URBAN EROSION CONTROL AS PANACEA FOR ENVIRONMENTAL DEGRADATION

A CASE STUDY OF FEDERAL GOVERNMENT OF NIGERIA – SULEJA TOWNSHIP EROSION CONTROL PROJECT

SUBMITTED BY

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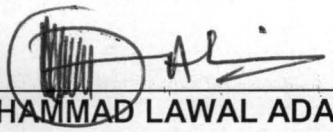
DECLARATION

This thesis entitled Urban Erosion Control a Panacea for environmental degradation, a case study of Federal Government Suleja Township Erosion Control Project, was written to the best of my ability, in partial fulfillment of the requirement for the award of Post – Graduate Diploma in Environmental Management of the Federal University of Technology, Minna.



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CERTIFICATION

I, certify that I have read, supervised and accepted the project written and submitted by MUHAMMAD LAWAL ADAMU, PGD/GEO/2003/2004/296 in partial fulfillment of the requirements for the award of Post Graduate Diploma in Environmental Management of the Federal University of Technology, Minna; its approved for it's contribution to scientific knowledge and literary presentation.

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To my parents, my family (wife and children), Lecturers and all lovers of truth.

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ABSTRACT

The control and management of physical environment is of natural and global phenomenon today.

Soil erosion is one of the environmental issues in an express of stress on the soil mass, which has colossal effect in man and his environment.

The urban erosion control measure through physical protection and management strategies is the focal point and goal of the study. The factor of urban erosion control as a solace to the ever-going environmental degradation of our major cities is matter of great study.

The study has been divided into five chapters. Chapter one discussed the introduction of the topic – a brief historical background and physical state of the study area.

A wider discussion of the topic termed literature review was in Chapter two. This dealt with overview of the general consequences of soil erosion and development strategies in Nigeria.

Chapter three is the beginning of the actual assessment of the project activities. Two steps were reconnaissance and questionnaire survey. Data both from primary and secondary sources respectively were gathered. This process is referred to as Methodology.

The next progressing work is the organisation and presentation of data extracted in a more comprehensive form for purpose of establishment of result. This process is referred to as data analysis under chapter four.

The concluding part of this thesis is in chapter five. A recommendation resulting from analyses were highlighted and the general conclusion completing the work was carefully articulated.

TABLE OF CONTENTS

LIST OF PLATES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 Background Study

Erosion and flood control has been an integral part and policy of the federal government urban and rural development programmed.

Section 5.3 of the National policy on the Environment states that to achieve effective management of urban, river and coastal flooding and stabilize gully and coastal erosion sites and enforce management practices aimed at preventing / minimizing the incidence of erosion various strategies would be required for the control of flooding these includes: -

(a) Enforcing compliance with planning / urban laws / edict.

(b) Building embankments and levies along rivers and coastlines prone to flood.

(c) Ensuring appropriate management of functional urban drainage channels.

(d) Enforcing environmental sanitation land in town and cities, the project are therefore some of the means achieving and management of soil and coastal erosion in Nigeria.

In the past substantial properties and some times lives are most annually due to soil erosion and flood. For example the historic Ogunpa flood disaster in Oyo State and most recent the Gombe town and emit ions flood disaster in Gombe State. This un-quantifiable loss affect individual, homes, communities, and country at large. In addition, factors of Rural – urban drift, urbanization, human activities and other negative tendencies, reduced our cities to a mere slum.

The plight of urban communities, which includes environmental problems ''' and flood disaster became equally significant, hence the need for the

establishment of, Ministry for the Environment Federal / State Environmental Protection Agency (FEPA/SEPA), Federal and State Urban Development Control Agency (FUDA/SUDA), Directorate of Food, Roads and Rural Development Infrastructure (DFRRI) and River Basin Development Authorities.

Suleja town has been experiencing flood and soil erosion hazard annually. It's in this context the "SULEJA EROSION CONTROL PROJECT". The project involves the construction of about 15km distance concrete drainages along the mainstream and waterways of Suleja township. Secondly there was the township Road network construction project, supported with concrete drainages, so as to ease conveyance of water to the main stream.

This study is therefore intended to appraise the Federal government effort in erosion and flood control in Suleja town as an urban setting and how far it has gone in finding solution to environmental degradation of the area.

1.2 Statement of Problems

The major problem of Suleja erosion control cannot be dissociated from the initial physical environmental problems of the area.

The effect of gully erosion and flood has been identified as the major natural disaster of the area. The gullies that exists in Suleja widens down stream as a result of increased volume of run-off and the non-provision of drainage structures to transport the storm water which collect into these natural channels to their out falls. The situation further worsened by erection of buildings and waterways there by hindering its free flow. Some major road network streets had been gradually eroded by erosion creating several pothole. Drainages are similarly blocked creating new waterways into houses and street subjecting the foundation of building to danger and collapse as result of the impediment of the flow of the

will over flow with excessive velocity of high scouring potential. This has contributed largely to the scouring of the channel beds and banks and consequent under wining of foundation of structures close to the channel.

1.3 Aims and Objectives

The aims of this study are to examine the problems, prospect, and progress of the SULEJA TOWNSHIP EROSION CONTROL PROJECT.

Objective:

In order to achieve the aim of the study, the following objective would be implied.

(a) To examine the role of urban and soil erosion control project and it's effects to physical development of Suleja town.

(b) To ascertain the physical, social and economic advantages of the project.

(c) To examine the Federal Government policy on urban erosion control as a means of justification for environmental protection strategy. And to proffer further solution to the problem of gully erosion and flood menace in Suleja and Niger State in general.

1.4 Scopes and Limitation

The scope of the study will be limited to urban erosion control project in Suleja town. How the federal government ecological project became solution to the ever-growing environmental degradation of Suleja town.

1.5 Study Area

Suleja town has 4 districts out of the 11 district of Suleja Local Government Area of Niger State.

Due to its location and typical of Nigeria society, Suleja is made up of

capital territory Abuja, there is no tribe in Nigeria that is not represented or staying in Suleja. The predominant tribe includes: Hausa, Gwari, Igbos, Koros; and Yorubas.

Suleja town is now attaining position of center for commercial activities more than any town in Niger State. The origin of the town is traced to Zagi – Zagi of the present day Zaria. Abuja kingdom is an off-shoot of the old Zazzau, was both in nature and character a replication of some Zazzau stock called Zage – Zagi with their leadership who called their old capital Zaria at the closing years of jihad were in 1807.

The first ruler of Abuja now Suleja is Abubakar Ja (light skinned Abubakar) from 1825 – 1851, then Abubakar (1851 – 1877), the 3rd is Muhammed Ibrahim Yalai (1988 – 1902), Mamman Gani (1902 – 1917), while the fifth is Musa Angulu, the 6th is Sulaiman Barau (1944 – 1979), the 7th Ibrahim Dodo Musa (1979 – 1993) the present Emir Alh. Muhammed Auwal Ibrahim was appointed in 1993 as the 8th Emir of Suleja.

The flight from Zaira, took place after a battle between them and their old friends the Fulani, off around Hukuyi, in the present day Kaduna State. Both the ruling class and their countries and others ran out, not for fear of any subjugation and obligation but to save what was remnant of their values and lives to fight another day and this come in 1892 at the "Rafin Ruwa battle".

This flight took the Zage-Zagi and their ruler through aura, to Kajuru Kagarko, in Kaduna State and down to Zuba in the present FCT, Jiwa, Pai, Gulu, Lapia, Lambata, back to the now called Suleja.

1.6 **Niger State at National Setting**

Niger State is one of the 36 States of the Federal Republic of Nigeria. It

Niger State is made up of undulation lowland of average height of 2,737 square km above sea level. Niger State is flanked by six of the 36 (thirty six) States including Abuja, Federal Capital Territory, Kwara, Kebbi, Sokoto, Kaduna are bounded to the northwest. Kwara bound it to the South; to the Northeast is Abuja FCT. It has twenty-five (25) local government areas, viz: Suleja, Shiroro, Rijau, Mashegu, Lapai, Agaie, Katcha, Bida, Edati, Mokwa, Agwara, Kontagora, Rafi, Mariga, Chanchaga, Munya, Tafa, Lavun, Bosso, Wushishi, Gbako and Paikoro.

The state is located almost at center of the country between latitude 5^0 and 9^0 North, and longitude 7^0 and 25^0 East and occupies an area of about 82 625km^2.

Niger state being in lower part of the country, is the geographical and hydrographical center of Nigeria forming central water dived from the descent in a series of steps of the wide Niger through. The area is dated by rock and also broken by V –Shape river valleys. It's a host to 3 major hydro electrical power stations viz, Kainji, Shiroro and Jebba, hence called the "power state".

1.7. Locations and Geographical Setting of Suleja

Suleja town in Suleja Local Government Area of Niger State is situated on the South East of Minna, the state capital with a road distance of 104km from Minna. The area within the study / catchments area of the project is located on latitude 9^0 10` 42` North of the equator and longitude 7^0 10` 46`` East of Greenwich line.

Traditional farmers and predominantly trader habit the town. Suleja town being satellite town to the Federal Capital is densely populated with the attendant problems of excessive waste generated as result of population

The road-net work had been 75% renovated, double tarred, with good drainage. The remaining 25% is dilapidated to a very bad state of disrepair.

1.8 Topography

Suleja being lower part of the state is the geographical center of Nigeria, farming a central water divine. From an elevation of about 1,500 to 1,800m. Niger descent is a series of step to the wide Niger trough. The North lowlands, forming a continuous plain about 100km wide, which gradually slopes from foot of Niger escarpment.

North of the Southern lowland is an area of transition only part of its plains, the northern half of a number of different landscape, its northern most section is broken country of 840m, narrow valleys. At the foot of these hills lies the Abuja plain evaluation 350 – 500m. The south half belongs to the Niger plain. It is generally higher in the east and has step slopes toward river.

Its outstanding features are rivers, valley and hills surrounding Suleja, which represent the southern most outline of the Niger. Famous hill is the "Zuma rock" along Abuja – Suleja – Kaduna Road. Suleja is situated 15km from Gurara River, which forms the extension of the river Kaduna in the North.

1.9 Geology

There is no actual detailed geographical map covering Suleja region available but the geological main structure of the North Kwara and Kogi State, valley show that Suleja town is an assembling to basement complex. Metamorphic rocks, granite and basalt of two or more ages, the crystalline rock surface drop in steep step to the northern part of the basement complex covered by shallow soil and number of inserbergs of outline of grantic.

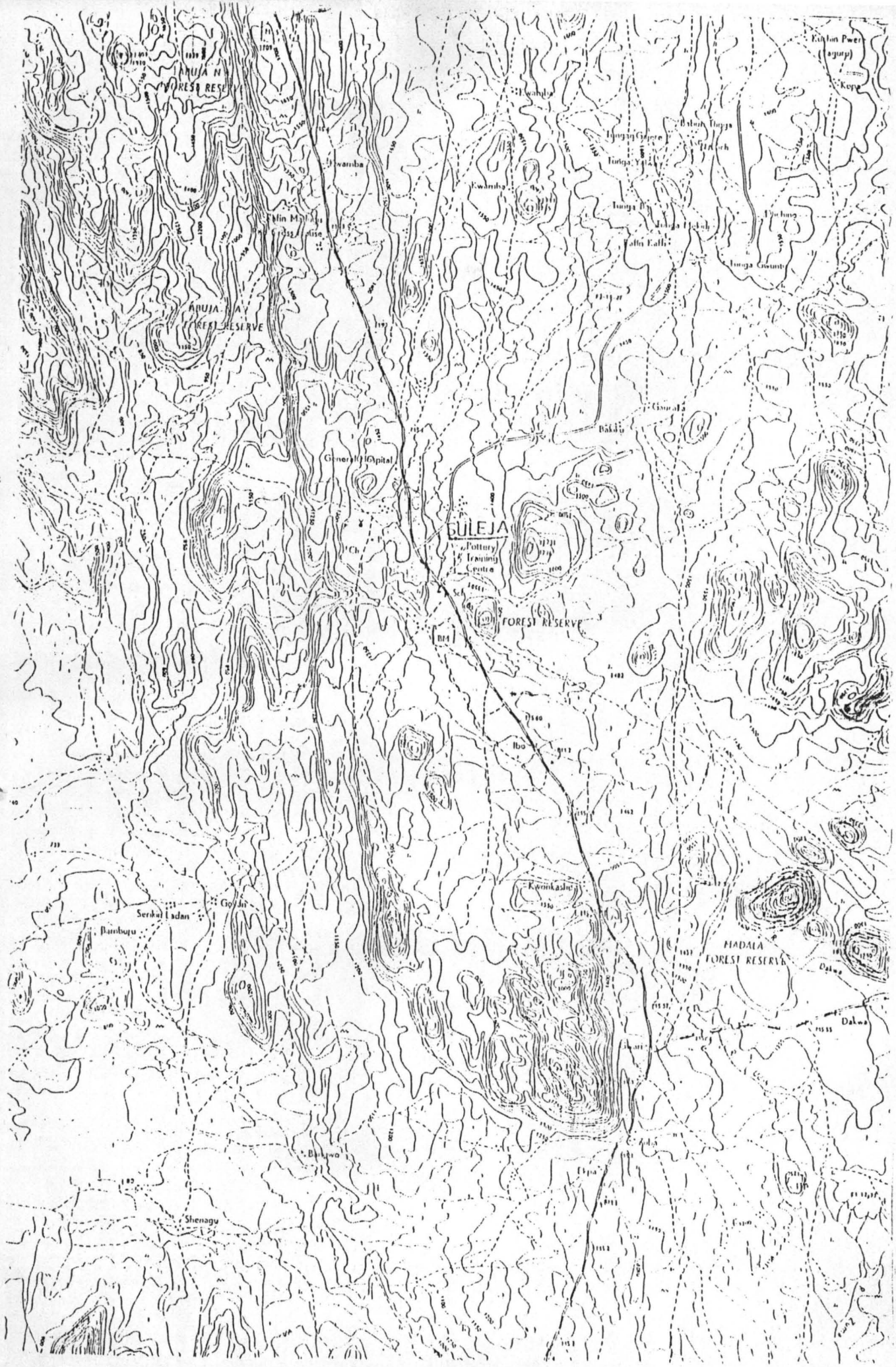

Figure 1.1: Topographic Location of Suleja Township and its Environments

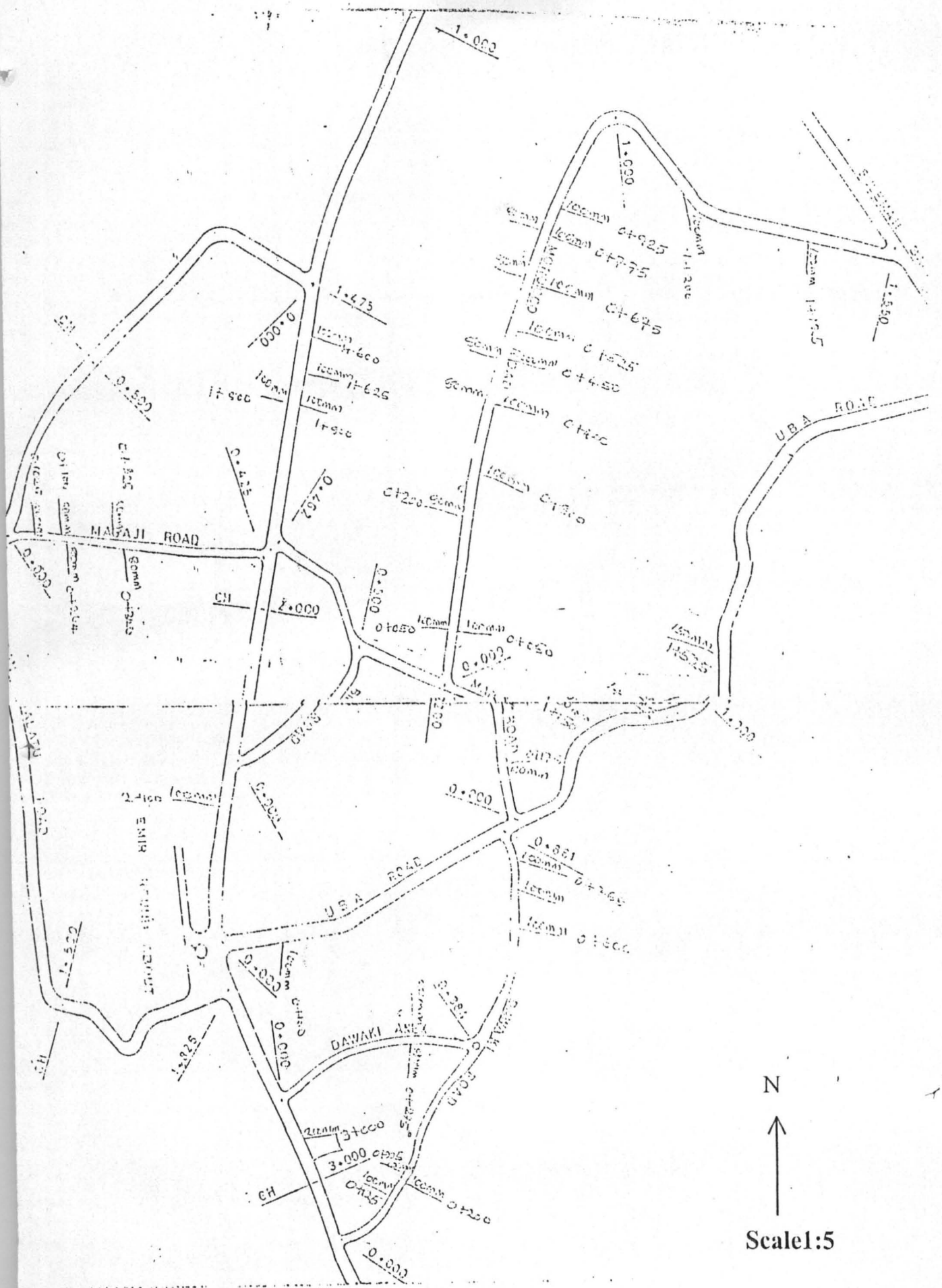

Fig.1.2: Suleja Township Road Network newly renovated tarred and with concrete drainages.

The over burden is derive from the crystalline of grantic rock and a laterisation has taken place, soil type is generally impervious of water, and it's harder by exposure to surface.

1.10 Temperature

The highest temperature always tends to occur at the end of the dry season close to the spring equinox. Thus March has the highest temperature – sources, master plain for Suleja 1985.

The lowest monthly main temperature of the year occurs in the middle of the rain season, when daily minimal temperature is low.

1.11 Rainfall

Rainfall is the primary factor for considering in the study erosion and flood problems. The run-off of a given study area is dependent on the rainfall intensity all other factor remaining the same. Reports have shown that the surrounding hills the town; especially areas close to the natural waterways, which have developed deep gullies.

1.12 Definition of Basic Concept

Definition of important concepts and terminologist used in this project has been briefly explained in this section.

a. **Soil Erosion**: This is the removal of layers of the soil profile by natural forces directly by wind and rainwater.

b. **Erosion**: This is the reduction of a land by mechanical and chemical weathering of land and rocks. The natural agents of erosion are wind, waves, ice, and running water. This agent transports the eroded materials and deposited elsewhere.

c. **Soil Structure**: This is an important characteristic of soil, which relates to the way soil particles candidate into bigger process help together by one colloid. It determines and influences the rate at which eater is absorbed.

d. **Rain Wash**: This is the movement of looses uncomplicated materials down slope by torrential rainfall.

CHAPTER TWO

LITERATURE REVIEW

2.1 Principles of Soil Erosion

Generally soil has the physical basis for the socio-economic activities of man including agriculture. This is an important environmental factor because its fertility and other properties determine to some level numerous agricultural products in the world and to some level as certain the population distribution. These qualities of soil to man results into abuse of the soil. This abuse results into soil erosion and flood.

Adeleke and Roang (1981) defined soil erosion "the active wearing away of the earth surface by moving agents like running water, wind, ice and waves. Soil erosion is rampart where the surface of the soil is exposed by either deforestation or otherwise of the surface of the land"

"For instance the Roman Colony throughout their empire needed wood to heat their bath and the more matters needed large quantities of charcoal, since coal was not then in use. The action of Roman colonies was responsible for deforestation of Mediterranean lands" (Strahler and Strahler, 1988).

Taken a global perspective, soil erosion is the general removal of the topmost layers of the land surface, which store plant nutrients. In some situation of soil erosion, bare rocks are exposed as result of complete removal of the soil of the topmost part. Soil erosion menace is a natural disaster that has taken great toll of destruction in many parts of the world. The problem of Suleja is one of such menace in Nigeria.

This is a disastrous from the environmental degradation. The menace is greater when the rate of soil erosion exposes the underlying rocks. Whatever the factors and forces may have been and in what order and intensity they

acted, prolonged destruction of the plant cover by human agencies lead to severe soil erosion. There are many causes of soil erosion but major form of its is the man indeed, this leads to environmental degradation in many parts of the world especially in, China, the Mediterranean region and African countries like Nigeria.

However, the extent of soil erosion depends on the degree of the contributing factors.

2.2 **Factors Contributing to Soil Erosion**

There are many factors that contribute or determine the occurrence and severity of urban soil erosion. These factors can be classified as natural and indirect factors. The natural factors are group under the physical factors while the indirect factors are under human and animal factors. They are as follows:

2.3 **Natural Factors**

Among the natural factors responsible for soil erosion are, soil texture, vegetational cover, rainfall, nature of terrain etc.

Soil Texture: Soil texture is the determining factor to the extent of erosion. Soft and porous soil is easily washed-off by run-off unlike consolidated soils and rocks.

Rainfall: The intensity of rainfall in a given area determines the rate of run-off and absorption of rainwater. Areas characterized by torrential rainfall experience high rate of run-off which if un-channeled devastates the physical environment by removing the soil surface through the aid of other physical factors such as topography, soil etc.

Nature of Terrain: The topography of an area determines the speed of run-off in the area undulating terrain accelerates run off unlike flat terrain. However,

the rate of erosion on any terrain is determined by nature of the prevailing rocks and soil texture of the area. For instance, Enugu state is gentle but the nature of the soil is responsible for high rate of erosion in the area, while Suleja slope is steep but the nature of the rocks present in the area reduces the erosion effects on earth surface in the area.

Vegetal cover: In most of the areas vegetational cover determines the extent of protections of the soil surface in the area. those areas with sparse vegetation are more prone to erosion because the soil surface is directly exposed to the agents of erosion such as wind and rainfall.

2.4 **Human and Animal factors**

Human factors: Human activities such as intensive construction, poor cultivation habits wrong location of footpaths, indiscriminate destruction of vegetal cover and intensive development expose the soil surface to erosion hazards or weaker the compactness of the soil as in the case of vibration, thereby making it liable to erosion menace.

The high rise of population density within a scope of decade made Suleja town vulnerable to erosion and flood. There are indiscriminate construction activities such as roads and built up environment reduces the total area for absorbing rainfall thus runoff serfs in.

Indiscriminate waste disposal also influences soil erosion by blocking waterways and causing unchained run-off. The situation is larger aggravated when the drainage system are poorly maintained coupled with absence and poor drainage system which enhances run-off which in turn results in flooding and erosion.

Animal factor: The role of Animals in influencing erosion in an urban area

significant. Animal factors which influences erosion is overgrazing. The deforestation of the Mediterranean land by the Roman colonies exposed the grasses and moody shrubs of the Mediterranean hand to sheep and goats which sum to have been the principle machines of destruction aided and abated by their herders.

Annual burning of the shrubs cover which is carried out to encourage the growth of succulent new vegetation was the factor in destroying forests in Spain to graze merino sheep (Shalter and Strahler, 1988) whatever the factors and forces may have been and in what order and intensity they acted prolonged destruction of the plant cover by human agencies led to severely soil erosion.

2.5 **Various Forms of Soil Erosion**

The severity of soil erosion is responsible for its types. However, there are various types of soil erosion. The major types include Gully Erosion, Rill Erosion and Sheet Erosion and the minor types include Splash and Leaching.

Gully Erosion: Buchaman (1974) defines gully erosion as the type of erosion, which arises from intensive run off following a heavy leach of disintegrated material leaving deep channels in the land. In West Africa, gully is experienced, Agulu (Nigeria), Varongo District (Ghana) and along the road linking Bobo Dioulosso with Onagadougon in Upper Volta.

However, gullies seldom achieve depths of 15m but may be widened and deepened during rainstorms.

Rill Erosion: Goh (1981) describes rill erosion as the type of erosion in which top soil is removed down small parallel channel. By this, the exposed sub soil may then be dried out and cracks appear on the surface. These cracks provided small channels down which rain water may be channeled to initiate

Sheet Erosion: This is the process by which even shells of the top soil is removed down slop. This is major type of erosion, which is common on the earth's surface.

Splash Erosion: This is the type of erosion, which moves sand particles from its potion to another as a result of weight of rain droplets.

Leaching Erosion: This is the type of erosion, which transports the nutrients in the soil from the upper layer to lower depths. By this process, the soil particles are not removed but the nutrient is the one that is affected.

However, these types of soil erosion are developed from the actions of the agents of soil erosion.

2.5.1 **Soil Erosion and its Agents**

The chief agents of soil erosion are running water, wind, ice (glacier) underground water etc. These agents of soil erosion are responsible for the various types of soil erosion experienced in the world over.

2.5.2 **The Role of Running Water**

This is the most important of the erosion agents. This agent could be in form of rainwater run-off or river water, as the rainwater runs-off, its action is corrosive on the soil surface. This agent works prominently on the areas where the rainwater is not channeled.

The river is as well a powerful agent because by its action of corrosion, abrasion, it depends the river-bed and widens the river banks. There are factors, which influence water erosion. This is shown in figure 2.1.

2.5.3 **The Role of Wind**

Soil erosion induced by wind action is more prevalent in the desert and dry lands. It works in the form of sheet erosion covering wide areas. Its action is mainly through abrasion and deflation that normally results from the blowing away of the top soil, which is characterised as dry, loose, sandy and bane vegetation.

The factors that encourage this agent are:

1. Lack of binding materials (clay/humus) in the surface soil.
2. Lack of rainfall.
3. Rapid rate of evaporation (which dries up the top soil).
4. The presence of level surface and absence of wind breaks.
5. High velocity of winds.
6. Smallness of the size of soil particles.

This agent is responsible for the land forms in the desert e.g. gour in the Sahara, Yardangs in the interior deserts of Central Asia, Mesas and Butes of Eastern Mauritania, etc. It is also responsible for landform of wind depositions in desert. For instance, the sand dunes and brackens of Sahara and West Australian deserts.

2.5.4 **The Role of Moving Ice**

Moving Ice otherwise known as placation is the most powerful of the erosion agents though not very common like running water agent. Glaciations generally give rise to erosional feature on the low lands.

Through these processes are not mutually exclusive because a glacier plays a combined role of erosion transportation and deposition through its course. Its action is by plucking and abrasion. The effect of this agent is

experienced in Switzerland. However, the action of ice as an agent of denudation is not common in tropical countries like Nigeria.

2.5.5 **The Role of Underground Water**

Under the ground at depth, which varies with circumstances, ground water is usually found. This level is called the water table. Underground water plays role in land sculpturing in two important ways:

1. By feeding rivers from springs, it helps to maintain the flow of those rivers and so assists normal river erosion.
2. By work on the rocks below the surface, it is directly responsible for certain features on the surface.

2.6 **The Process of Soil Erosion**

Soil erosion undergoes three stages, which are as follows: early stage, middle/ youth stage and old stage.

2.6.1 **First Stage**

At this stage, individuals do not take notice of the erosion activities because the erosion is very mild and the action is vertical. That is, the nutrients of the soil are pushed downwards and where horizontal process occurs, it is not well noticed because (lie top soil is gently removed (sheet erosion).

Attention is not given at this stage because the erosion activities have not proved itself a problem to the environment. From this stage, further stages develop, which might attract attention depending on its location.

2.6.2 **Middle stage**

This is the stage at which the presence of solid erosion noticed. At this stage, roots of grasses are exposed, movement of the rain run-off is noticed and

given to the activities of the erosion until the old stage is approaching or has fully set in.

2.6.3 **Old Stage**

At this stage the soil erosion has become a menace. The rule produced has grown into deep gullies; the form lands become heavily affected culvert and bridges are removed, drainage system are covered with eroded materials and run off concentrates in particular spots (flooding developed) causing environmental hazards.

At this stage, individuals become aware of the menace but control measure are more difficult and much fund will be required in the control and prevention for further damage.

All these stages constitute environmental problems and prone difficulties to physical development if not controlled.

2.7 **Consequences of Soil Erosion**

Soil erosion as a universal phenomenon has effects, which are either positive or negative. Through most positive effects of soil erosion has a major negative effect on environment but the fact that they attract some positive interest, they could be said to be positive effects.

2.7.1 **Positive Consequences of the soil**

Among the positive effect of soil erosion activities are the emergence of spring water, tourism centre, provision of sand for construction purpose increase fertility of the soil etc.

i. *Tourism Centre*: Areas affected by soil form some of the major tourism centre of the world, example of these are the badlands of

Dakota in USA, Batu caves in Kuala Lumpur, Carls Bad cave in New Mexico, U.S.A ad Postujua caves in Yugoslavia.

ii. *Spring Water*: Spring water, which develops as a result of soil erosion feeds streams and rivers thereby increasing water volume for human usage.

iii. *Provision of Sand*: Sand which is used for construction purposes are as a result of soil erosion. For example beaches of seas and rivers suppliers sand and gravel are by products of erosion of the shorelines.

iv. *Increased Soil Fertility*: The fine dust blown beyond the desert limits is deposited on neighbouring lands as loess is found in Northern China in the loess Plateau of the Hwang Ho basin (Goh 1981).

2.7.2 **Negative Consequences of Soil Erosion**

Soil erosion is the same age with the world but it rates increase as population and development of the world increases. As a matter of fact, men have made several efforts in the control of soil erosion which if not, may be the whole world could have been washed into sea by now. Among the various measure employed in the control soil erosion in the world are re –establishment of a vegetation cover and conservation of the vegetation and also reclamation of the topsoil.

2.8 **Diversification and Nature Of Soil Erosion In Nigeria.**

Nigeria is a country with four distinct vegetation belts. These vegetation belts are influenced by different climates. The humidity in the southern and eastern parts of the country decreases as one goes towards the North. As a result of this, the agent responsible for soil erosion in the country varies.

In the North – East, e.g. parts of Borno State, wind is the chief agent of erosion so also is parts of Sokoto and Kano areas. Though results of running water erosion is most time very devastating in these areas, for instance the gullies of Eastern Highland of Adamawa States and Sokoto basin.

Agent responsible for soil erosion in the Southern and Eastern parts of Nigeria is running water which is as a result, torrential down pours in these areas coupled with the topography, soil and man activities this is shown on figure 2.2 unlike the middle belts and Northern Nigeria, the Eastern and Southern Nigeria experiences high rainfall. Thus gullies are the major types of erosion experienced in the Eastern Nigeria while rills and or sheet erosion is experienced in every corner of Nigerian environment.

2.9 **Measures used in Controlling Soil Erosion**

Soil erosion is the same age with the world but it rates increase as population and development of the world increases. As a matter of fact, men have made several efforts in the control of soil erosion which if not, may be the whole world could have been washed into sea by not. Among the various measures employed in the control soil erosion in the world are re-establishment of a vegetation cover and conservation of the vegetation and also reclamation of the topsoil. This measure suffers the problem of instability by platens because soil is impoverished or absent.

In addition, sudden rainstorms may result in the vegetation being washed away before it has had a chance to fix the soil with its roots. In Niger State of Nigeria, where there is problem of gully erosion, vegetation such as cashew plants has been planted in affected and susceptible areas to check and prevent its occurrence.

2.10 Government Policy Issues as it Affect Soil Erosion in Nigeria

Environmental issues and problem are by their very nature complex. The ramification and title urgency that then demand are such that they are or should be the concern of all individuals and all levels of government. This is because environmental threats often are not limited only to one community or region. Rather, they affect the whole regions and in many cases the entire earth.

Therefore, there is need to reach agreement on common concerns and actions at both the national and international levels. Though environmental protection and conservation, which define a different relationship with nature and natural forces are often not in harmony with progress and economic growth as perceived by governments. The government policy on soil erosion is embodies in the national development plans.

2.11 First and Second National Development Plan: 1962 – 68 and 1970 - 74

These plans contained serious inadequacies with regard to planning for sustainable development. Environmental issue's "wore" not given any detailed separate analysis or treatment in (their own right). The policy on soil erosion emerged as essentially welfare and social services issues, as by products of planning for agriculture, forestry deficiencies in the provision of water prevention of soil erosion, overgrazing etc, they were often couched in purely welfarist public health or economic development.

2.12. The Third National Development Plan: 1975 - 80

The plan confronted environment issues in its discussion of irrigation, soil conservation, anti drought measures and the importance of land use surveys. Further discussions focused on the problem of forest resources, under which programmes of forest plantation development, forest regeneration and

protection. Forestry were enumerated, protective forestry emerged specifically as a conservation issue as the physical environment in the arid zone by planting trees on farmlands in village and along public highways as shelter belts.

2.13 The Fourth National Development Plan: 1981 - 85

In this plan, there was a return to the position in the second plan; which put most of the environmental and regional development issues under the social sector.

However, in advance on the third plan was that environmental planning and protection received independent attention as a plan item in the context of, which examined development issues within the framework.

CHAPTER THREE

METHODOLOGY

Two methods of survey were generally used in the process of gathering data and in relation to the assessment of the existing facilities, utilities and services of the study Area.

These methods were both used to collect two distinct types of data namely, primary and secondary data through primary and secondary sources respectively. The whole processes were tailored towards the objectives of the study.

3.1 Reconnaisance Survey/ Method

The process of reconnaissance involved direct personnel assessment of the project infrastructures and gathering of data, which included photograph of the project areas, physical measurement and enumeration taken of some specific project structures.

The secondary data gathered under this method included, the base map and other related plan obtained of the study area which guided the assessment of the completed project structures.

3.1.2 Questionnaire Survey Method

This method of survey involved the use of prepared questions, which were in printed form and administered through personal interview of the respondents. Data collected through this method included, communities perceptions on structures in terms of its value, quality of work executed, adequacy and gains of the project.

CHAPTER FOUR

RESULTS PRESENTATION & DISCUSSION

4.1 Physical Characteristics

4.1.2 General

The project site "SULEJA TOWN" located on latitude 9^0 10`4`` North of the equator and longitude $7^0$ 10` 46`` East of the Greenwich line has its physical characteristics defined by its geographical location. The relevant physical characteristics from the point of view of the project are topography, geology and rainfall.

Some useful hydrometeorological data on the area was obtained from the meteorological department of Minna International Airport, Maikunkele and Nnamdi Azikwe International Airport Abuja. These stations were chosen because they are the closet stations to the project area.

4.2. Rainfall

Rainfall is the primary factor for consideration in the study of erosion and flood problems. The run-off of a given study area is dependent on the rainfall intensity all other factors remaining the same. Reports have shown that run-off water from the surrounding hills flood the town, especially areas close to the natural waterways, which have developed into deep gullies.

4.2.1 Landform / Land Use

The project site is made up of hills with steep slopes, which are built up resulting in high volume of our land flow. In view of the very steep nature of the hills, the time of concentration of the storm run-off is very small. This means that the raindrops, which flow down the hills with high kinetic energy, get into the

channels as soon as they drop thereby resulting in very high volume of storm, which consequently inundates the adjoining properties.

The high-energy potentials developed by the storm as they flow down the hills disintegrate the soil particles, which, is carried away by the storm water. The continued repetition of this over the years have led to the development of deep gullies which is by its resultant effect of bank failures undermines foundation of many buildings close to the gullies. This has subsequently led to collapse of many of such structures.

The Suleja town is completely built up while the surrounding hills are rocky. This situation makes the soil to be highly impermeable resulting in high overland flow during rainfall.

4.3. **Topography**

The topography of an area is defined by earth features such as hills, valleys, and rivers etc. that exist within the place. Some of these features have direct effect on the climatic condition that affect erosion and flood menace. Rainfall which is a major factor affecting erosion and flood problems is highly dependent on the topographic features.

Suleja, the project site has its topography features that affect erosion and flood and this was evident in our survey and studies. The topographic map of Suleja, which was obtained for the studies, has full detail of the topographic features of the town.

However, the engineering survey of the gully sites carried out by the project engineers on the sites include, traversing and spot leveling of the gully centre lines and banks. From the survey information to obtain includes all the necessary data / information for the hydraulic design of the engineering

The information obtained from the Topographic map of Suleja shows slopes of as high as 10.7%, which is indicative of the steep nature of the town. This feature enhances erosion and flood as a result of the high velocity with which storm water flows into the channels as soon as they drop on the ground. This possesses high energy potential, therefore eroding the channels beds and banks as it flows down through their lengths.

4.4 Hydrometeorology

4.4.1 General

Hydrometeorological factors like precipitation wind speed etc are of paramount importance in erosion study. The factors that affect erosion in any particular area depends on the other related physical characteristics. The major hydro-meteorological factor in consideration here is rainfall where hourly, daily and annual rates and intensity have been studied with a view to analysing its relationship with the resulting run-off.

Suleja falls within the Savanna (mid land) region with annual rainfall of between 1000 – 1400mm. Wet season in this region is about 5 – 6 months in length but of very high intensity.

The meandering nature of the water channels, non-provision of drainage channels and the high-energy potentials of the storm water have contributed immensely to the menace of gully erosion and flood in Suleja town. For efficient drainage system, it is necessary to estimate the quantum of run off that must be provided for hence the hydrological study of the project area.

4.2 Hydrological Survey

A survey of hydrological factors was carried out to assess their various effects on the erosion/flood problem in Suleja. Data obtained from the survey was analysed to assess how they affect the gully erosion / flood in Suleja town.

4.2.1 Data Availability and Network

The meteorological data used for this study was obtained from the Meteorological Department of the Federal Airport Authority of Nigeria at the Minna and Abuja International Airports. Data obtained from these stations are the rainfall records for periods between 10 – 20 years.

4.3 Rainfall Data Interpretation

The rainfall data collected from these stations were studied and analysed to obtain maximum and minimum rainfall for each month of the period under study. The mean rainfalls for the various months were equally obtained. A graphic interpretation of the data is shown on a histogram of mean rainfall. This shows clearly peak periods of rainfall and the span of rainy season in the area.

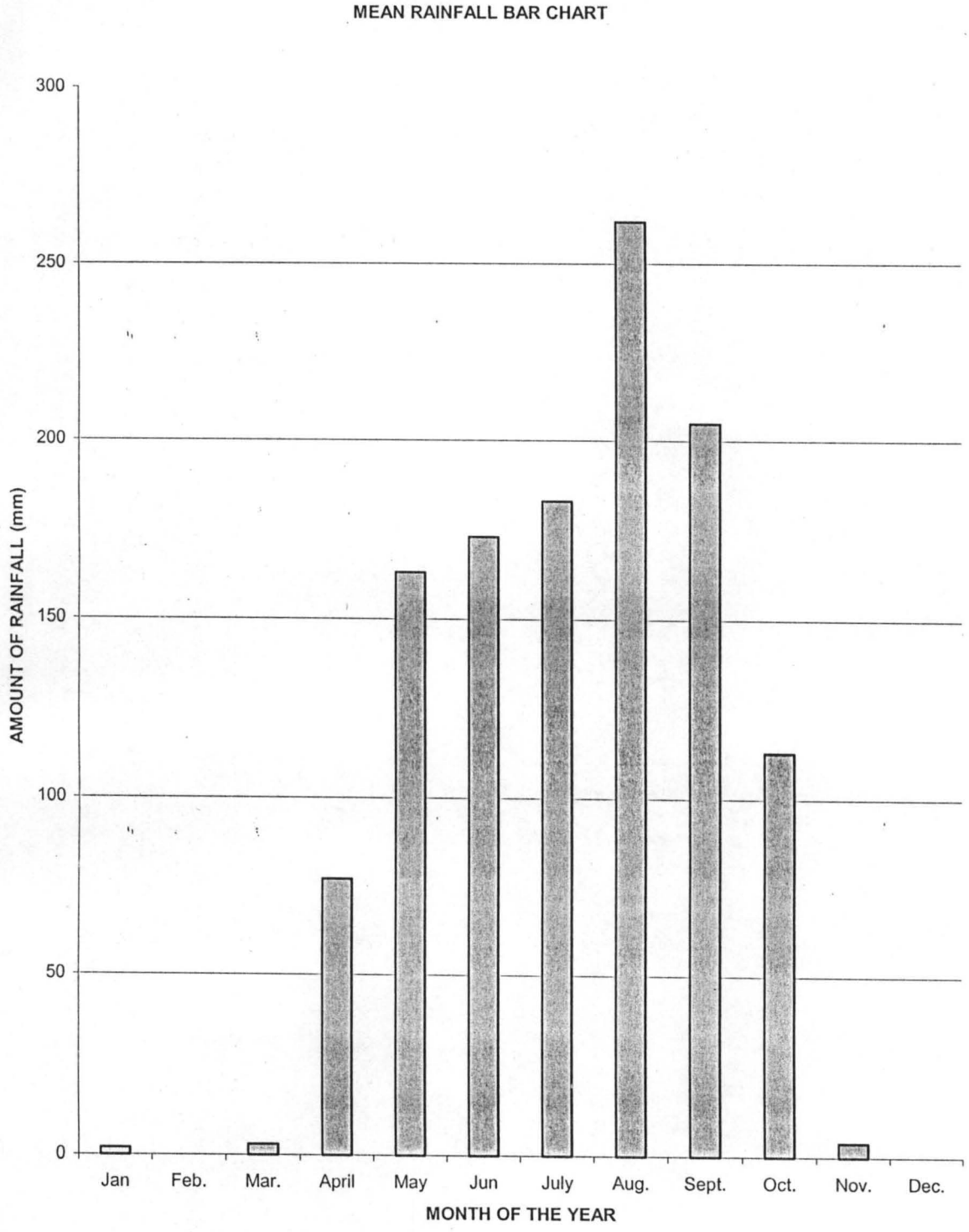

Fig. 4.1: Mean Rainfall Bar Chart for 13years
Source: Zik International Airport, Abuja.

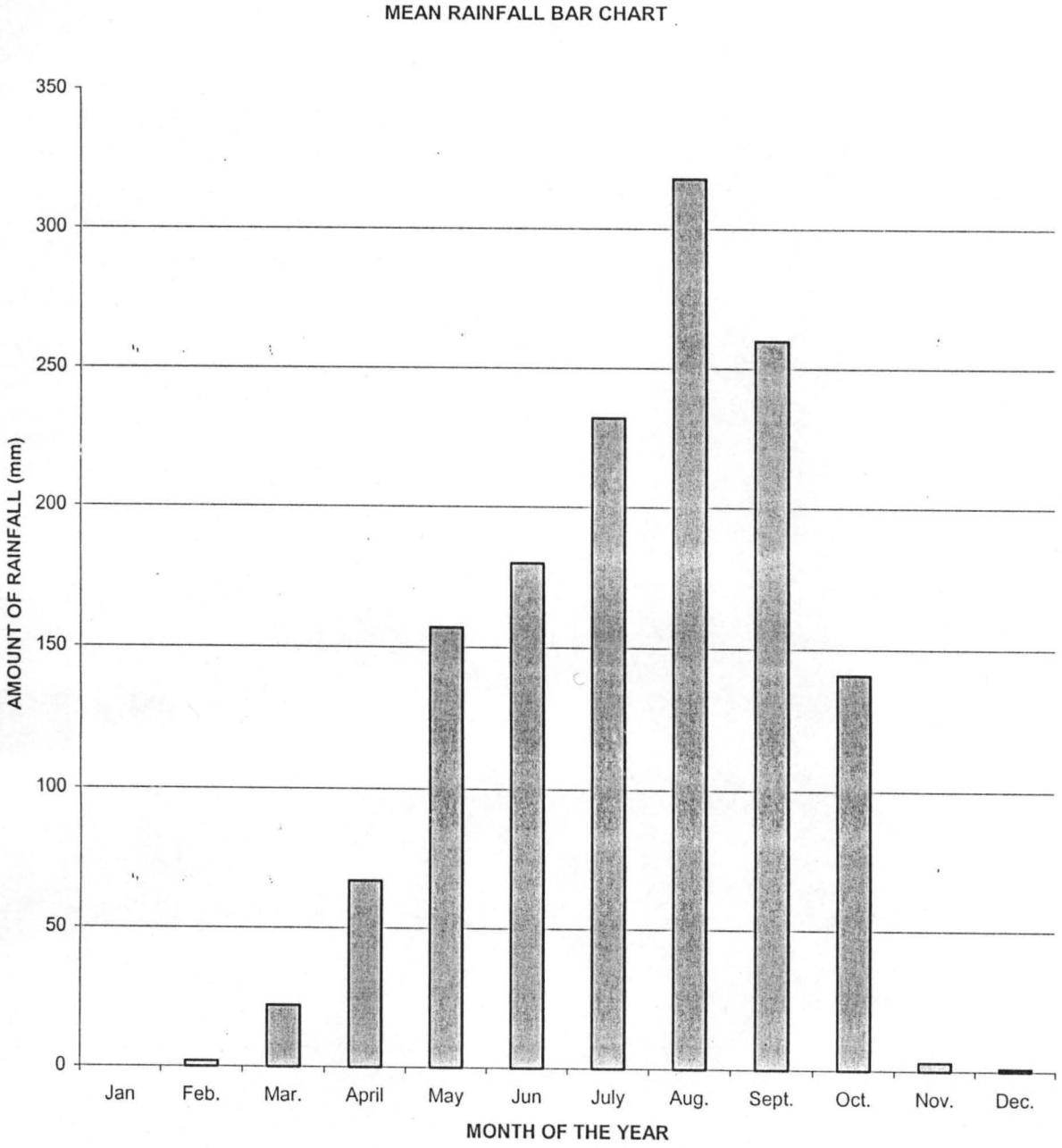

Fig4.2: Mean Rainfall Bar Chart (18years)
Source: Minna International Airport

HYDRO-METEOROLOGICAL RECORDS

DATA: RAINFALL (mm) **PERIOD: 1987 – 1999**

TOWN / VILLAGE: ZIK'S INT. AIRPORT ABUJA **STATE: FCT**

LATITUDE: _____ **LONGITUDE: _____**

	MONTH												
Year	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
1987	0.0	0.0	13.5	44.6	109.5	53.9	143.7	238.6	99.6	100	0.0	0.0	803.5
1988	10.5	0.0	0.1	57.9	94.6	135.5	175.0	309.5	352.1	36.7	0.0	0.0	1202.1
1989	0.0	0.0	7.3	98.9	215.1	250.8	158.2	206.9	179.6	85.2	0.0	0.0	1131.5
1990	0.0	0.0	0.0	107.5	199.5	79.9	178.1	181,9	187.0	191.9	0.0	0.0	1107.9
1991	0.0	0.0	0.0	114.5	336.0	180.1	192.9	918.3	190.8	32.9	0.0	0.0	1316.7
1992	0.0	0.0	1.3	158.2	176.8	162.9	196.4	231.5	230.3	96.6	31.9	0.0	1241.9
1993	0.0	0.0	0.0	0.0	174.4	170.3	189.7	171.1	198.3	63.3	0.0	0.0	1041.3
1994	0.0	0.0	7.3	72.5	119.4	239.1	142.3	967.2	161.3	208.1	0.0	0.0	1412.3
1995	0.0	0.0	0.0	100.5	123.2	144.5	153.1	909.0	187.1	135.7	23.6	0.0	1279.3
1996	0.0	0.0	0.0	48.6	164.7	226.0	259.7	257.0	191.1	127.9	0.0	0.0	1274.0
1997	0.0	0.0	3.6	80.6	238.4	233.0	172.4	192.7	203.3	115.0	6.1	0.0	1245.1
1998	0.0	0.0	0.0	92.2	121.2	221.0	155.1	293.0	201.9	212.6	0.0	0.0	1247.0
1999	0.0	7.9	0.0	35.7	102.8	164.2	293.9	295.7	237.1	212.0	0.0	0.0	1249.5
MIN	0.0	0.0	0.0	0.0	94.6	83	142.3	151.0	99.6	36.9	0.0	0.0	803.5
MAX	10.5	7.9	13.5	158.2	336.0	239.0	259.7	409.0	382.1	2003.0	37.9	0.0	1912.3
STD. DEV.	2.8	2.1	4.1	39.5	66.4	52.1	34.1	63.0	62.3	62.0	11.4	0.0	230.9

Table 4.1: Hydrological – Meteorological Rainfall Data
Source: Zik International Airport Abuja.

HYDRO-METEOROLOGICAL RECORDS

DATA: RAINFALL (mm) **PERIOD: 1983 – 2000**

TOWN / VILLAGE: MINNA INT. AIRPORT, MAIKUNKELE **STATE: FCT**

LATITUDE: _____ **LONGITUDE: _____**

	MONTH												
Year	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total*
1983	0.0	0.0	1.3	7.4	142.5	190.9	262.3	259.8	335.2	53.2	3.3	0.00	1248.9
1984	0.0	0.0	10.9	68.1	104.5	204.9	240.5	221.5	279.6	112.6	0.0	3.4	1246
1985	0.0	0.0	58.7	37.1	184.8	251.2	213.1	360.3	397.5	28.3	0.0	0.0	1531
1986	0.0	0.0	79.6	117.9	155.1	112.7	235.5	388.3	298.6	180.7	23.2	0.0	1591.6
1987	0.0	7.4	9.4	22.6	66.0	185.8	159.5	399.4	347.5	168.9	0.0	0.0	1366.5
1988	22.2	16.4	50.4	68.7	129.3	138.2	142.5	295.3	245.2	90.2	0.0	0.2	1198.
1989	0.0	0.0	53.3	50.9	153.4	401	211.0	278.2	192.2	136.0	0.0	0.0	1215.1
1990	0.0	8.0	0.0	68.1	177.2	195.0	368.3	234.0	196.3	142.6	29.9	38.5	14359
1991	0.0	0.0	41.1	100.0	226.0	251.9	192.6	381.3	137.2	184.2	0.0	0.0	1514.3
1992	0.0	0.0	9.8	104.1	132.5	207.0	164.7	273.8	348.5	171.7	15.5	0.0	1427.6
1993	0.0	0.0	37.2	40.2	151.5	238.9	290.7	325.7	224.6	134.7	27.3	0.0	1470.8
1994	0.0	0.0	0.8	90.7	176.1	199.4	170.0	554.9	310.4	149.5	0.0	0.0	1651.8
1995	0.0	0.0	26.7	58.3	118.9	114.5	221.3	117.4	1994.9	152.5	1.4	0.0	1305.9
1996	0.0	0.0	2.5	70.5	238.0	172.5	215.7	325.9	235.1	140.4	0.0	0.0	1400.6
1997	0.0	0.0	0.9	76.7	163.6	139.8	186.9	225.0	246.7	198.3	9.3	5.3	1252.5
1998	0.0	28.7	9.9	86.5	102.1	105.4	310,0	196.1	181.2	315.0	0.0	0.0	1424.9
1999	0.0	0.0	12.4	53.5	228.0	162.1	345.4	364.5	282.5	114.9	8.0	0.0	1571.3
2000	0.0	0.0	0.0	583	138.6	143.8	143.8	276.4	214.8	97.6	0.0	0.0	1184.3
MIN	0.0	7.4	0.8	7.4	66.0	112.7	142.5	196.1	137.2	28.3	1.4	0.2	1184.3
MAX	22.2	28.7	79.6	117.9	238.0	251.9	368.3	554.9	397.5	315.0	27.9	38.5	1651.8
MEAN	1.23	3.4	22.5	65.5	154.9	180.2	233.7	317.2	260.4	142.9	6.4	2.6	1391
STD. DEV.	5.1	7.5	24.0	27.7	44.3	41.8	62.5	89.6	68.5	60.2	9.8	8.8	142.5

Table. 4.2: Hydrological Meteorological Records
Source: Minna International Airport

4.4 **Rainfall Run-off Relationship**

Rainfall –run off relationship is given by the rational formula quoted thus:

$Q = C.\ I.A$ (Imperial)

$= \frac{C.I.A}{360}$ (Metric)

The rational formula is one of the most acceptable method of calculating run-off of a small catchment area:

Where Q = run off in ft 3/sec (m^3/sec)

I = rainfall intensity in in/ hr (mm/hr)

A = catchment area in acres (ha)

C = runoff coefficient

(i) Run-Off Coefficient: is a weighted average of Coefficient for particular types of soil and land use. A run-off coefficient of between 0.50 to 0.90 in generally adopted for built up areas depending upon the type of surface development and topography. Evaluating the relevant factors, a run-off coefficient of 0.70 was adopted for Suleja town.

(ii) Rainfall Intensity: is a function of time of concentration. Time of concentration is the time required for a run-off from the most remote position of the drainage area to reach the design point. This is the time required for maximum flood to develop. The greatest intensity, which will develop the critical run-off, will occur when the duration of rainfall is equal to time of concentration.

(iii) Catchment Area: The catchment area of any design point is the entire area upstream of the point that contributes to the design run-

off. The catchment areas for each of the gully sites were obtained from the topographic map of Suleja.

Plate 4.1a: Signboards at Project Site.

Plate 4.1b: Part of Victory Road in deplorable condition

Plate 4.1c: Another Part of Victory Road completely devastated by erosion no longer motorable and road culvert blocked by deposits from unconstructed rainwater run off.

Plate 4.1d: GRA / Union Bank Road, washed away by Erosion, water storm channel not in existence

Plate 4.1e:'B.Division', water channel, drainage not connected to the main township drainage.

Plate 4.1f: Dawak Junction / U.B.A Road Water Channel, Drainage Banks not fully sandfill creating another vacuum for water pool.

4.5 **Level of Activity and Potential Damage**

The level of activity of a gully is an important indication of the potential of damage that it can cause if unchecked. However, no mathematical or statistical formulation for gully erosion is available. The measure of activity level is dependent on monitoring of the gully unit. This entails a detailed topographic survey of the gully section at certain intervals of the period preceding and after each wet season. In view of the urgency required to check the gully erosion / flood menace in Suleja no time was allotted for a thorough monitoring of the

gully sites, however relevant information were obtained from the inhabitants of the areas traversed by the various gully sites.

Even though damage potentials of the erosion force in Suleja could not be assessed due to lack of data, it should be noted that any level of activity of erosion imposes danger to life and property.

In Suleja a large-scale damage have been done to both properties and public utilities by the menace. The major gully sites identified and studied include:

1. Hassan Dallatu Road Gully

   This gully, which, started from the left side of the Road after Church road junction transverses in between Anguwar Magajin Mallam and Anguwar Zariyawa across Rubu road to join the gully from Maman Gani Road near Gwarinpa.

2. Mamman Gani Road Gully 1

   This started from the left side of Maman Gani Road at Rubu road junction and traversed through Gwarinpa to post office on Faruku road. This gully, which has merged with the Hassan Dallatu Road Gully crosses Faruku Road and merged with the Moroco Road gully by the GRA Road near Anguwar Dan Chuka.

3. Maman Gani Road Gully 2

   This has its source from the right side of Maman Gani Road at Anguwar Dallatu and traversed in between Anguwar Masallaci. Gayan Primary School and Anguwar Kanya down to Government Teachers Day Secondary School from where it discharges into River Iku.

4. Emirs Palace Gully

This has its source from Anguwar Pawa and traverses the side of Anguwar Yarikiya down the slope and discharges to River Iku.

5. Kantoma Gully

This started from the side of Dawaki hill and traversed through the slope to NEPA Power House and Niger State Water Works and across Salanke Road with its outfall at River Iku Kantoma.

6. Morocco Road Gully

This has its source from the fishpond behind NITEL office and traversed the entire length of Morocco road to Anguwar Dan Chuka where it merged with Maman Gani Road Gully 1. The gully formed at this point traversed in between Dawaki area and Anguwar Beri – Beri and crossed Faruku Road at Dawaki road junction. This further traversed Anguwar Kerenkaka and Anguwar Doka with its outfall into River Iku.

4.1g: Dawaki Junction – Kantoma – Channel uncovered by Township Erosion Control Project. Showing Diverstating effect on building and other structures.

4.7 Causes of Gully Erosion / Flood in Suleja

4.7.1 General

Gully erosion develops from continued removal of soil masses from their positions. This is a natural channel that arises from collection of rills, which was developed by continuous removal of large mass of soil. Even under most stable natural conditions erosion is always in progress but does not necessarily call for human concern except when it is disrupting other human activities. Gully erosion has very bad effect on human activities. Destructive actions of erosion can disrupt human activities like communication water supply electricity etc.

Soil erosion can cause a lot of havoc in built up areas and even on farmlands. During the process of soil erosion arable lands can be destroyed by removal of fertile topsoil and thereby reducing the fertility of the area.

Gully erosion and flood has led to the destruction of many engineering structures in the country. Such structures threatened by uncontrolled erosion and floods are buildings, dams, bridges, roads etc. So many communities in Nigeria have been rendered inaccessible due to the menace of Gully / Soil erosion and flood which washed away roads that lead to such communities.

In Suleja, the rate of gully erosion process desires immediate action to remedy the situation. However, to identify the measure required to control flood and gully erosion in Suleja, there is needed to find out the causes of the menace. In view of this a study of the erosion forces, agents and factors prevalent in the area has been carried out.

4.8 Soil Erosion Factors / Agents

The rate at which the process of erosion proceed depend on three main factors viz:

(i) Energy of the erosion agents

(ii) Erosibility of the soil

(iii) Protective influence of vegetal cover

The susceptibility of the soil to erosion depends upon many factors, most of which are interrelated. Some of the important factors influencing the resistance of soil to erosion are:

(i) The soil structure

(ii) Stratification

(iii) Permeability

(iv) Moisture content

(v) Texture

(vi) Mechanical composition

(vii) Type and extent of vegetal cover

(viii) Land slope

In Suleja rainfall play a very vital role because of its high energy potential. A study of the rainfall pattern shows that it is always of a short duration and of a high kinetic energy, which disintegrates the soil and subsequently carried away by the following storm water.

The project area is completely built up, therefore no vegetal cover exists, so the raindrops are having direct impact on the soil, however there is no much soil disintegration because a large percentage of the areas are either paved or have compacted by vehicular or human movement. This reduces the soil permeability and increases the overland flow.

The steep slope of Suleja enhances the increase in the energy potential of the storm water, therefore its ability to disintegrate the soil as it flows down the slope.

The existing channels in Suleja town meanders through the stretch of the valleys and this enhances the effect of erosion agents on the channels. The channels are either blocked with solid wastes or building structures which reduce their capacity. In view of this the storm water erodes the banks in order to increase the channels capacities so as to be able to convey the volume of storm flowing into them. These banks eroded collapse as a result of the erosion thereby increasing the area of activities of the channels.

In summary, the causes of gully erosion and flood in Suleja include but not limited to the following factors – lack of vegetal cover resulting in direct high impact of raindrops on the soil, steep slope of the land, meandering nature of the channels, blockage of the channels with solid wastes and building structures; and low permeability of the soil.

Erosion Effect on Building

The incursion of gullies and flooding also constitutes problems to the buildings in the area; the buildings include residential and commercial buildings in the area. As observed from the field summary 416 or 55.00% of the building of the sample are greatly affected by erosion menace.

Table 4.1 shows respondent assessment of the effect of erosion and flood on buildings.

SEVERITY	NUMBER	PERCENTAGE
Very Severe	120	30
Severe	100	25
Mild	156	35
Not affected	40	10
Total	416	100

Source: Field Survey 2003 / 2004

Table 4.2: Effects of Erosion on Roads and Drainage

SEVERITY	NUMBER	PERCENTAGE
Very Severe	91 street	60
Severe	4 major street	20
Mild	1	10
Not affected	1	10
Total	15	100

Source: Field Survey 2003 / 2004

4.9 Efforts made towards Erosion Control in Suleja Town

General effort has so far been made by different bodies in the control of soil erosion in Suleja town. The bodies involved in the control of soil erosion in the area are the Federal Government State and Local Government, external bodies and members of the communities.

The major effort so far recorded was from the Federal Government and the Niger State Government.

The major projects were already completed:

(a) Suleja Township erosion control project – by the Federal Government

(b) Suleja Township roads rehabilitation project – A joint effort by Federal and Niger State Government.

The former is the bedrock of this project case study contracted through the "National Committee on Ecological Problems" with the "Upper Niger River Basin Development Authority" as the executing agency. The later was a joint project of the Federal and Niger State.

From the survey conducted the two projects were completed between 1999 to 2002.

This involves:

(a) Construction of 3km Township Road Network with casted-concrete drainages (see fig.2)

(b) Construction of master drainages along 4klm stream and gullies that exist in the town and discharge same to river Iku

(c) Construction of culverts of sizes adequate to discharge the run-off across the road.

(d) There are footbridges build on footpaths with enough clearable to discharge the resulting storm water.

The local government and the community are not left out in the erosion control effort, through the annual tree planting campaign exercise. This also yielded immerse result, going by the number of tree, planted in the town.

In this regard therefore with these giant projects, from the public responses to the survey interview the panacea can said to be found to the environmental degradation problem of Suleja township.

4.10 **Short falls**

Despite the colossal effort of human and financial resources, the project cannot be said to be without shortfalls. These includes:

(a) Despite the structures used for erosion control are economically design, but are not strong enough to be stable during erosion and flood, as some part have already started collapsing.

(b) The banks of the constructed drainages and gully erosion sites are not sandfill, creating the formation of another pool and mosquito breeding sites.

(c) The expected distances to be covered by the flood control measures are not completed (i.e. Dawaki junction to River Iku). This is the last and most significant connecting part of the project that was left abandoned (see plate).

(d) There are similarly important road network in the township still unattended to (i.e. Emirs palace – ungkoko road, GRA to Kaduna road junction, etc).

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Summary Findings

The analysis has been carried out successfully leaving no data available unanalyzed. Here is the summary of such analysis presented in form of findings as end result of the exercise. The following are such useful findings:

1. It has been analysed and came up with the finding that the major case of soil erosion in the area are ignorance of human activities, absence of drainages, rugged terrain and high intensity of rainfall.
2. Most of the roads, in the town are in deplorable condition, as most of them are washed away by incessant erosion activities.
3. The population of the study area has generally outgrown the infrastructural facilities of the area as result of its proximity to the Federal Capital Territory, Abuja.
4. Social activities have been hampered as social activities were duly analyzed to be inadequate. The environment has been distorted. The economic base has shown no competence in the ability to put.
5. It was found during the analysis a complete absence of waste collection and disposal system of the town. Hence necessitating the empty of refuse in stream, dreams and water channel encompassing water blockage and flood.
6. Commonly and individual effort toward erosion control in the town is not encouraging.
7. Finally the Federal Government should look at the shortfall of the "Township Erosion Control Project" under review so as to redress its

shortcomings, (i.e. completion, expansion and extension) of the project to all nook and corners of the Area.

5.2 **Recommendation**

The effect of the environmental degradation of the area of study has been assessed, analyzed and presented in form of findings. The major issues of concern here is how the urban erosion control projects are implemented in line with the specific set objectives and goals.

Its on this basis various stages shall be advanced as recommendation towards achieving the set goals of ensuring successful environmental protection measure in our towns and cities.

The recommendations are as follows: -

- The Federal Government should introduce a more effective and well-articulated policy measures on all environmental protection programmes, in order to drive long term benefit and ensure sustainable development.
- Be actively involved in soil erosion control, through playing active supervisory role to their projects from planning to implementation process.
- A well-articulated re-development and rehabilitation programme is required to correct the degraded land road, and drainages. Management and maintenance strategies are to be put in place to check factors of urban degradation and other environmental related problems.
- A well articulated environmental sanitation programme is required to ensure more healthy way of disposing refuse through re-enactment of public health laws in Nigeria.

- Environmental Education and community mobilization, is a tool for creating awareness in the study area. It will be great assistance if a brief knowledge of the environment is impacted on the people of the area so as to emulate spirit of environmental quality ideology.
- Early detection and control of gully sites is desirable, by the Urban Control and development agencies, to avoid situating reaching deplorable condition.
- The community should co-operate with the government through observance of all environmental protection laws and ordinances in the area and country in general.

5.3 **Conclusion**

The entire study was well conceived and carried out with a clear goal and objective of achieving an improvement on the quality of the environment of the study area. Its clearly identified through the studies that urbanization factors clearly so side-by-side with environmental degradation activities.

The Federal government in her part has succeeded in making measures to check vices of urbanization, through establishment of a concrete policy on the environment and introducing for reaching environmental development and protection programmes and activities.

Its under the solace of these environmental protection programmes, we have governmental organisation like the Federal and State Environmental Protection Agency (FEPA), Federal and State Urban Development control.

In the case of Suleja township "Erosion Control Project", the National Committee on Ecological problems, under the executing agency of "Upper Niger River Basin Development Authority" had done a desired project that will bring a

sustainable development to Suleja community in particular and Niger State in general.

It is on this context the Federal government should continue to encourage country development programmes, through community self-help effort, by seeing all Federal Government projects as their personal projects, for their protection and continuous maintenance at all levels.

Caution should also be exercised by individuals while embarking on physical development projects that could provoke soil erosion, flooding and environmental degradation.

It is the ardent believe of the project writer and researcher that if the recommendations made in this report are fully adhered to the erosion menace, and the environmental degradation problem of the area will be a thing of the past.

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URBAN EROSION CONTROL AS PANACEA FOR ENVIRONMENTAL DEGRADATION
- A CASE STUDY OF SULEJA TOWNSHIP EROSION CONTROL PROJECT

HOUSEHOLD DATA BASE

QUESTIONNAIRE

SECTION A:

PERSONNAL INFORMATION

(1) Name of householder: _____

(2) Occupation: _____
(Farmer, Trader, Civil Servant etc)

(3) Marital Status: _____

(4) District: _____

(5) Ward: _____

(6) Age: _____

(7) Sex: _____

(8) Religion: _____
(Islam / Christianity)

SECTION B

INFORMATION ON POPULATION AND HOUSEHOLD SIZE

(9) Type of infrastructure you are occupying (Brick, plank, mud house)

(10) Are you head of your family? Yes / No: _____

(11) Family Size: _____
(including house helps)

(12) Total population of the Area _____ DNK _____ precisely _____ approximately _____

(13) Prevalent type of community of aggregation (circle appropriate) compact; dispersed, mixed; DNK

N.B
*DNK – Do not know

SECTION C: INFORMATION OF INFRASTRUCTURE, RESOURCES OF CATCHMENT AREA AND PROJECT ASSESSMENT.

(14) What is the nature of the terrain? (mountainous; flat; other specify)

_____

(15) Have you experience any form of environmental hazards (gully erosion, flooding, land pollution?) Yes / No

(16) If Yes mention type: _____

(17) How much of the Area is affected by erosion / flood before the township control project?

None ☐ <5% ☐ 5 – 10% ☐ >10% ☐

(18) For how long?

DNK or less than 1 week ☐ 1 – 3 weeks; ☐ more than 1 month ☐

(19) Have you benefited from the project, if yes go to Q20, if none go to Q22.

(20) How much have you benefited from the Township erosion control project?

Partial ☐ annually ☐ DNK ☐

(21) What type of benefit?

Land/space increase ☐ Building protected from erosion ☐

House protected from treat of flood ☐ Roads tarred ☐

All of the above ☐

(22) If none why? (explain) _____

_____

_____

(23) Tick below degree of damages on this Road and situation of its drainages

☐ Very Severe ☐ Severe ☐ Mild ☐ Not affected

(24) Accesses and tick below the effect of erosion and flooding on the building visited

☐ Very Severe ☐ Severe ☐ Mild ☐ Not affected

(25) Comment generally on the quality of the project in the study area:

_____

_____

_____

Thanks for your co-operation please.