etc). most of these kinds of waste are discarded on a regular basis from specific locations. However, there are wastes sometimes called special wastes, such as construction debris, leaves

and street liter, abandoned automobiles, and old appliances, that are collected at sporadic intervals from different places.

24. Solid Waste Management

Solid waste management is defined according to Hilary, Rolf and George, (1977), as "the steps or stages, which involves the generation, on site storage, collection transfer and transportation, processing and recovery and the disposal of solid waste and residual matter".

Waste management, III its ramification, is a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of wastes in a sanitary, aesthetically acceptable and economic manner (Uchegbu, 1998). It includes all administrative, financial, legal and planning functions as well as the physical aspect of waste management handling (Gulpin 1976).

Studies indicate that waste generation in a typical modern city is astounding, every action taken by man on earth as a survival strategy is bound to produce some form of waste, which might threaten the environment.

2.4.1. Interrelationship of the Functional Elements and Solid Waste Management System.

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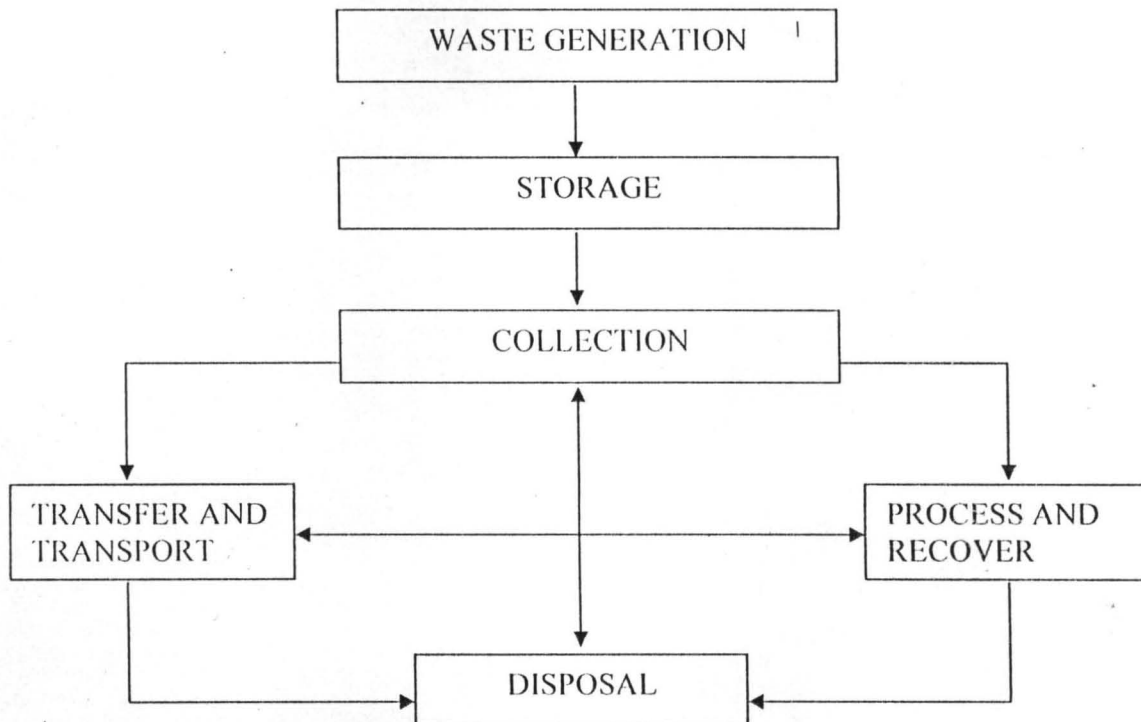
- ### Waste Generation

This involves the identification of materials or objects as no longer being of any value and are either thrown away or put together in a place for subsequent disposal. Wastes are generated as a result of man's activities in his home or residents, municipal open space, commercial centres, industrial areas, institutions, etc.

- ### Storage

Storage of solid waste involves the use of different types of storage facilities like refuse bins, empty drums, receptacles and other

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containers for storing of waste after it has been generated. The following factors could be considered in the storage of solid waste: the types of container to be used, the location' of the container, public health and aesthetic consideration and the collection methor to be used. However, the types and capacities of the containers used depend on the characteristics of solid waste to be collected, the frequency and the space available for the placement of the containers.

- **Solid Waste Collection**

Collection of solid waste is one of the crucial stages of urban solid waste management system. It is labour intensive and involves the removal or moving away of waste from generation point or storage point to disposal point. The quantity, characteristics and source of waste generated are important factors in determining the types of vehicles and collection system to be used. Waste collection varies from one land use area to another since the types and characteristics of waste generated in an area in directly proportional to the type of land use. And it is the responsibility of the Local Government to assist in the collection system. The most commo

techniques used for waste collection in Nigeria include street corner collection (also known as Chinese collection system) in which wastes are discharged directly into collection vehicles from household. This method is very efficient in terms of cost reduction, maintenance of aesthetic and prevention of hazards. Wastes are collected from skip bins, storage containers.

Roadside collection is also another technique in which wastes are collected from street-to-street from containers provided for waste collection in front of houses and other structures: this system is practice extensively in Abuja and other state capitals as Minna, Niger State by the current State Government led by the Chief Servant Dr. Babangida Aliyu.

- **Transfer and Transportation**

The conventional method of transporting refuse to disposal sites is through vehicles of different categories, which include: open truck tippers, the closed-top non-compacting trucks, the close top compacting truck: the pulverizing truck. The principle of transfer and transport involves the movement of waste from a smaller collection vehicle to the larger transport equipment or tractor – trailer trucks

Advantages

 i. It is very efficient and transfer in operation

 ii. It could be operated on both small and large scale

Disadvantages

 i. It is capital intensive

 ii. May not be readily available

 iii. There could be failure of machines, and

 iv. It requires skilled labour

- **Disposal**

After processing the solid wastes, the refuse has to be finally disposed off using different methods of disposals (Richard 1979).

Methods used in selecting waste disposal are as follows: Characteristics of refuse, Economic consideration, Availability of disposal site, Cost of labour, (Oluwande 1991).

2.4.2 Methods of Tackling Solid Wastes

Until recently, the disposal of municipal solid waste did not attract much public attention. From prehistory through present day, the favoured means of disposal was simply to dump solid wastes outsides of and around or village limits or in the "back 4C

Frequently, these dumps were in wetlands adjacent to a river or lake, which are in turn burned to minimize the volume. Unfortunately, this method is still being used in remote or sparsely populated areas ar most of the urban areas and the state capitals in Nigeria. Disposal of solid wastes on land is by far the most common method in the United Kingdom and probably accounts for most of the nation's municipal refuse. Incineration accounts for most of the remainder, whereas composting of solid wastes accounts for only an insignificant amour: Selecting a disposal method depends almost entirely on costs, which in turn are likely to reflect local circumstances.

Options are still limited. Realistically, there are no ways of dealing with waste that have not been known for many thousands of years. Essentially, six techniques are in use: these are;

i.   Source reduction,

ii.   Open dumping,

iii.   Sanitary landfills,

iv.   Incineration,

v.   Compositing, and

vi.   Recycling.

- **Source Reduction**

The most fundamental way to reduce waste is to prevent it from ever becoming waste in the first place. Waste prevention, also known as source reduction, is the practice of designing, manufacturing, purchasing, or using materials (such as products and packaging) in ways that reduce the amount or toxicity or trash created. Reusing items is another way to stoop waste at the source because it delays or prevents the entry of those items into the waste collection and disposal system. Source reduced and reuse have many benefits, including saving natural resources, reducing the toxicity of wastes, and reducing costs. Waste is not just created when items are discarded by consumers, but throughout the life cycle of any product, that is, from extraction of raw materials, to transportation, to processing and manufacturing facilities, to manufacture and use, waste is produced.

Selecting non-hazadours or less hazardous items is another important part of source reduction. Using less hazardous alternatives for certain items (e.g. cleaning products and pesticides), sharing products that contain hazardous chemicals instead of throwing out

left over, reading label directions carefully, and using the smallest amount necessary are ways of reducing waste toxicity. The benefits of preventing waste go beyond reducing reliance on other forms of waste disposals, it can also mean economic saving for communities, businesses, schools, and individual consumers.

- **Open Dumping**

An open dumping is an area where refuse is deposited and allowed to remain exposed to the atmosphere. It is the most common refuse disposal method used in most Nigeria urban centres (Oluwande, 1991).

- **Sanitary Landfills**

This is the most satisfactory solid waste disposal methods especially in the developing countries like Nigeria. Sanitary landfill is defined as a method of depositing of refuse on land without creating nuisance or hazardous to public health or safety by utilizing the principles of engineering to confine the refuse to the smallest practical volume and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent interval as may be necessary, (Boun and Backer, 1973).

Sanitary landfill is the cheapest satisfactory means of disposal, but only if suitable land is within range of the source of the wastes; typically, collection and transport account for 75 percent of the total cost of solid waste management. In a modern landfill, refuse is spread in thin layers, each of which is compacted by a bulldozer before the next is spread. When about 3m (10ft) of refuse has been laid down, it is covered by a thin layer of clean earth, which also is compacted. Pollution of surface and groundwater is minimized by lining and contouring the fill, compacting and planting the cover, selecting proper soil, diverting upland drainage, and placing wastes in sites not subject to flooding or high groundwater levels. Gases are generated in landfills through anaerobic decomposition of organic solid waste. If a significant amount of methane is present, it may be explosive; proper venting eliminates this problem. Almost 80 percent of all household waste in Britain is sent to landfill.

A modem municipal landfill is typically a depression in an impermeable clay layer that is lined with an impermeable membrane. Each day's deposit of fresh garbage is covered with a layer of soil. Selection of modem landfill sites must be based on an understanding

of groundwater geology, soil type, and sensitivity to local citizen's concerns. Once the site is selected, extensive construction activitie ; are necessary to prepare it for use. New landfills have complex bottom layers to trap contaminant – laden water, called leachate, leaking through the buried trash. In addition, monitoring systems are necessary to detect methane gas production and groundwater contamination. In some cases, methane produced by rotting garba(is collected and used to generate electricity. The water that leaches through the site must be collected and treated. As a result, new landfills are becoming increasingly more complex and expensive. They currently cost between $1 to $2 million per hectare ($400,000 per acre) to prepare.

- **Incineration**

Refuse incineration is a controlled combustion process for reducing solid, gaseous or liquid combustible waste primarily to carbon diozide (Co2) other gases and relatively non-combustible residues. Two types of incinerations are commonly used: centi .. incinerations used by municipals and onsite incinerations commonly used by individuals (Robert, 1978).

In incinerators of conventional design, refuse is burned on moving grates III refractory – lined chambers; combustible gases and the solids they carry are burned in secondary chambers. Combustion is 85 to 90 percent complete for the combustible materials. In addition to heat, the products of incineration include the normal primary products of combustion – carbon dioxide and water as well as oxides of sulphur and nitrogen and other gaseous pollutants; nongaseous products are fly ash and unburned solid residue. Emissions of fly ash and other particles are often controlled by wet scrubbers, electrostatic precipitators, and bag filters.

- **Compositing**

Compositing is the biochemical degradation of the organic fraction of solid waste material to humus-like materials. Modern scientific compo sitting has been described as a rapid but partial decomposition of moist, organic matter by the use of aerob' microorganisms under controlled combustion (Robber, 1973). Domestic solid waste contains 2/3 in weight of organic matter which after decomposition can be used as valuable fertilizer known as compost.

Composting operations of solid wastes include preparing refuse and degrading organic matter by aerobic micro-organisms. Refuse is presorted, to remove materials that might have salvage value or cannot be composted, and is ground up to improve the efficiency the decomposition process. The refuse is placed in long piles on the ground or deposited in mechanical systems, where it is degraded biologically to humus with a total nitrogen, phosphorous, and potassium content of 1 to 3 per cent, depending on the material being composted. After about three weeks, the product is ready f curing, blending with additives, bagging, and marketing.

- **Recycling**

The practice of recycling solid waste is an ancient one. Metal implements were melted down and recast in prehistoric times. Today, recyclable materials are recovered from municipal refuse by number of methods, including shredding, magnetic separation of metals, air classification that separates light and heavy fractions, screening, and washing. Another method of recovery is the wet pulping process: incoming refuse is mixed with water and ground into slurry in the wet pulper, which resembles a large kitchen dispos

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unit. Large pieces of metal and other nonpulpable materials are pulled out by a magnetic device before the slurry from the pulper is loaded into a centrifuge called a liquid cyclone. Here the heavier noncombulstible, such as glass, metals, and ceramics, are separated out and sent on to a glass and metal recovery system, other, lighter materials go to a paper-fibre recovery system. The final residue is either incinerated or is used as landfill. Increasingly, local authorities and private refuse-collection organizations in several countries are requiring those who generate solid waste to keep bottles, cans, newspapers, cardboard, and other recyclable items separate from other waste. Special trucks pick up this waste and cart it to transfer stations or directly to recycling facilities, thus lessening the load at incinerators and landfills.

This is one of the best environmental success stories of the late 20th century. In the United States, recycling, including compo sitting, diverted 54 million tones (60 million U.S. tons) of material away from landfills and incinerators in 990, up from 34 million tons in 990 – a 6º percent increase in just nine years.

- **Resource Recovery**

Numerous thermal processes, now in various stages of development in the United States, recover energy in one form or another from solid waste. These systems fall into two groups: combustion processes and pyrolysis processes. A number of companies bum in-plan wastes in conventional incinerators ' produce steam. A few local authorities produce steam in incinerators in which the walls of the combustion chamber are lined with boiler tubes, the water circulated through the tubes absorbs heat generated in the combustion chamber and produces steam. Pyrolysis, also called destructive distillation, is the process of chemical decomposing solid wastes by heat in an oxygen-reduced atmosphere. This results in a gas stream containing primarily hydrogen, methane, carbon monoxide, carbon dioxide, and various other gases and inert ash, depending on the organic characteristics of the material being pyrolyzed.

2.4.3 Determinants of Urban Solid Waste Generation

Some of the major factors that influence urban solid waste generation are:

i.   Population growth

ii.   Urbanization and social composition

iii.   Commercial growth and industrial development/practice

iv.   Agricultural practice

Rapid population growth increases the urban solid waste generation, this increase in population could be as a result of excessive or high birth rate of the city of urban centre or due to rural drift in search of greener pasture or other purposes which could include social amenities, health care, education and so on.

CHAPTER THREE

METHODOLOGY

3.1` Data types and Sources

The data that re used for this study were obtained from primary and secondary sources:

3.1.1Primary Sources

Primary data were collected from a field survey of survey the study area. Thereafter, questionnaire were structured, ar administered by the researcher using the electoral world.

Information collected from field includes socio-economic characteristics of the respondents, environmental, neighbourhood and health conditions of the study area. Furthermore, information was collected from officials of environmental sanitation institutions involved in administration and control of environmental sanitation in the area. The Health institutions in Minna were visited were visited and information relating to management of issues resulting from poor environmental sanitation and cases of patients treated due to poor sanitation ailments were collected.

3.1.2 Secondary Source

The secondary data were collected from books, journals, past dissertations, environmental sanitation institutions and hospitals about such issues relating to environmental sanitation and health of the people in the study area. Also, maps were obtained from Ministry of Lands and Survey, Niger State.

3.2 Instrumentation for Data Collection

In collecting primary data, three different sets of questionnaire were used. The first sets of questionnaire were administered on some selected localities within Sabon Gari. These questionnaires sourced information on the existing environmental condition of the study area. Such environment components as waste disposal methods, pollution control measures, water supply system, land use control and regulations as well as environmental sanitation measures such as cleanliness of the environment, prompt disposal of refuse, environment – health awareness/education and environmental sanitation and health laws were assessed.

The second sets of questionnaire were administered on officials of government agencies responsible for environmental control,

management and sanitation located within the study area. Information that were sourced through this set of questionnaire includes examining the existing environmental health and sanitation laws, the level of compliance with the various environmental sanitation laws and regulations, impediments faced in enforcing th various environmental sanitation regulations, availability of required facilities and personnel as well as way sin which they believed the system can be strengthened and attitude of the people towards sanitations officials.

The third sets of questionnaire were administered on seni medical or paramedical officers in the public and private sectors and other relevant health institutions. Information that were sourced through these questionnaire includes the common diseases resulting from poor environmental sanitations, their causes, records of cases investigated and efforts geared towards minimizing or combating th environmentally related health problems.

Secondary data were collected through visits to the various Establishments/organizations earlier mentioned as secondary data sources where information could be obtained for the study.

The sampling procedure adopted was the systematic sampling of one house in every fifth house in the identified communities of households of Minna. In each residential building, a household was selected for interview. In each household, the head of the household or other available adult of the household (in the absence of the head of household) of the (head of household) provided information about the household. The environment of the residence was observed to confirm the claims of the respondents. At the end of the survey, 321 household questionnaire, representing 71.3% of the total household questionnaire administered were appropriately and fully completed were used for the analysis .

3.2.2 Method of Data Collection

The data collection was achieved through the use of questionnaires and published and unpublished texts. The research personally collected all data from the various environmental sanitation institutions.

3.3 Method of Data Analysis

The data collected through the field survey were collated, sorted out and analyzed. The analyses were presented in the form

of tables, frequently, diagrams and statistical charts where appropriate.

3.4 Problem of Data Collection

The major problem encountered during the period of collecting the primary data was the low response of people as a result of suspicion despite disclosing once once identity as a university student undergoing a research work in the chosen topic. The acquisition data was a difficult task. The people do not understand the purpose of the data and its use so there was wide spread ignorance. A lot of persuation, explanation and commitment have to be used to get the people to answer questions to fill the questionnaire. It took repeated call to get response as most tenants would rather one to the landlords who could not be traced. Most people especially the illiterates refused to co-operate because they thought the researcher is a health officer inspecting their environment in order to arrest environmental sanitation violators

The responses of the environmental sanitation institutions and health institutions in the study area were not encouraging. It took

repeated calls before the researcher was able to get the responses

he used for this analysis.

CHAPTER FOUR

ANALYSIS AND DATA INTERPRETATION

4.0 Introduction

This chapter present the survey results in two sections. The first section deals with the analysis on the socio-environmental conditions of the surveyed area. Marital status, occupation, etc of the respondents. The second section is n the responses of officials of government agencies responsible for environmental control, management and sanitation located within the study area.

4.1 Data Analysis and Interpretation

Table 4.1 Marital Status of the Respondents

Marital Status	Frequency	Percentage
Single	129	40.2
Married	192	59.8
Divorced	0	0
Widow/Widower	0	0
Total	321	100

Source: Field Survey, 2009

From Table 4.1, it is revealed that about 40.2% of the respondents are single, 59.8% are married and non with the case of divorce or widowed. (See also figure 4.1).

Table 4.2 Occupation of the Respondents

Occupation	Frequency	Percentage
Civil Servant	96	29.9
Farmer	33	10.3
Others (Business/Company Worker)	192	59.8
Widow/Widower	0	0
Total	**321**	**100**

Source: Field Survey, 2009

Majority of the respondents representing 59.8% are either doing business or company workers. About 10.3% are farmer are 29.9% are civil servants. (See Table 4.2).

Table 4.3 Name and District of the Respondents

Name of District	Frequency	Percentage
Limawa	160	49.8
Sabon Gari	139	43.3
Dutsen Kura	22	6.9
Total	**321**	**100**

Source: Field Survey, 2009

About 49.85 of the respondents are living in Limawa, 43.4% are living in Sabon Gari and Dutsen Kura accommodates about 6.8% of the respondents.

Table 4.4 No. of Persons per Household of the Respondents

Number of Persons	Frequency	Percentage
1-3	224	69.8
4-6	64	19.9
7-9	14	4.4
10-12	19	5.9
13 and above	0	0
Total	321	100

Source: Field Survey, 2009

From the survey carried out and as shown in table 4.4 and fig. 4.2, 69.8% of the respondents are living 1-3, 19.9% are living 4-6, 4.4% are living 7-9, 5.9% are living 10-12 person per household respectively and non of the respondents are living 13 and above.

Table 4.5 Types of Refuse Generated in the Area

Types of Refuse	Frequency	Percentage
Domestic	225	70.1
Agriculture	65	20.2
Office	18	5.6

Industrial	13	4.1
Others	0	0
Total	**321**	**100**

According to tale 4.5, the results of the field survey, 200 about 70.1% of the wastes generated in the area are from residential uses, 20.2% are from agricultural land use or produce, 5.6% are from office and institutional land use and industrial uses amount to about 4.1%. This is to the understanding of the respondents.

Table 4.6 Types of Refuse Collection Containers

Types of Container	Frequency	Percentage
Trash Can	170	53.0
Dust Bin	82	25.6
Baskets	65	20.2
Others	4	1.2
Total	**321**	**100**

Some people make use of any kind of containers as home to store their waste according to their reach, but on the streets the researcher observed that there are standard refuse bin bunkers are

being placed at a strategic location on the street. As shown by the survey, 2009 53.0% of the respondents make use of trash can, 25.6% use Dustbin, 20.2% uses baskets while 1.2% use oth containers (See Table 4.6 and Figure 4.4).

Table 4.7 Types of Collection Points in the Area

Types	Frequency	Percentage
Refuse container	182	56.7
Communal Depot	63	19.6
Open dumping	76	23.7
Incinerator	0	0
Others	0	0
Total	321	100

Source: Field Survey, 2009

According to Table 4.7, the result of field survey 2009, 56.7 make use of standard refuse containers, 19.6% use communal depot, 23.7% still dump their refuse without control, while there non of the respondents making use of incinerator.

Table 4.8 Agency Responsible for Refuse Collection in the Area

Marital Status	Frequency	Percentage
Private Arrangement	149	46.4
Government	166	51.7

Company	6	1.9
Others	0	0
Total	**321**	**100**

From table 4.8 about 46.4% made private arrangement to clear their refuse, 51.7% depend on government agency services, 1.9% are cleared by some construction companies in the area.

Table 4.9 Distances between Collection Points and the House of Respondents

Distance	Frequency	Percentage
10m – 20m	223	69.5
21m – 40m	68	21.2
41m – 60m	18	5.5
61 & above	12	3.7
Total	**321**	**100**

Table 4.9 and figure 4.5 revealed that about 69.5% of the respondents live 10m – 20m away from the collection points, 21.2% are 21m – 40m away from the collection points, 5.5% are 41m-60m

away, while 3.7% are 61m and above away from the collection points.

Table 4.10 Immediate Disposal of Waste by the Respondents

Immediately	Frequency	Percentage
Yes	95	29.6
No	226	70.4
Total	**321**	**100**

Source: Field Survey, 2009

About 29.6% of the respondents dispose their wastes immediately while the largest percentage (70.4%) store their wastes for some times before taking them to collection points (See Table 4.10).

Table 4.11 Frequency of Waste Disposal by the Respondents

Time	Frequency	Percentage
Daily	146	45.5
Weekly	43	13.4
Irregular	132	41.1
Total	**321**	**100**

Source: Field Survey, 2009

It is revealed that 45.5% of the respondents disposed their wastes daily, 13.4% disposed waste weekly and 41.1% disposed their waste irregularly without taking into account the volume and time.

Table 4.12   Frequency of Collection by the agencies

Marital Status	Frequency	Percentage
Daily	38	1.8
Once a week	39	12.1
Twice a week	38	1.8
Thrice a week	142	44.2
Not Regular	64	19.9
Total	**321**	**100**

Source: Field Survey, 2009

From the table 4.12 and figure 4.6 the collection of waste depends on the volume of wastes generated and agency responsible for the collection in the area.

Table 4.13   Payment for refuse collection by Respondents

Payment	Frequency	Percentage
Yes	290	90.3
No	31	9.7
Total	**321**	**100**

Source: Field Survey, 2009

About 90.3% said they pay for refuse and waste management, while 9.7% said they do not (See table 4.13).

Table 4.14 Amount paid for Refuse Collection by Respondents

Amount N	Frequency	Percentage
4,000	149	46.4
1,000	166	51.7
2,500	6	1.9
Total	**321**	**100**

Source: Field Survey, 2009

From table 4.14 it is revealed that about 46.4% paid N4,000 per month for solid and sewage management, 51.7% paid N1,000 and 1.9% paid N2,500 monthly for waste management.

Table 4.15 Types, Compositions and Sources of Refuse Generated

Type	Composition	Source
Domestic	Food prygration, tins, metals and glasses	Homes, offices, hotels
Agricultural	Crop residue, animal bones and fesses	Slaughter homes
Industrial	Paga	Factories
Institutional	Papers	Offices

Source: Field Survey, 2009

. Table 4.16   Effectiveness of the method used in the Area by the Respondents

Effectiveness	Frequency	Percentage
Poor	8	2.5
Fair	93	29.0
Good	200	62.3
Very good	20	6.2
Total	**321**	**100**

Source: Field Survey, 2009

Table 4.16 and figure 4.8 revealed that the waste collection and management methods are 2.5% poor, 29.0% fair, 62.3% good and 6.2% said the methods are very good and effective.

4.2   Discussion of the Results

Niger State Environmental Protection Agency

The Agency was established solely to manage both the solid and liquid waste in the Minna Metropolis. Since its establishment, it has employed different means to tackle the waste problems in Minna Metropolis.

Mode of Conveying the Waste from the Collection Point to the Dumping Site.

The method adopted by the Board to carry out solid waste management in the metropolis is the establishment of commun refuse depot at the satellite towns and use of refuse containers in the main city. But some of these depots are not maintained properly leading to a very bad condition of refuse in some part of the metropolis. Also some of the works were contracted to companies. The board do mostly enforcement job. The contractors make use compactors to transport the wastes.

Solid Waste Disposal Techniques in Minna

Because of the low technological development, the waste could not be properly classified into different categories, but basically we have waste from agricultural land use, residential (domestic industrial, commercial, institutional land uses etc these waste are mixed up and they are evacuated together and dumped in the site for land fill. The ultimate destination of all un-recovered solid waste in Abuja is sanitary landfill design to confine the material to the

smallest possible area and volume and preventing access by vermin and disease vectors.

The following steps for refuse disposal through landfill method within the study area are:

- The deposition of solid waste in a prepared section of the site, in such a way that the working force has a minimum area.

- Spreading and compaction of the waste in thin layers

- The covering of the waste with a layer of compacted cover soil either daily or more frequently is required.

- The final cover of the entire construction with a compacted earth layer of 2 or 3ft thick.

Solid Waste Management in Minna

The solid waste management department of the Environmental Protection Board is the one responsible for solid waste management in the Federal Capital Territory Abuja.

The primary focus of solid waste management objectives is on management of solid waste (residuals) in the manner of protecting public health and utilizes management system which can be operated

and maintained at reasonable cost and with semi-skilled or unskille staff.

Coffo committee (1988) noticed that solid waste management is an important aspect of hygiene, its collection treatment and disposal deserve attention if we are to avail from chemical pollution danger of water supply and the physical environment. The sol waste management programme is base don the following assumptions.

- Residential solid waste be generated at 0.5kg per capital/day and have an uncompacted density of 120 kg/m^3

- Non-residential solid waste to be generated at 0.3kg per capit and have uncompacted density of 180kg/m^3

- The collection points will be thrice in a week.

- All collection points will be accessible to the collection equipment,

- All waste paper produced by Federal Government Institutioi will be recycled,

- No other refuse recovery used programmes are assumed.

4.3 Method of Collection and Disposal by the Waste Management Department.

In the study are, individual houses or groups of houses have refuse bins and litters baskets in which they store their refuse. There are refuse containers positioned at every block of flats, while som household has personal arrangement with private people who come weekly to collect the agreeable period and payment is mode on personal effort. Some of these refuse collection are thrown indiscriminately into an open dump not conductive for the livelihood of the environment.

The solid waste management department department of the Environmental Protection Agency is not frequently collecting the refuse periodically as it is in the city center of Abuja by the use of compactors and then transport to the final disposal site, which is about 20 km from the city center.

The researcher investigate various methods of waste disposal management known to the respondents. The conventional sound waste disposal management system is that of sanitary landfill system which covers the highest respondents, the knowledge of waste disposal system suitable for Minna was as a result of waste burning

system. The landscape of Minna is dotted by points of refuse burning smoke which undermines seriously the inherent dangers in refuse burning.

Strength and Categories of Staff

The staff strength of the solid waste management department is 100 comprising of labourers, casual and skill labourers, driver, sanitarians and supervisor as shown in table below:

Table 4.17 Staff Strength and Categories

CATEGORIES	NUMBER
Labourers (Skilled)	150
Drivers	100
Sanitarians	20
Supervisors	17
Casual labourers	230
Total	**517**

Source Field survey, 2009

Table 4.18   Types of Equipment Available

Equipment	Total Number Acquired	Number Functioning	Number Not Functioning	Percentage of Number Functioning
Refuse compacting truck	14	3	1	21.86
Open Tipper	10	6	4	60.0
Pay loaders	4	1	3	25.0
Bulldozerss	3	0	3	
Landfill Compactor	2	0	2	0
Grader	1	1	0	100.0
Mechanical Sweeper	4	2	2	50.0
Low loader	1	1	0	100.0
Excavator	1	0	1	0
Total	**40**	**14**	**26**	**35.0**

Source: **Niger State Environmental Protection Agency.**

ii   Inadequate funds and funding: The study also revealed that since the inception, the board has not enjoyed adequate funding as provided in the yearly national budget. When funds are released, they are often not adequate. This impairs greatly the collection system. The level of environmental sanitation invariably the public health.

iii. Non availability of Waste Receptacles: According to the study, the board distributed over 2,000 waste receptacles of various sizes (120/240kg) to the housing units in the territory to ease waste collection processing yet many premises are without standard waste receptacles. This is du to the fact that as many about 10,000 standard receptacles are lying waste due to one little problem or the other. This has led to accumulation and illegal dumping of waste on the streets, corners, highways and undeveloped plots all over the surrounding areas.

iv. The problems of disposal of refuse (littering habit): Littering habit among the citizens of the city, is anther expose by the study as causing street and surrounding littering are grossly not adequate.

v. Absence of Transfer Station: According to the study, a adequate number of transfer stations were provided in the master plan of Abuja to reduce the turn around time and enhance adequate waste collection frequently. At the moment none of these transfer stations has been developed

. contrariwise, the proposed site have been re-allocated for others purposes. The increasing volume of rood traffic in the city nowadays and the collection system of solid waste on ground have drastically reduced the coverage of the collection teams, the resulting in wastes accumulation within the neighborhood.

vi. Sub- standard Waste Disposal Technique: Finally, the study concluded the sanitary landfill system is the wastes disposal method adopted for the FC Although, there is adequate and suitable landmass for this method of solid waste disposal in the territory. The dual problems is lack of adequate adequate equipment and well equipped manpower have continued to hamper the system and problem of inadequate staff to carry uot solid waste collection and disposal effectively in the study area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Findings

The preceding chapters have satisfied the basic aim of this study, which is aimed at examining the causes, consequences and effectiveness of solid waste management Minna maturation

The following are the major findings of the study.

The major sources of the solid waste generation in the study area commercial and residential, followed by offices and other sources like uncontrol leaves from garden.

A survey also show that the dumping sites where not properly managed a the collection points littered with waste materi such as polythene, papers a leaves.

The field survey revealed that the method used for waste management sanitary landfills. The problem is the management of the landfill to avoid contamination of the environment. There is no control measure put in place to change that.

From the result of the survey, the consequences of poor management solid waste are the unaesthetic environment of Minna.

It is a revealed that the agency also in need of modern and functional equipment well trained and qualified staff to carry out the work effectively and efficiently.

Though some of the respondents satisfied with the present management, some complained of the amount paid and inefficiency on the part of agencies responsible for waste management in their area.

A major finding was that the environmental sanitation institutions are adequately staffed and funded and these have hindered their performance. Furthermore, the environmental sanitation/health officers were of the view that non of the environmental sanitation/health laws and regulations are outdated and the need t be reviewed in order to make them relevant to the present day sanitation.

From the foregoing, environmental sanitation or waste management positive roles on health. The existing situation needs to be improved upon as human being and his environment are inseparable and must be considered in the relationship with each

other. This therefore calls for policy recommendations sharpen tools that will actualize the health needs.

5.2 Conclusion

For efficient solid waste management within the study area Abuja,

Their need for a comprehensive legislation to guide the activities of the Niger State Environmental Protection Board in Agency.

The Board must pre-plan the elements or the solid waste management system detailed planning, scheduling and good routir system with specific and substance task per route. There is need to provide adequate facilities or equipment for effective protection or the system in Minna .

Creation or the transfer stations as earlier mentioned cannot be overemphasized, they are found to improve productivity ar minimize waste of productive time.

The government to improve the quality of their production in order to reduce the volume of generated and ensures that good material and its durability can be revised, thus enhancing the cheapest way or disposing refuse.

5.3   Recommendations

Based on the findings of the research a number of proposals and recommendations are hereby advanced with a view to improving waste management strategies and ensuring decent environment.

The proposals and recommendations are treated under three main headings, which are the collection, disposal and management technique of solid waste in Abuja to improve operational efficiently of exiting solid waste management.

Collection:

Collection of solid waste within the study area should involve the development of two functional systems, an on-site handling storage and processing system and a co-coordinated collection solid waste to a central disposal area.

The mast effective vermin control, measure is proper sanitation. The type of on-site collection system needed is a function of the source. Single-family houses could keep waste in small storage containers prior to collection, medium and high density area could use large, portable or fixed, open-top or closed containers commercial and industrial facilities could also use similar devices.

Solid Waste Collection Operations and Equipment Alternatives

The Use of proper containers not only reduces collection time, it often results in lower labour force equipments and invariably improves diseases vector and vermin   control.

Operation Consideration.

One of the fundamental aspects of solid waste collectic system   involves point of collection, which represents the specific location that are wastes to be picked up for disposal.

There are two basic alternatives regarding point of collection proposed: curbside collection of waste and backyard collection waste.

Curbside Collection of Wastes

This requires the resident of waste   generation to place the waste at the street curb o the day of collection,. Which need retrieval and replace the empty waste containers on the resident to empty the waste into the communal bins at the street curb and retrieve the empty container.

Backyard Collection of Waste

This is also called the set out and back method. The collection crewman carries the refuse containers to its storage area. In most

cases, it is advisable to adopt the two type of collection. Point of collection, as it relates to the collection waste from institutions, office, retail and other development should occur at the storage container location.

Strategies for these are as follows:

- There should be mass production and distribution of environmental sanitation regulation.

- Stickers posters and pamphlets should be pasted at strategic places within the city prohibiting indiscriminate dumping of refuse, and make sure the stickers do not litter the environment.

- Mobiles cinema and public address system could be employed in such place as market: this will go a long way in helping the dissemination of information to the grass root population.

Purchase of more Equipment

More equipment should be purchased, such as the open-topped front and tipper vehicles for back log clearance of solid wastes, the compactor refuse collection vehicles could be used.

The number of vehicles tend to determine the number of crews so the higher the number of collection crew and hence the lesser the number of trips per day, per vehicles, this b will prolong the life the vehicles.

Enforcement of Environmental Laws

The decree establishing the Environmental Protection Board has some provisions for its enforcement, which ranges from fine to imprisonment or both, such law should be strictly enforced. Was management officers should be trained to go around the town regularly to supervise the dumping areas and the entire also environment and that such environment should be served with a notice or clearance or dirt within six days and failures to comply should be liable to punishment or fine.

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TITLE: ASSESSMENT OF THE EFFECTIVENESS OF THE SOLID WASTE MANAGEMENT SYSTEM IN MINNA METROPOLIS

The questions below are in respect of a research work, kindly supp the necessary information by filing or ticking ( ) where appropriate. Note that the information supplied is strictly for academic purpose and would be confidentially treated.

Questionnaire for Household

Tick as applicable ☐

1. Marital Status: (a) Single ☐ (b) Married ☐ (c) Divorced ☐ (d) Widowed ☐

2. Occupation: (a) Civil Servant ☐ (b) Farmer ☐ (c) Other specify ...

3. Name of District: (a) Sabon Gari ☐ (b) Dutsen Kura ☐ (c) Limawa ☐

4. No of person per household: (a) 1-3 ☐ (b) 4-6 ☐ (c) 7-9 ☐ (d) 10-12 ☐ (e) 13 – above ☐

5. Type of Refuse generated in the house: (a) Domestic ☐ (b) Agriculture ☐ (c) Office ☐ (d) Industrial ☐ (e) Others specify...............

6. Type of refuse containers used in the house: (a) Trash cans ☐ (b) Dustbins ☐ (c) Baskets ☐ (d) Others specify ....

7. Type of collection point in the area: (a) Refuse container ☐ (b) Communal depot ☐ (c) Open dump ☐ (d) Through burning ☐ (e) Other specify)...

8. Who is responsible for refuse collection in the area: (a) Private Arrangement ☐

   (b) Government ☐ (c) Company ☐ (d) Other (specify).......

9. What is the distance between collection point and your house?

   (a) 10m-20m ☐ (b) 20m-40m ☐ (c) 40m-60m ☐ (d) 60m ar ` above ☐

10. Do you dispose your waste immediately? Yes ☐ No ☐

11. How often do you dispose waste? (a) Daily ☐ (b) Weekly ☐ (c) Irregular ☐

12. How frequent is the refuse collected? (a) Daily ☐ (b) Once a week ☐

    (c) Twice a week ☐ (d) thrice a week ☐ (e) not regularly ☐

13. Do you pay money for the .>\ refuse collection? (a) Yes ☐ (b) No ☐

14. If yes, how much do you

    pay?...

15. Level of satisfaction with the method of waste management (a) Poor ☐

    (b) Fair ☐ (c) Good ☐ (d) Very Good ☐

16. What possible suggestions do you have to improve on the collection

    and disposal of waste in your area:...