ENVIROMENTAL APPRAISIAL OF DRAINAGE SYSTEM IN MINNA TOWN

BY

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DECLARATION

I hereby declare that this project work is an original work carried out and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communications, published and unpublished work were duly referenced in the text.

.... 19/02/2010 ....

Maduka Chijioke

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CERTIFICATION

This project entilted " Environmental Appraisal of Drainage System In Minna Town" by Maduka Chijioke , meets the regulations governing the award of the degree of Bachelor of Engineering (B. ENG.) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

I dedicate this project to **ALMIGHTY GOD** for His Mercies, Protection, Blessings and Guidance to me and my family, and to my Parents and siblings and to all who help in the struggle to promote human life.

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I acknowledge the utmost help of Almighty God for protecting and guiding me through the period of the course and making me finish the project and programme successfully.

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ABSTRACT

Available records indicated that erosion and flood problems in Minna have assumed such frightening magnitude in terms of lives and properties, lost to the menace that steps are required to be taken to check this ugly situation. This study is in response to the need to find solutions. Various methods were used for the appraisal, among which were reconnaissance of the town, effect of rainfall on the erosion and flood of the town. Rainfall data were collected and street map to illustrate study areas. It was found that, drainage system of the town is grossly inadequate with poor sanitary culture, improper layout of houses and high rainfall depth, all contributing adversely to the erosion and flood problems of the town. In view of the effects of the problems on the town, recommendations were made as a measure to be taken to reduce the problems and this should be implemented to achieve the desired effective control of runoff through the drainage system network.

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CHAPTER ONE

1.0. INTRODUCTION

1.1. Background of Study

The degree of urbanization and extent impervious area which comprises the roof areas and large expanses of paved surface, in which there is very little or even no part of the ground into which rainfall could infiltrate affects the volume of runoff obtained from a given rainfall. The effect of this (urbanization) development on elements of hydrological cycle, like precipitation, infiltration, percolation, transpiration, evaporation and surface runoff, therefore assume significant importance hence the need for this study.

A major objective in water management therefore is to see that excess runoff which is inimical to the environment is removed and extreme flood and erosion event (both arising from runoff) are controlled. So as to minimize distress and objective, the construction of well articulate drainage network then becomes pertinent.

The term drainage means a system in which excess rainfall (funoff) and unwanted water are carried away from the living area or roadways and disposed off safely into stream, ponds, rivers or lakes to prevent it from constituting in a nuisance in the form of erosion or flood to environmental planning and protection. It is the process of collecting, disposing and transporting of surface water originating on or near the right of way or flowing in streams and rivers-crossing or boarding that right of way.

There are three primary types of drainage, namely;

i. Land drainage

ii. Surface drainage

iii. Subsurface drainage

Drainage plays a very important role in the urban low income and medium income housing area, especially in the developing countries, this is because it removes unwanted water from the site or living area as quickly as possible, thus reducing likely health hazards of blood and erosion to the inhabitants of the area (public) and the deterioration of other agricultural infrastructures such as farm buildings and roads.

Although problems of flood and erosion are nationwide in Nigeria, but to varying intensity in different places, however the problem is most prominent in the Eastern and Northern Nigeria, and as a result, Arable Lands, agricultural produce, Landed properties, household properties have all been damaged with gullies created right in the middle of roads and many agricultural farm, markets and communities cut off from one another. The country lost a whopping sum of ₦200 billion to heavy rainfall and floods, which ravaged part of the country within three months (Aug – Oct) in 1999. (Weekend Concord)

Similarly recent September 12th severe flooding in Kubwa, FCT Abuja arising from torrential rains unable to be controlled by existing drainage network reportedly destroyed properties worth billions of Naira. Also sometimes in September in Niger State, severe flooding which also claimed several lives and properties was reported. This phenomenon has so far been most devastating and the worst in 30 years.

It is known that flood and erosion are natural occurrence, however, the general apathy shown by people of Niger State towards environmental sanitation is very poor and the use of drainage system for refuse dumping which blocked the drainage paths as a result of ignorance of the system, purpose is also not encouraging (Puch 2004)

Drainage is often considered as a minor problem in Nigeria for the hydraulic and Agricultural Engineers and frequently designed as if the work were unimportant, there tasks actually involve substantially greater capital investment and probably consume more engineering time each year than all of the flood mitigation (flood control) activity undertaken.

It should be noted that one of the most important factors of consideration for the design of rural roads and cities is the provision of proper and adequate drainage facilities. Adequate and economical drainage is absolutely important for the protection of the investment made in the areas and for safe guarding the lives and properties of those using it.

Final design requires even more detailed map of these areas where construction of drainage system is proposed. All existing facilities e.g. gas, electricity, water, sanitary sewers and telephone must be accurately located together with buildings, canals, rail road's or other structures that might interface with the proposed route. If rock is experienced or expected near the surface, rock profile as determined by boring along the proposed conduit are necessary so that the pipe layout can be selected to minimize rock excavation.

The main distinction between drainage and flood is in the techniques employed to cope with excess water and in the fact that drainage with water before it has reached major stream channels. Finally, the accumulated water should be discharged as close to its source as possible. Gravity discharge is preferable but not always feasible.

However, the structural and environmental appraisal of drainage network of Minna is one of the towns affected by reported calamities cannot therefore be over emphasis, hence this project. In this regard investigation of various factors causing this menace in the town will be addressed by this project and probable solution recommended.

1.2. Objectives of the Study

1. To appraise the general condition of drainage network in Minna in order to minimize the rate of erosion and flood being experienced almost annually by some residents of the area.
2. Identification of the problems confronting the drainage system of the town.

1.3. Justification of the Study

The project is necessary to arrest the perennial cases of flooding and erosion as reported. The enormous financial, agricultural and material losses to the problem in the town require drastic measure to prevent further destruction of lives and properties.

1.4. Scopes of Study

The scopes of this project includes

a. Data Collection

b. Field work

c. Preliminary investigation of refuse disposal in the area and the attitude of people in the area towards drainage use.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1. General Review

Drainage can be defined as the controlled discharge of rainfall runoff and runoff is the quantity of water remaining after percolation, evaporation e.t.c. which has been deducted from the total precipitation.

Drainage can also to be an integral part or irrigation development to protect irrigated land. Drainage have a principal purpose, the protection urban and sub-urban areas. The degree of protection afforded is usually depended on the values of the improvement served.

A factor which affects the adequacy of surface drainage or runoff is the tributary area. This is the area over which a particular intensity falls. The area is usually such that all runoffs finally collect at a particular position which is lower to the area.

The development of effective drainage system is to prevent harmful accumulation of excess surface water, which is probably one of the important activities of an Agric. Engineer. The important of adequate drainage in the world today benefits on, Agriculture, building foundation. Water impoundment, structures pavement slope of high ways.

In adequacy of drainage in Nigeria today causes loss of properties, lives and agricultural products.

Generally, Minna is well located from a storm water drainage view point. There are many well defined water courses and therefore no part of the town in far from a natural drainage. The major problem that exist is the ability of water to flow freely to these water courses, and only by construction of road side ditches which must be kept clean can this problem be overcome.

Refuse frequently ends up in open drains, if the solid waste management system is inadequate, vegetable matter from silage may be deposited in the drainage such blockage result in standing ponds of dirty water are potential mosquito breeding sites. Flooding may subsequently occur due to the loss of flow capacity.

2.2. Drainage System

Drainage can be use to define a system dealing with handling of or disposal of excess surface runoff (water) from an agricultural field or road. Drainage can also be said to be and integral part of irrigational development to protect irrigated land. The main purpose of drainage is to protect agricultural and non-agricultural urban and suburban areas.

Also the purpose of adequate drainage system is to eliminate harmful accumulation of surface runoff, which could cause damage of properties through erosion and floods.

Objectives of drainage system therefore are

i. The drained water should not eventually return from where it was originally drained.

ii. The drained water should eventually join natural streams/rivers.

iii. Gravity water or surface runoff should be drained as soon as possible but not quickly to encourage erosion.

iv. Drainage layout should not spoil environment. It should be discreetly located or covered such that the area still retains it's character.

There are three principal categories or methods of drainage

a. Surface drainage

b. Subsurface drainage

c. Land drainage

2.2.1. **Surface Drainage**

Surface is the removal of water from the surface of the Land. The water may be from excess, rainfall, over-irrigation, losses from conveyance channels and storage systems, or seepage from areas of higher elevations. Flat or level land having impermeable sub soils with shallow top-soil frequently requires surface drainage because pipe drains are not practical or economical. Open drains are advantageous for removing large volumes of either surface or subsurface water, including storm water from land where the table is near the ground surface. Open drains are essential for disposing of storm water also. The selection of surface drainage system for farm and roads depends largely on topography; soil characteristics, crops and availability of shallow soil of 20 to 50cm depth, with underlying very slowly permeable subsoil's, require surface drainage because subsurface drainage is not practicable or economical. Surface drainage is also desirable in fields where adequate outlets for tile drains are not available.

2.2.2. **Subsurface Drainage**

Subsurface drainage is accomplished by buried pipes, or pipless drains (moles), and by deep open drains.

a. **Pipe drains:** Pipe drainage consists of a system of pipes made of baked clay tiles, concrete, plastic tubing, or any other perforated conduct. The excess soil water enters in lateral line through butt joints, slots or other perforation and flows towards the collector and the main drains.

b. **Moles Drains:** Moles drains, or pipeless, are cylindrical channels artificially produced in the subsoil by means of moles plough. Moling is often considered to be temporary method of drainage, as the moles function efficiently only for a few years and then gradually deteriorates

c. **Bio-Drainage:** is the use of quick growing plants to improve marshy and water logged lands such plants draw water at a fast rate.

2.2.3. Land Drainage

Land drainage removes excess surface water from an area or lower the ground water below root zone to improve plant growth or reduces accumulation of soil salts. The purpose is to improve volume water in a reasonable time. Land drainage has many features in common with municipal storm drain system. Open drain are less objectionable in rural areas than in cities and are widely used for drainage in surface water at a considerable saving in cost over that of the buried pipes. Swampy land can be reclaimed by proper land drainage. It is especial useful in farming because it improves crop production.

2.2.4. Drainage Density

For a complete drainage network, we measure the total length in kilometers of all the channels and divide this figure by the total area of the drainage basin in square kilometers, yielding the drainage density observed value of drainage density range from as small as $2km/sq^1/_2$ to as great as $300km/sq^1/_2$ or even more.

But if a drainage value of 10 is obtained, this number means that there are 10km of channel for every sqkm of land surface. This is because areas and lengths are measured from map which projects sloping surface and channels on a horizontal plane.

2.2.5. Optimum Drain Size

It is possible to determine an exact drain size to carry the required flow. However, the method used to calculate runoff is not exact, and is limited by the accuracy of the meteorological data available. In practice it is usual to standardize on a limited number of drain size in order to simplify constructions, the drain selected should have the capacity to carryout least the rainfall.

It access width are severely restricted, and open drain having the capacity to carry the runoff from a stream having a one-year period may be prohibitively large. In such cases, the maximum drain size which is practicable more frequently then once annually.

At the junction of two drains, the invert level of the minor drain should be above that of the major drain which it is joining; hence this prevents back flow of water up the minor drain.

2.2.6. **Rainfall Intensity**

The rainfall intensity represents a rate of rainfall and it's magnitude depends upon the storm duration (that is the length of time for which rain is falling in a particular storm) and the return period of the rain fall intensity (that is, the number of years on average between the rainfall intensity being greater than or equal to a specified intensity).

To decide upon a suitable return period for the design storm it should be based on a cost benefit analysis which quantifies the physical and social work appears to have been done. However, no conclusive work appears to have been done which quantifies the actual cost of flooding on low income housing sites. Thus selecting of a suitable return period for the design storm is arbitrary, a return period of one year is often adopted.

Also, the determination of a suitable value of rainfall intensity depends upon the available ability of meteorological data for the exact location in question. The rainfall intensity reduces as the duration of the storm increases. The rational method assure that the storm duration which is appropriate for a particular drainage catchment equal the total time it takes for rain falling on the most distant part of the catchment to flow down to the outfall point of the catchment,. This is defined as the "time of concentration".

Time of concentration: This is the time of entry + the time of ground flow into one of the storm water drains, it can be taken to be three (3) minutes for urban housing areas. The time of flow is simply the time taken for that water to flow its entry point into the storm water drain to the outfall point. In order to calculate the time of flow, it is necessary to know the length of the drain and the velocity of flow in the drain.

2.3. Surface Runoff

Surface runoff is defined as the portion of precipitation that makes its way towards streams, channels, lakes etc. Drainage appraisal and investigation depends on the knowledge of the amount of runoff that will occur in a given area.

It is good to know that the peak rates of runoff, the total volume of the runoff, and the distribution of runoff rates, throughout the year.

Part of this rainfall is interpreted by vegetation; some of it is stored in depressions on the ground surface and called surface detention.

There are two basic paths to escape for surplus water; firstly, surplus water may percolate through the soil, traveling down and under the force of gravity to become part of the underlying ground; water body. Following subterranean flow paths, this water emerges to become surface water, or it may emerge directly in the shore zone of the oceans.

Secondly, surplus water may flow over the ground surface as runoff to lower levels. As it travels, the dispersed flow becomes collected into streams which eventually conduct the runoff to the ocean. Surplus water as runoff is a vital part of environment of terrestrial life forms and man in particular. Surface water in the form of stream, rivers, ponds and lakes constitutes one of the distinctive environments of plants and animals.

2.3.1. Runoff Prediction

The characteristics of the rainfall play a very important part in determining the amount of runoff that will occur. A light, gentle rain may be intercepted by vegetation or absorbed by soil. A sharp intense rainfall of short duration may result in large amount of runoff, because the rainfall rate greatly exceeds the infiltration rate.

The rational formular for estimating the peak rate of runoff is;

$Q = 2.78CIA$

Where Q = Design peak runoff in m^3/hr

C = Volumetric runoff coefficient

I = Rainfall intensity of the storm which could be either in millimeter (mm) per hour (hr) for a duration on equal to the time of concentration

A = Impermeable area or catchment area in hectares (m^2)

There are a number of ways to interpreting the variable in the above formular, the most straight forward is to assume that the coefficient "C" is 1.0. and the area "A" comprises all impermeable or catchment areas such as roofs and any surface which is likely to drain into the storm drains. Open areas which are grassed are excluded. In this case the above formular is reduced to $Q = 2.78IA$

2.4. Soil Erosion

Soil erosion may be defined as the process of detachment, movement and deposition of soil particles due to surface runoff or by wind.

Soil erosion can be classified into two main groups;

i. Geological Erosion

ii. Accelerated Erosion

2.4.1. Geological Erosion

Geological erosion includes soil forming as well as soil eroding processes which maintains the soil in a favourable balance, suitable for the growth of most plants. Geological erosion is sometimes referred to as natural or normal erosion and is found when the soil is in its natural environment under the protective cover of native. It is a long-time eroding process which has contributed to the formation of our soils, their distribution on the surface of the earth and it also causes most of our present topographic features such as canyons stream channels and valleys.

2.4.2. Accelerated Erosion

Accelerated erosion includes the deterioration and loss of soil as a result of man's activities, the soil loss is normally in excess of geological erosion. It is normally associated with change in natural cover or soil condition and is caused primarily by water and wind.

Accelerated erosion is considered in conservation activities. Hereafter, accelerated erosion will be referred to as soil erosion or simply erosion.

2.5. Erosion Agents

In humid regions, water is the primary agent causing erosion while wind is responsible for same in arid areas. Wind erosion may be serious on sandy soils and on organic soil in humid areas particularly windy seasons.

2.5.1. Water Erosion

This is the removal of soil from the land surface due to the action of running water including runoff from rainfall. Water erosion is sub-divided into raindrop, sheet, gully, rill, stream channel system etc.

2.5.1.1. Raindrop Erosion:

This is caused by the impact of water drops falling directly on soil particles. Although the impact on water in shallow stream may not splash soil, it does cause turbulence, providing a greater sediment carrying capacity.

This type of erosion is extremely harmful to the land, because it is usually so slow that the farmer is not conscious of the existence. On bare soil it is estimated that as much as 100 tons of soil per acre are splashed into the air by heavy rains.

2.5.1.2. Rill Erosion

This is the removal of soil by running water with the formation of small eroded channels less than 0.3m in depth that could easily be destroyed by normal tillage. Rill develops when there is a concentration of runoff water which, if neglected grows into large gullies. Detachability and transportability in rill erosion are more serious because of the higher runoff velocities that are involved.

2.5.1.3. Inter Rill Erosion

This is the general term used in combining splash erosion and sheet erosion. It is a function of soil properties, rainfall intensity and slope.

The relationship among the parameters is generally expressed as:

$$Di = Ki\, I^2\, Sf$$

2.5.1.4. Gully Erosion

This is the removal of soil by excessive running water, resulting in the formation of channels rnaging in sizes from 30cm to 10m or more. These large channels cannot be destroyed by normal cultivation or tillage practice.

The rate of gully depends primarily on the runoff producing characteristics of the watershed, the drainage are, soil characteristics, and alignment, size and shape of the gully and the slope in the channel.

2.6. Major Factors Affecting Soil Erosion by Water

The major factors that are affecting the removal of soil by water are;

i. Climate

ii. Soil

iii. Vegetation

iv. Topography

Of these factors, the vegetation and to some extent the soil may be controlled, but the climatic and topographic factors, except slope length are beyond the power of man to control.

2.6.1. Climate

Climatic factors affecting erosion are precipitation, temperature, wind, humidity and solar radiation. The most important factor of climate is rainfall. Temperature and wind are most evident through their effect on evaporation and transpiration. However, wind also changes raindrop velocities and the angel of impact. Humidity and solar radiation are some what less directly involved in that they are associated with temperature.

2.6.2. Soil

Physical properties of soil affect the infiltration capacity and extent to which it can be dispersed and transported. These properties which influence erosion include soil structure, texture, organic matter, moisture content and density or compactness, as well as chemical and biological characteristic of the soil.

2.6.3. Vegetation

The major effects of vegetation in reducing erosion are

a. Interception of rainfall by absorbing the energy of the raindrops and thus reducing runoff.

b. Retardation of erosion by decreased surface velocity

c. Physical restraint of soil movement

d. Improvement of aggregation and porosity of soil by root and plant residue

e. Increased biological activity in the soil

f. Transpiration, which decreases soil moisture, resulting in increased storage capacity

2.6.4. Topography

Topographic features that influence erosion are degree of slope, length of slope, size and shape of slope. One steep slopes high velocities causes' serious erosion by scour and by sediment transportation.

2.7. Wind Erosion

Wind erosion unlike water erosion cannot be divided into types as it varies only by degree. For example, there may be only a slight disturbance on the surfaced covering a small area or there may be a huge dust storm covering several status. Wind erosion takes place at a slow, geological rate under natural vegetation and normal soil condition, whereas under cultivation, serious erosion may result. The major factor affecting erosion by wind is climate, soil and vegetation. However, these will not be discussed as the interest of the project is not influenced by wind erosion.

CHAPTER THREE

3.0. METHODOLOGY

The process of appraising any engineering work in other to determine or analyze the suitability, capacity or problems(s) facing the structure is an important aspect of engineering profession. However before a major engineering work is embarked on, such as networking the drainage system of a town. It is imperative that a lot of field work and engineering study of the town is carried out for effective end product.

Consequently, knowledge of climatic factors such as precipitation is highly essential. Similarly, the effect of topographic features, which influences to great extent erosion by runoff must also be reconsidered. These topographic features include degree of slope and length of slope.

3.1. Precipitation (Rainfall) Data

Precipitation includes all water that falls from the atmosphere to the earth and runs as surface runoff to the river channels after infiltration, evaporation and transpiration demands have been satisfied. The runoff constituted what is referred to as erosion and flood when it is not accurately discharged.

It then became relevant to analyze the rainfall data from this area so as to see the implication of it on the catchments area. Moreover variations in rainfall falling on an area from year to year make it important to design drainage network that would conveniently catered for this natural anomalies.

For the purpose of this study, the best evidence now available is the recorded rainfall data from Metrological Department Minna Airport Station.

The record of the immediate past (10) ten years was collected and used to determine the effects of rainfall in recent times on the drainage system of the town.

In order to avoid erroneous conclusions, it is important to give the proper interpretation to the precipitation data, which often cannot be accepted at face value. For this reason, the data histogram and line graph of rainfall depth for the month of July, August and September over a range of period (10 years) were considered as a tool of analysis.

3.2. Reconnaissance

The first operation, to be carried out after preliminary study on any study engineering work is the site visit termed reconnaissance, this is done to know the situation on ground and determine the avenue of approach and solution to the problem.

For this study, Bosso town was visited to assess the drainage network and identify areas where problems of erosion and flood are more pronounced. In this regard, quite a lot of areas were identified, but for the purpose of this project six (6) areas of serious erosion problems were selected for the study. Photographs of these areas were taken to depict the situation and for the better appreciation of the extent of destruction.

On this not, each of the shots (PLATES) shall be used as a guide to discuss the drainage network of each area and the effects of erosion and flooding in the area.

CHAPTER FOUR

4.0. ANALYSIS AND DISCUSSION OF RESULTS

Most major cities in Nigeria are known to have a serious problem of water way structures, thus Minna (Bosso) is not left out and hence coursing serious erosion problem due to the fact that there is no adequate drainage network or adequate maintenance of the existing drains channels.

However, flooding is a regular occurrence during the five months of the wet/rainy season and the effects are felt probably an average of four times during this period. It requires a storm of high frequency of occurrence to cause flooding. This is largely local and is as a result of runoff from almost one hundred percent impermeable areas having very short times of concentration. The soils are dense silty laterites and the roofs of dwelling of high density development are corrugated iron.

Similarly, some small local depressions, particularly in the high density area do experience flood water of some depth for long period after the storm has passed. Severe cases of channel and read edge erosion are also evident throughout the town for the purpose of this project. The following erosion and flooding majorly affected areas were identified.

The area as shown in the picture below is situated along new constructed road that enters through Mypa Junction. In this area, a well design channel was constructed by the government through Julius Beger during the Kure administration but due to the careless and unconcerned attitude of the residents of the area, the people now use the channel as a place for dumping refuse and solid materials and this is causing the damage of the drainage system and also polluting the area which is harmful and hazardous to the health and life of the inhabitants of the area.

Also lack of refuse dumping site is contributing to the dumping of refuse in the channels show below.

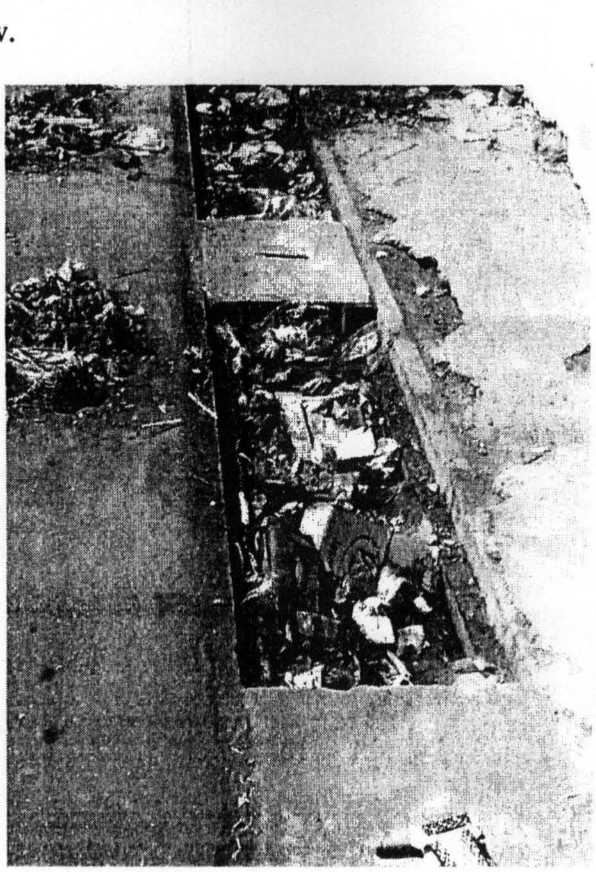

Plate. 4.1: Showing filled Drainage system along mypa road

Due to lack of adequate maintenance of the drainage system at the back of Emir's House in Bosso, the drainage channel curvet constructed for easy passage of people have collapsed. This drainage channel was constructed half way longtime age and since the government does not show concern for the maintenance of the curvet, the system is weak and can no longer carry load that is to be passed on it. Also lack of maintenance culture of the people by dumping refuse an solid materials on the drainage pathway, laid to the overflow of the drainage channel which eventually collapsed during the September 2009 flood in the area, exposing passer by and inhabitants to a high danger.

Plate 4.2. Showing a collapse Drainage system at back of Emir's house

In this area, located along Angwambiri, in Bosso. The drainage in the picture has been full with solid materials which block the drainage and as a result block the channel. These obstruct the free movement of water through the drainage. The blockage of the drainage by the solid materials and growing grasses eventually results to overflowing of the channel and the house situated close to the drainage got submerged in the flooding water resulting to the collapse of the fence (wall).

Plate 4.3. Showing a collapse fence at Angwanbiri

The picture below show an open well sited close to an unconstructed drainage path. The drainage path is filled with refuse waste, human and animal excreta and grass. Also waste water from nearby house runs into the drainage path because this drainage is not well constructed and cleaned up, the waste or dirty water in the drainage will end up percolating into the nearby open well which then contaminates the water inside the well that is being used by the inhabitants of the area. This contaminated water when used is very hazardous and dangerous to the health of the people around that uses this water. There by exposing the public or inhabitants to different diseases and illness.

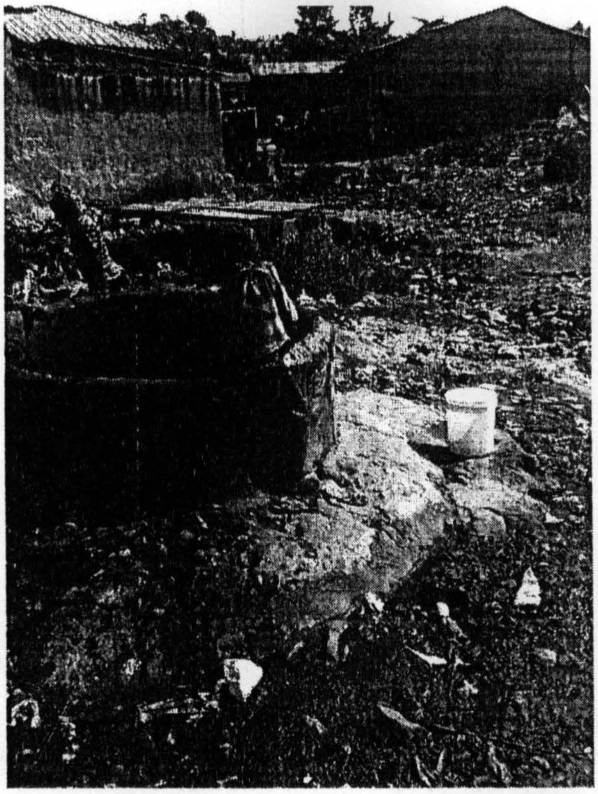

Plate 4.4. Drainage system close to an open well in Angwanbiri

Erosion and flood is a very dangerous occurrence that threatens the life and properties of the people living nearby in a community. The picture below shows the condition of the uncompleted erosion along Mypa Bridge. It also shows the wide and speedily spread of this erosion along the area. During the August, September flooding, due to the fact that the drainage path is not constructed. The erosion ends up spreading wider and causing the collapse of many houses and properties around the Mypa road.

Plate 4.5. Showing an erosion site along mypa bridge

The picture below is of a location along Newyork, Elwaziri Road in Bosso. It is an abandoned drainage and the residents of the area now dump refuse and solid materials inside the drainage. Also the drainage is been covered by grasses. All these therefore lead to the high rat of erosion spread along the path and it threatens the lives and properties a house around.

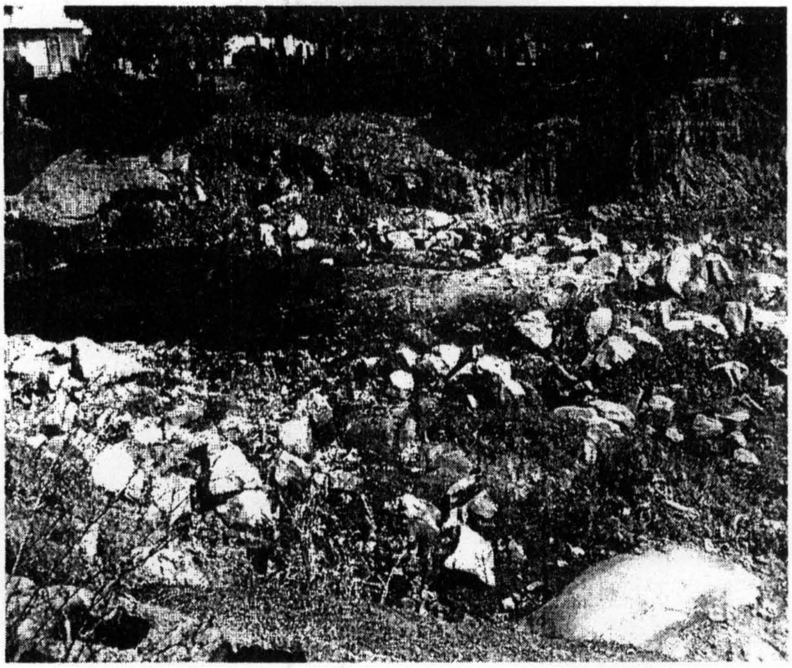

Plate 4.6. Showing an erosion site along El-waziri (New York)

Lastly, it was noted that most houses in Minna were constructed without plans or provision for drainage system. This is due to the fact that most houses were not inspected by the appropriate authorities before building them. Also the rate of indiscriminate and unplanned building in the community is high. Since these houses have no planed drainage from unset, the waste water and sewage waste are been allowed to flow along the streets and thereby contaminating the streets and making it unpleasant for living. Above all, exposing the inhabitants to high risk of different illness which is too hazardous to the health of the inhabitants?

4.1. Effect of Rainfall

Minna has a mean annual rainfall of 1228.1mm taken from a record of 10 years. The highest mean monthly rainfall is 273.1mm in September and the lowest of 1.3mm is in November. The rainy season starts April and ends in October.

For the purpose of analyzing the effects of precipitation in the catchments area in respect to erosion and floods, the mean montly rainfall of the months of July, August and September over a period of 10 years (1999 – 2009) was used. These are presented in form of barchart below.

The barchart graph shows that the mean rainfall depth for the month of July 2007 apart from that of July 2008.

Similarly, the mean rainfall depth for the month of August 2009 is also the highest rainfall depth recorded for that month over the ten years period under analysis. The nearest recorded rainfall depth to that of August 2009 was also observed in August 2006.

In the case of September, the highest mean rainfall depth over the period of analysis was recorded in September 2006. Following this is that of September 2007 with the remaining years recording values lower than that of two years of 2006 and 2007.

Generally, it can be deduced that the rainfall basically influenced the disastrous erosion and floods problems experienced since 2006 to 2009 over the town in that year. Since on the average, 2009 recorded the highest mean rainfall depth for the month of August followed by 2006 and 2007 for September and August respectively for the ten year period under analysis.

It is therefore accepted that the flood and erosion problems experienced since 2006 to 2009 were in response to the precipitation over the town. Moreover, the drainage system on the ground is not adequate and could not accommodate the attendant runoff experienced. All these factors made the impact of erosion and flood most felt during this period.

4.2. Refuse Dumping Sites

Almost all the streets that comprises of Minna Bosso area have no refuse disposal site except few places e.g. Bosso Market which has one which is inadequate. As a result of absence of refuse disposal sites, the residences of this area use the drainage system as alternative to dumping site. This attitude results to the blockage of the drainage system which in many cases prevent the free flow of water through the drainage and which finally causes flooding.

4.3. Drainage Maintenance

The residents of Minna (Bosso area) have poor drainage maintenance culture, and this is one of the reasons coupled with inadequate drainage system that make the area prone to flooding almost annually. They dump refuse and other solid materials in drainage system but they never care to clean the drainage. In fact drainage maintenance should be a collective effort of the government and inhabitants of the area in order to reduce the problem of flood in the area.

4.4. **Rainfall Data**

Mean monthly rainfall for Minna for ten (10) years from 1999 – 2009 were obtained and the total average over the period were used.

Table 4.1: Mean Annual Rainfall Data for Minna (1999 – 2009)

Month/Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1999											0.00	0.00
2000	0.3	0.00	0.00	3.6	135.9	161.0	208.8	308.5	303.0	153.4	0.00	0.00
2001	0.0	0.00	0.00	93.9	139.0	331.7	244.6	230.2	298.8	25.7	0.00	0.00
2002	0.00	0.00	5.7	98.88	42.6	201.0	143.2	226.5	260.6	180.3	0.3	0.00
2003	0.00	5.7	0.00	17.4	114.6	203.0	123.0	191.6	188.2	192.4	2.3	0.00
2004	0.00	0.00	0.00	32.2	151.9	194.9	210.3	211.4	241.5	77.6	0.00	0.00
2005	0.00	0.00	0.00	49.1	87.0	207.0	294.2	127.8	216.6	94.8	0.00	0.00
2006	11.2	0.00	TR	29.9	195.0	107.7	229.7	317.1	360.5	172.1	0.00	0.00
2007	0.00	0.00	0.4	73.1	156.6	123.6	314.0	310.1	330.2	11.51	0.00	0.00
2008	0.00	0.00	0.00	40.2	146.8	132.7	305.1	244.3	258.9	141.2	0.00	0.00
2009	0.00	0.00	0.00	42.8	101.4	108.9	246.8	497.6	273.5	85.2		

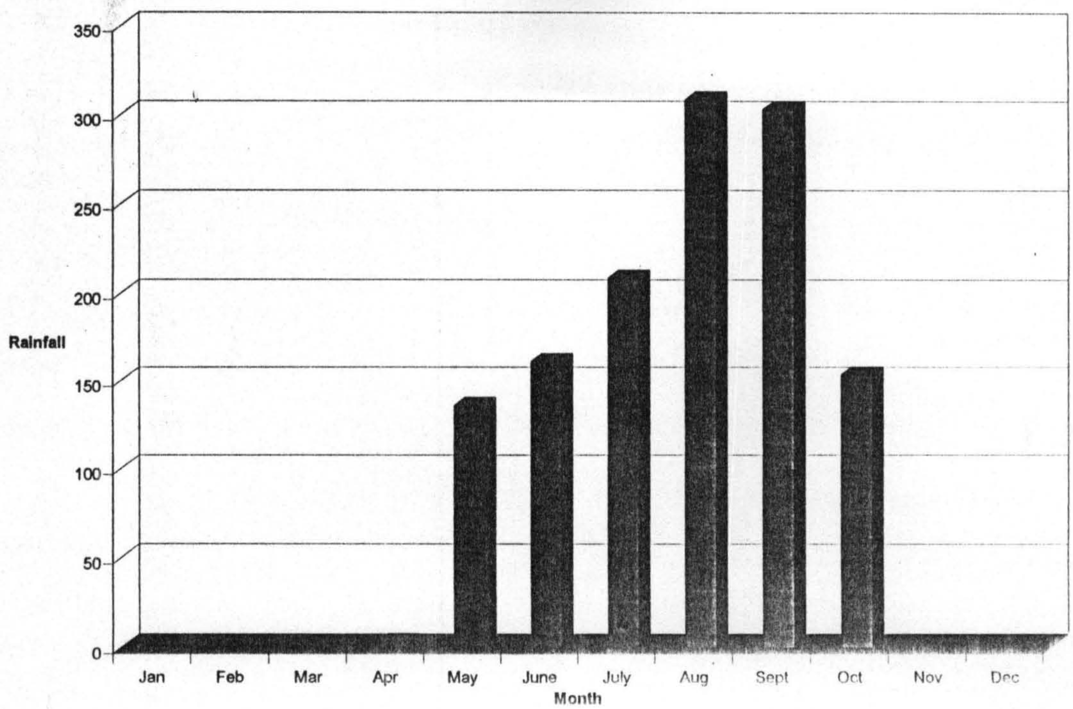

Fig. 4.2: Chart Showing the Rainfall data of Minna for the Year 2000

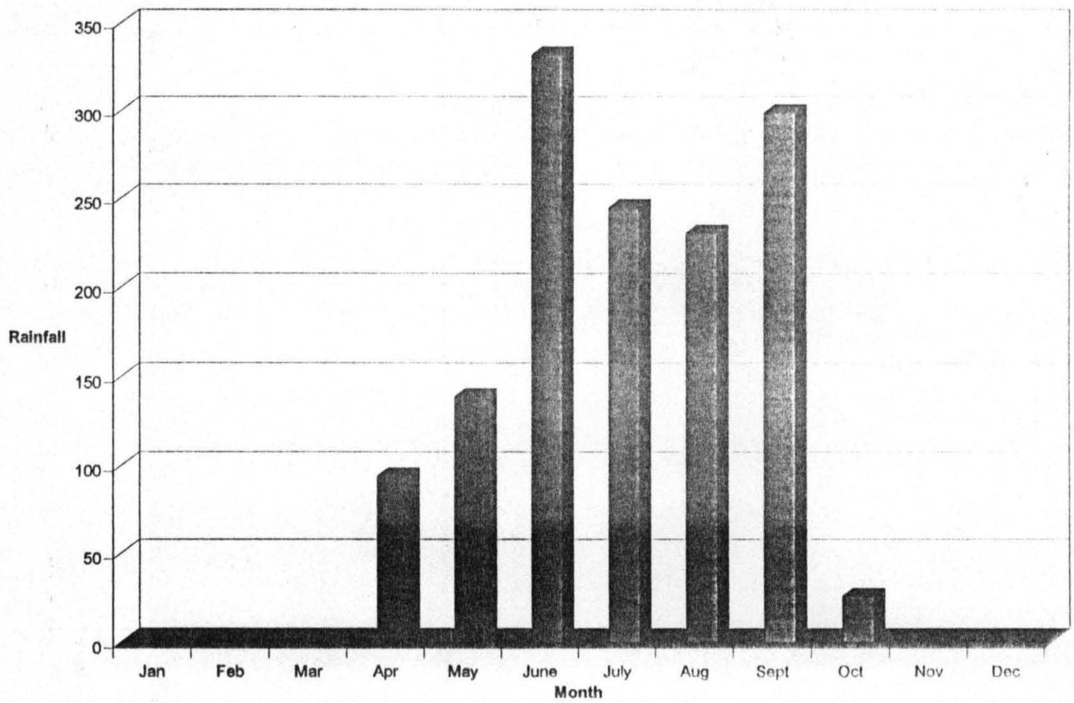

Fig. 4.3: Chart Showing the Rainfall data of Minna for the Year 2001

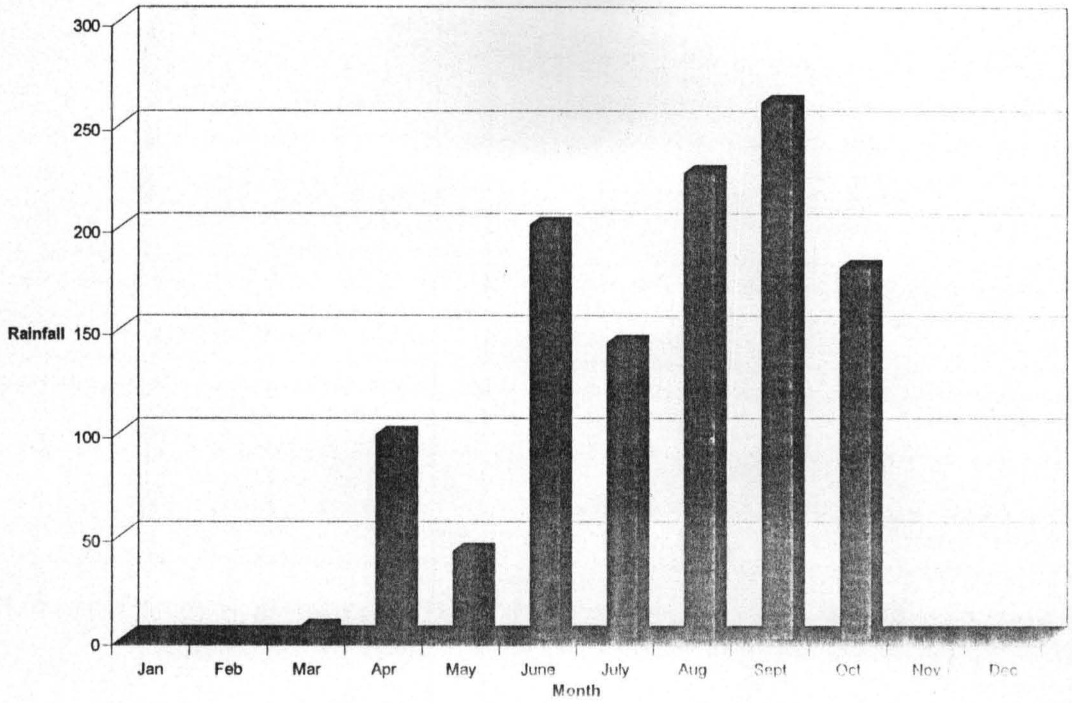

Fig. 4.4: Chart Showing the Rainfall data of Minna for the Year 2002

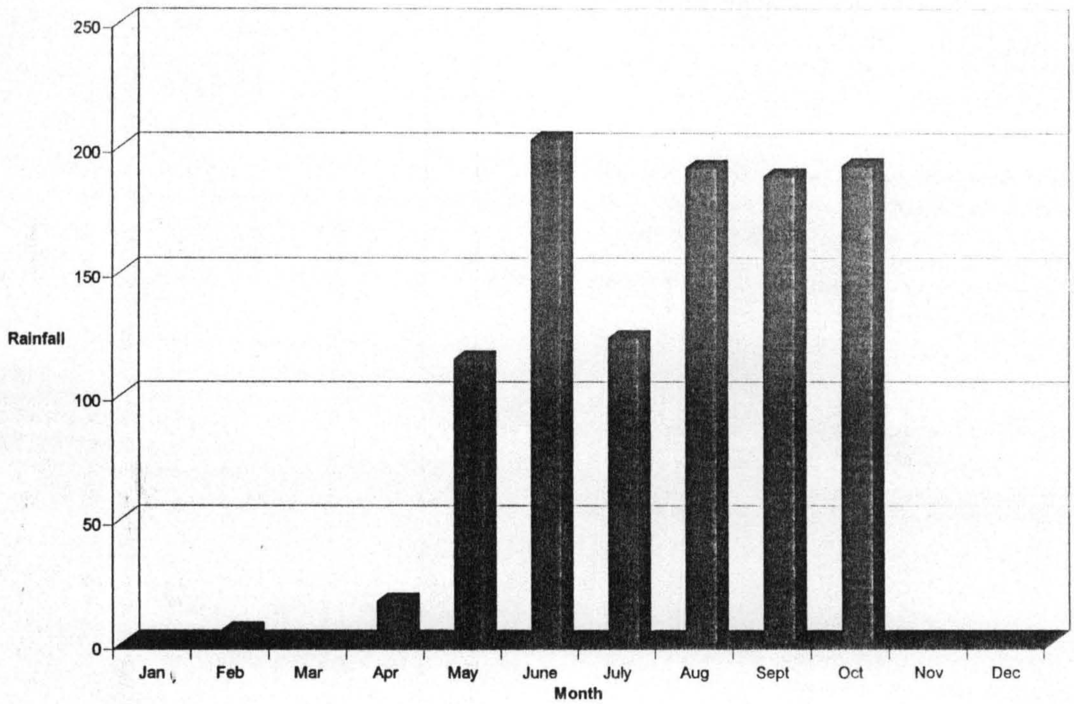

Fig. 4.5: Chart Showing the Rainfall data of Minna for the Year 2003

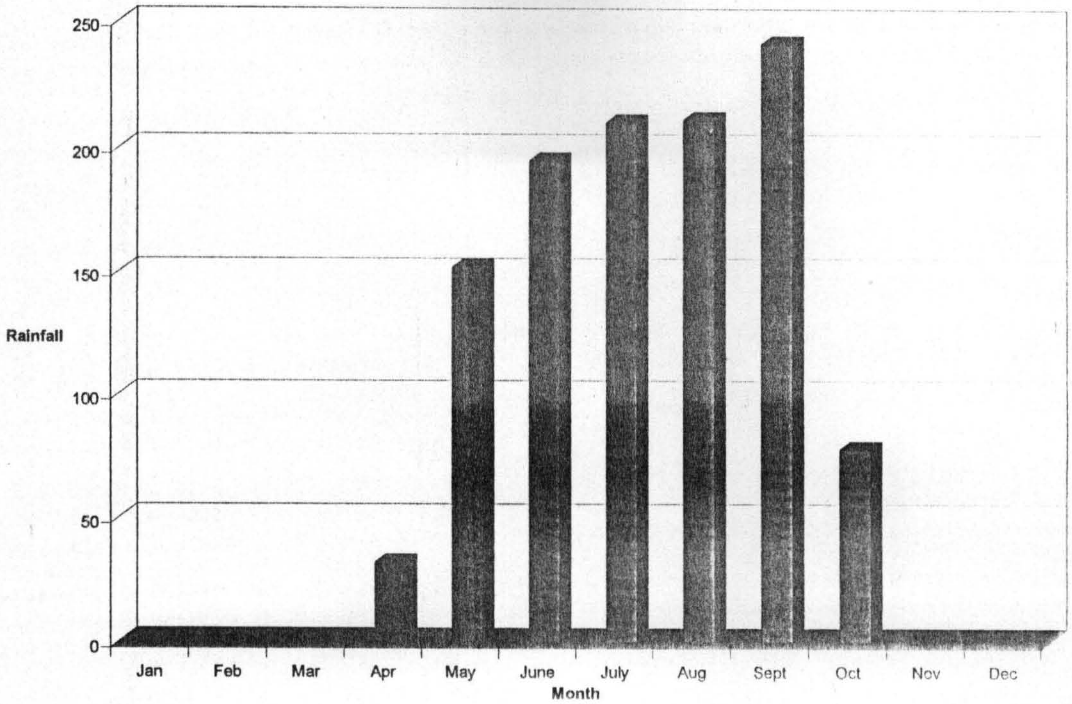

Fig. 4.6: Chart Showing the Rainfall data of Minna for the Year 2004

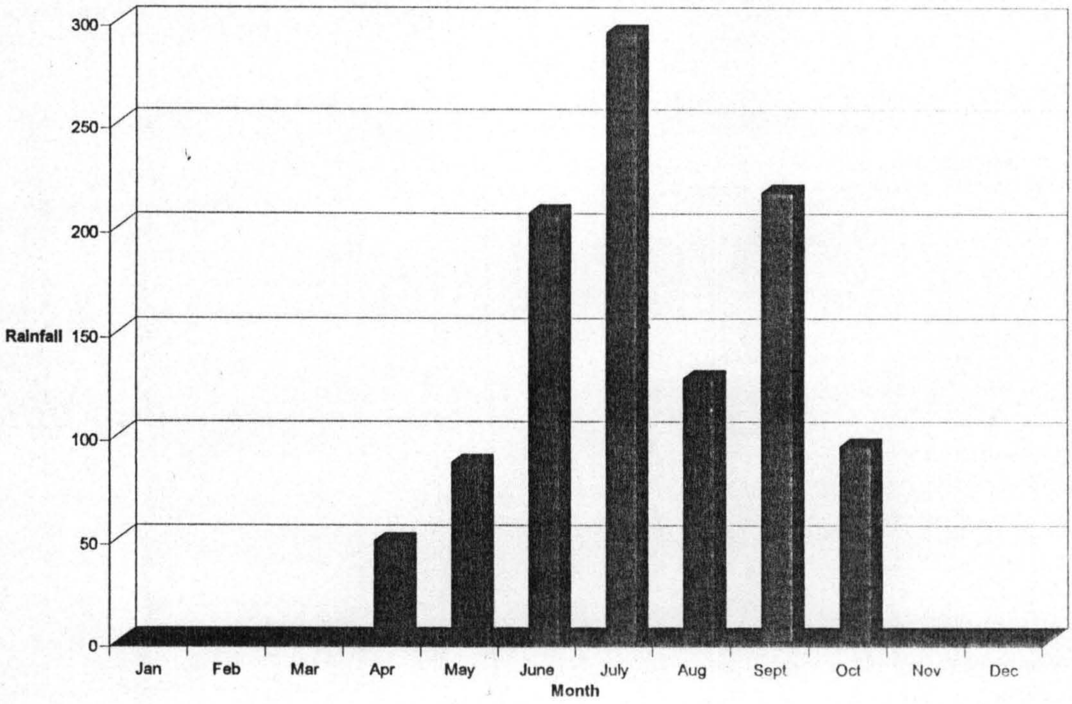

Fig. 4.7: Chart Showing the Rainfall data of Minna for the Year 2005

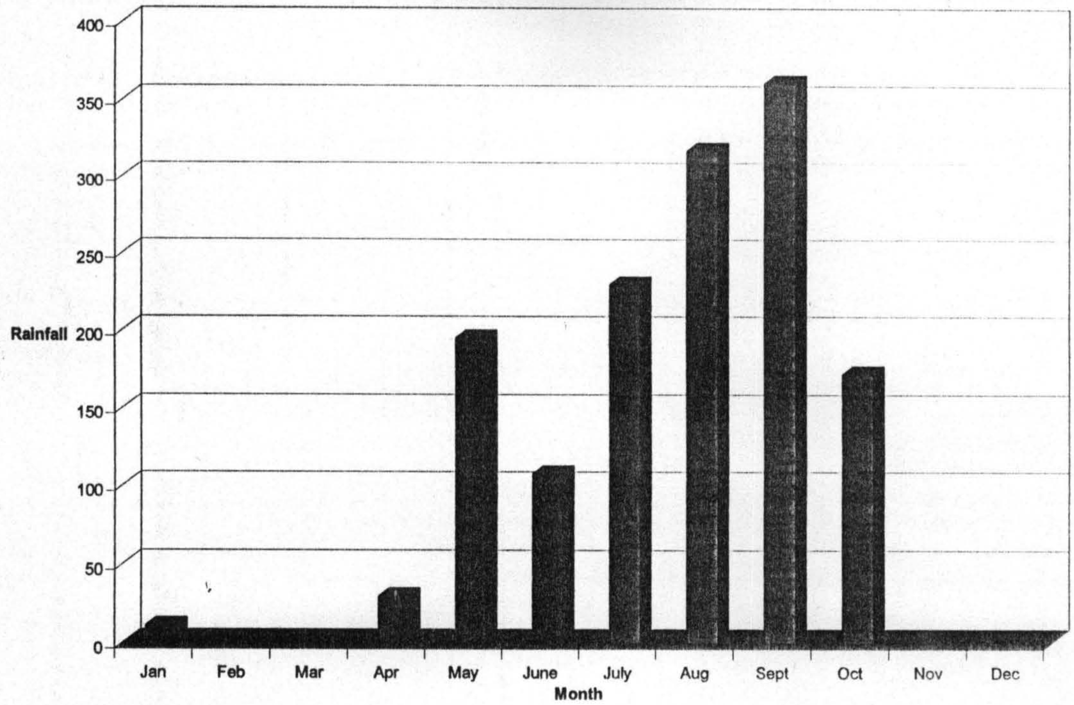

Fig. 4.8: Chart Showing the Rainfall data of Minna for the Year 2006

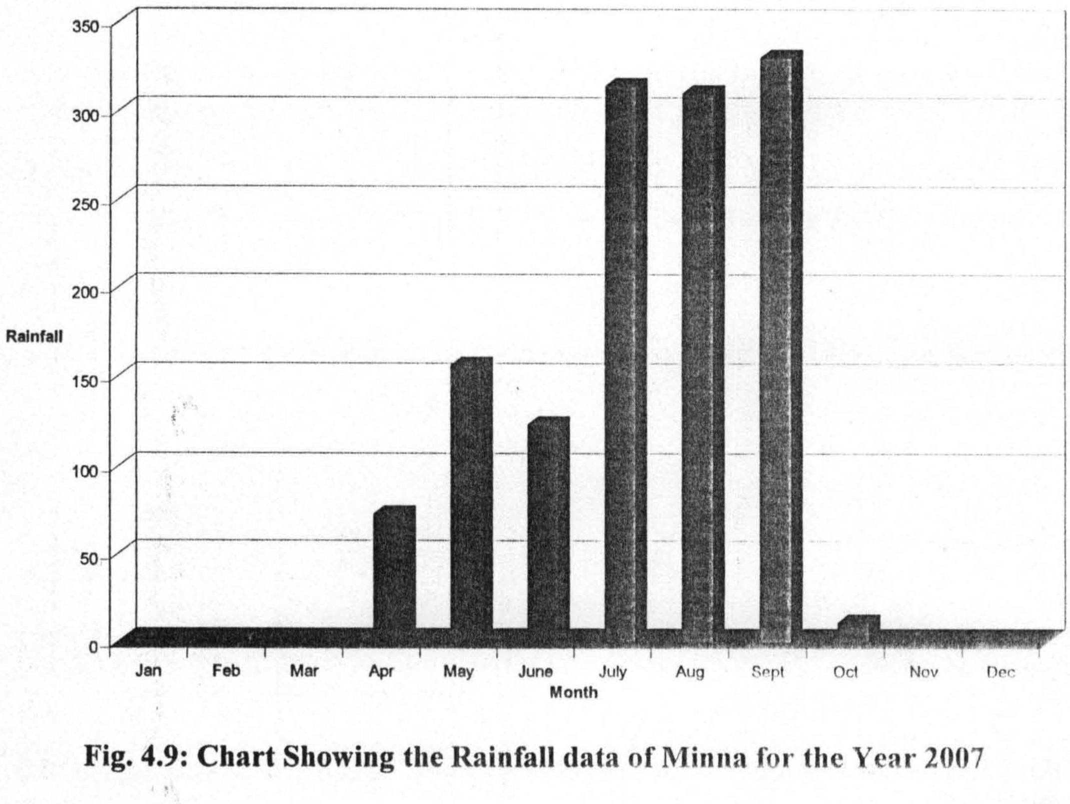

Fig. 4.9: Chart Showing the Rainfall data of Minna for the Year 2007

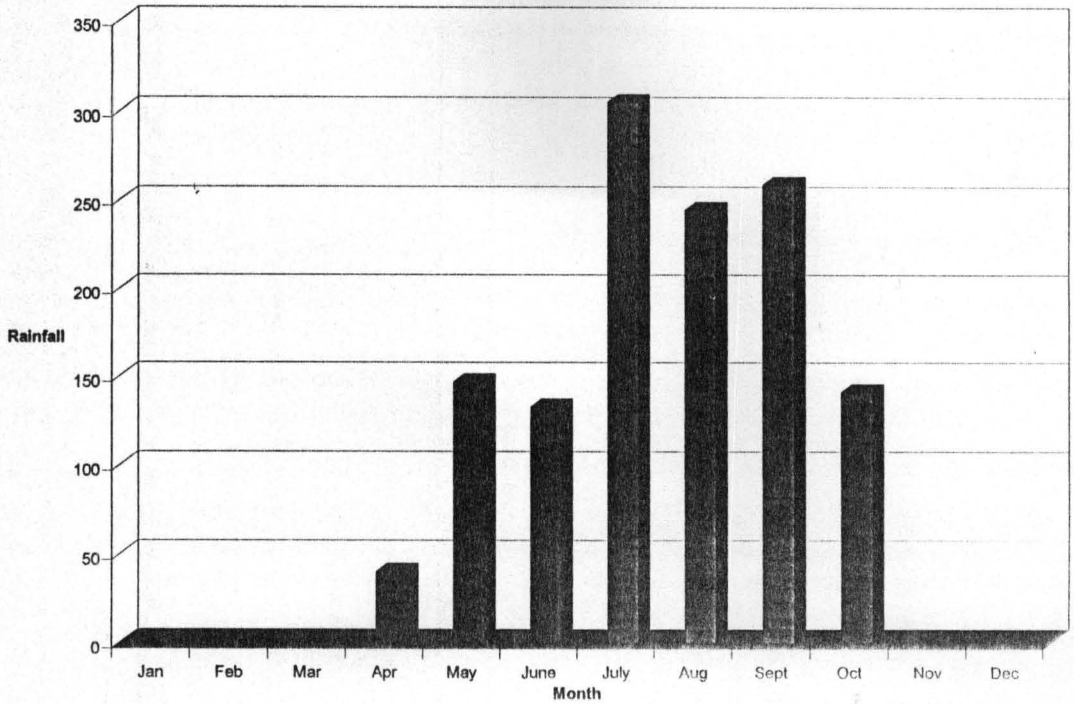

Fig. 4.10: Chart Showing the Rainfall data of Minna for the Year 2008

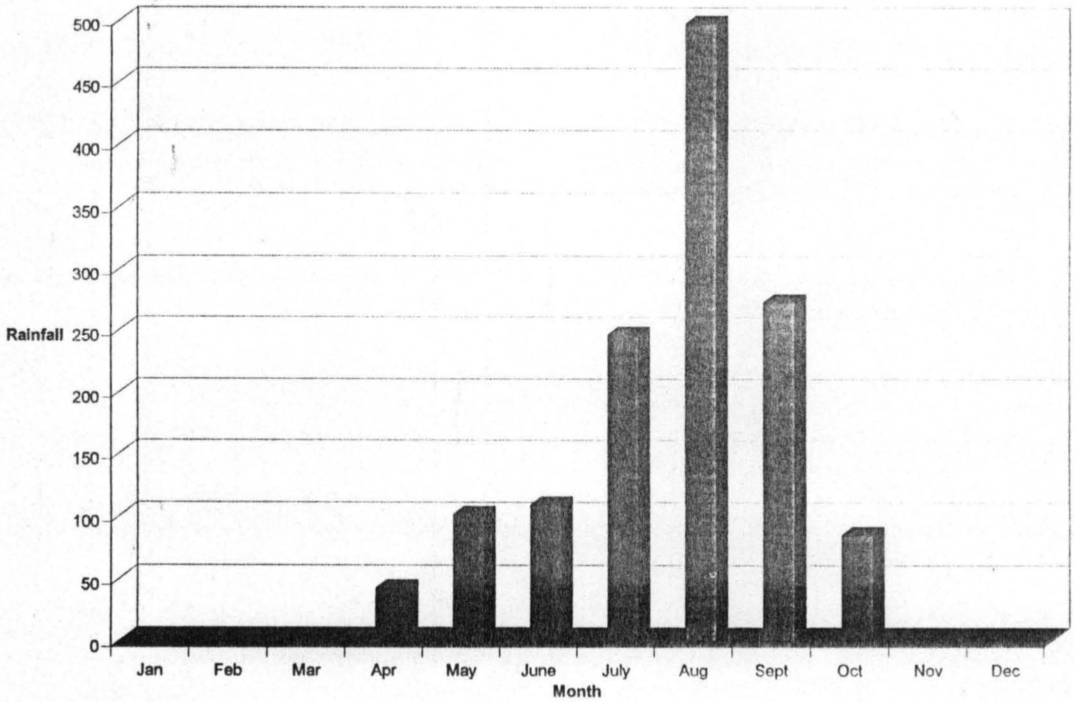

Fig. 4.11: Chart Showing the Rainfall data of Minna for the Year 2009

4.5. Rainfall Intensity Data

The highest rainfall amount from each month and its duration is recorded. The rainfall intensity is calculated and the maximum is used.

Table 4.2. Rainfall Intensity Computation (1999 – 2009)

Year	Max Rainfall (mm)	Duration (hrs)	Intensity = Rainfall Amount/duration (mm/hr)
1999	88.6	4.80	18.5
2000	48.5	3.05	15.9
2001	67.7	6.07	11.2
2002	95.6	5.34	17.9
2003	53.5	4.31	12.4
2004	107.0	6.12	17.5
2005	73.9	4.75	15.6
2006	77.8	3.50	22.2
2007	94.5	1.17	80.8
2008	84.2	5.20	33.5
2009	109.8	3.50	31.3

Source: Metrological Department Minna Airport

CHAPTER FIVE

5.0. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

From the study and work carried out, it can be concluded that drainage system in Minna will soon be rendered useless if the inhabitants of the area continue with the indiscriminate dumping of refuse and other solid materials in the drainage system. The inhabitants of the area have virtually turned the drainage into a refuse dump site, which the government constructed to keep the town and area clean and free of water logs.

All drainages are prone to blockage. Silt, sand and weeds are washed into and deposited in the drains. Refuse frequently end up in open drains because of the absence of refuse dumps and collection sites. Most of this drainage channels are filled up with sand and sediment deposit by inhabitants or eroded materials by wind or rain. The problem of flood in this area is due to the inadequacy of the drainage facilities and above all lack of drainage maintenance.

The drainage must be adequate in size and capacity and relatively gentle slope is required to direct the flow away from the area since development expansions is rapidly taking place in this area. With proper refuse dumping sites, adequate systems, the inhabitants of this environment will have a direction for the disposal or refuse and sewage from their houses, thereby reducing the problem of flood that occurs as a result of drainage blockage.

From the rainfall data in the result, it is seen that there have been a lot of rainfall between the months of July, August and September since 2006 – 2009 as the development results into flood in the area.

5.2. **Recommendations**

The analyzed data indicated mean monthly rainfall for the months of July, August and September to be on the high side, while the drainage systems to handle the runoff are grossly inadequate, with few existing ones in a deplorable state.

Similarly, the poor sanitary culture of the people is a source of concern. However because of all these and many more, the following are recommended.

i. The government should commence massive construction of drainage systems throughout the town to avoid further destruction of properties by erosion and floods.

ii. The governments through the media should commence enlightenment programmes on the adverse effects of dumping refuse in the drainage system.

iii. Government should make provision of designated refuse possible and as near as possible to areas expected to use it.

iv. Health and sanitary officers should go around every street at least once in a month to ensure that residents and inhabitants comply and adhere sickly on the laws on effective uses and management of drainage and refuse disposal. And also enlighten the inhabitants on the health hazards of the indiscriminate dumping of refuse.

v. Proper discharge of runoff from side drainage system of rehabilitated roads should be done by linking up this drainage system to the nearest water-course of river to forestall further destruction of the built-up areas in the high density development.

vi. On the high depression topographical areas, proper stone pitching slope or construction of gabions to maintain the slope should be done to avoid further degradation of the slope and washing away of land areas down stream of the slope.

vii. The Land survey department of Ministries of Works, Housing, Land and Survey and Niger State Urban Development Board should ensure that every body abides strictly by the state or city development plan. They should ensure that construction of any type is not carried out or allowed on drain paths, and where such exist should be removed.

viii. The action of the people by prohibiting demolition of certain structures because of cultural believe, even while these structure impedes adequate runoff control should be discouraged through proper enlightenment of adver5se effects of erosion and floods.

ix. Erection of structures on runoff courses should henceforth be prohibited by government.

x. Clearing of already silted drainage system should be done without further delay.

xi. Adequate protection of drainage system against siltation should henceforth be put in place.

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