AN ASSESSMENT OF THE IMPACT OF FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, DRAINAGE SYSTEM ON THE DOWNSTREAM CHANNEL USING MORPHOMETRIC ANALYSIS.

BY

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DECLARATION

I hereby declare that this project titled "An assessment of the impact of Federal University of Technology Minna, Drainage system on the downstream channel using morphometric analysis is my work and never submitted to any school.

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CERTIFICATION

We certify that Mohammed Badamasi Yunusa Reg. No originally carried out this research. M.TECH/759/SSSE2001/2002, in the department of Geography. Federal University of Technology, Minna, Niger State.

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DEDICATION

This project is dedicated to God who made and control all things for His love and mercy. And to my parents Mallam Abdullahi Umar and Mrs. Abdullahi for their parental care and encouragement.

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ABSTRACT

This study is an assessment of the direction and the magnitudes of some of the changes, which the construction of drainage can generate in the equilibrium states of the morphological and cascading components of a river system in downstream location.

Terrestrial photographs were used both of dry and wet season during the field observation to give first hand information of the study area. Two environmental systems have been investigated in the study area. The channel cascade system, and the valley side slope process response system. The magnitudes of the components of these systems were determined for a period of the construction of the drainage channelization in the Bosso River.

The result of the investigations show that, in the Bosso River, the drainage and their management by man have modified the channel flow regime, the channel and low terrace gully geometry, and the channel debris storage. The growth of vegetation in the Bosso River Channel has also been encouraged.

Thus the Bosso River has changed from a seasonal to a perennial stream downstream of the drainage, but with high discharge in wet season.

The alteration of the channel cascade system has triggered off the morphological and ecological changes in the channel and in the low-terrace gullies along the channel. Gully incision occurred on the low terrace, increasing the depth of gully mouths. Channel erosion also occurred in Bosso River form storm channel, where a much narrower channel increases. In floodplain suited to the low perennial discharge, was formed and incised to a mean depth of 2.26m. The establishment of the incised channel and the alteration of the channel cascade have led to the formation of a flood plain on which suspended load has been deposited.

These changes observed in the Bosso River channel have encouraged the growth of vegetation, which has stabilized the incised channel, the flood plain and the gully mouths.

It is shown in the work that, the drainage construction, and their management have generated more undesirable effects in the immediate downstream locations in the Bosso River, it is argued that there is a need for planners to know precisely the key variables to be controlled within particular systems in order to predict accurately the effects manipulate inputs will generate in such systems.

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INTRODUCTION

1.1.0 BACKGROUND

The drainage basin is one of the important and unique environmental systems in which to assess the impact of human management on natural system. For example, a drainage construction on channel upstream location has great impact on flow regime of downstream. The discharge in downstream area will induce change and adjustment in the channel morphological components. According to Mrowka (1974) and Schumm (1974), the impact downstream include change in channel shape, the channel sinuosity, the channel gradient and flood plain changes.

The drainage basin is a suitable environmental unit in which to pursue the search for quality in land and water. It is a natural system which man, more often than not, manipulates for socio-economic reason Mrowka (1974) has identified several ways in which man manipulates a drainage basin, one of which is direct channel alteration where man has altered the natural channel directly through the construction of drainage system.

In all ways that man manipulates the channel basin, the construction of the drainage system downstream, has received a considerable attention because drainage construction is considered as part of the most effective and desirable means of solving the problem of flooding and gully erosion, in some parts of Nigerian. It is apparent that the construction of drainage system in a channels stream constitute some problems, not only to the socio-economic system, but to the quality of natural system as Geomorphologies as scientists whose work is relevant to the contemporary needs and experience of their societies, could helps towards finding solution to some of the expected environmental problems by identifying and interpreting what problems are in the first instance.

1.1.1 AIMS AND OBJECTIVES OF THE STUDY

The aim of this study is to assess the impact of Federal University of Technology Minna channelized drainage system on the downstream channel using morphometric analysis.

The specific objective includes:

(a) To assess the effect of the channelization of Federal University of Technology Minna drainage basin on the cascade system of River Bosso.

(b) To assess the effect of the channel on the erosion of the cascading system.

3 To assess the effect of the channalization on the channel morphological debris.

1.1.2 **JUSTIFICATION**

The construction of drainage system in any area may pose some environmental problems downstream. These problems if ignored would degenerate into a serious disaster both on the ecology and landscape. The problem can also manifest in stream flow and in some cascading system of the channel, and the morphological debris, which represent one justification for planners, geographers, and policy makers with some basic knowledge of geomorphology and earth's surface processes.

1.1.3 Statement of Research problems

The construction of a drainage system upstream location, of River Bosso has disrupted the balance of certain process response system in the drainage system downstream and this will set in motion certain self-regulating processes in order to evolve a new dynamic equilibrium, particularly in the downstream location of River Bosso.

1.1.4 **SCOPE AND LIMITATION**

The study area is limited to the Federal University of Technology Minna, drainage system downstream location. This study focuses on the effect of the drainage construction with particular reference to the channel downstream location. Some environmental effects to be considered for the purpose of the study are the cascading system of the river erosion process, response system of the valley side, and the channel morphological debris. The area cover is not drawn to scale.

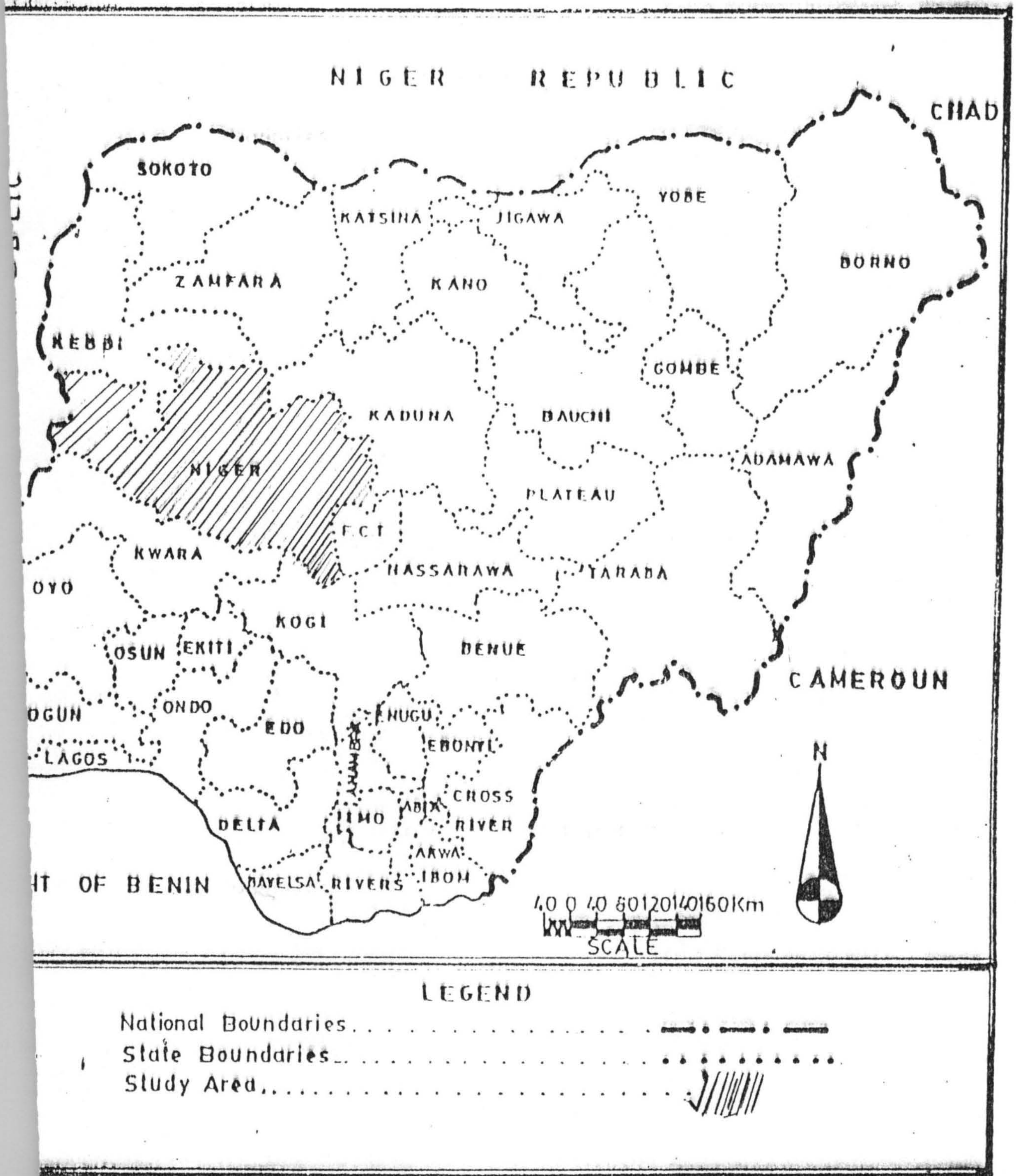
1.1.5 **DESCRIPTION OF THE STUDY AREA.**

The study area is Bosso drainage system of the channel of Federal University of Technology Minna, lies at latitude $9^{0}37$ North and longtitude $6^{0}33$ East. The study area in particularly is Federal University of Technology Minna channelized drainage system downstream location.

1.1.6 **CLIMATE OF THE STUDY AREA.**

The annual rainfall amount has been estimated to be between 1,120mm to 1,300mm (Adefolalu 1991). Long hour of sunshine together with high radiative power across the study area. The mean monthly temperature is highest in March at 30.5^{0}c (87^{0}F) and lowest in August at 25.1^{0}c (77^{0}).

The planning implications of these features relate to water storage (deficits) during the period when discharge exceeds recharge i.e. (October through May).



MAP OF NIGERIA SHOWING THE STUDY AREA

The study area is in the cold/cool to cool/worm zone with cooler sector in the north half of the study area

1.1.7 **GEOLOGY**

The Geology of the area lies within the Nigeria Basement Complex, which is part of the pan-African mobile belt and composed of two lithological groups. These are:

(i) The magmata gneiss quartzite complex that is polymetamorphic with ages ranging from eburnean to pan- African, forming sixty percent of the surface area of the Nigeria basement complex. This is dominated by quartz feldspars biotite, hernblende bearing gneisess schist, migmatites, metamorphosed in the amphibolites faces and described as basement complex. This contain relies of older metasediment, composed of strongly deformed quartzite's calcsicate rocks, amphibolites and variable altered ultramafic rocks.

(ii) Young metasediment of upper proterozoic age made up of low-grade psamitic pelitic rock and metavoleanic rock which form narrow schist belts classified as supracrustal, and are restricted to west of longitude 8^0,00 east.

1.1.8 **VEGETATION**

The vegetation in the study area occupies about 10.65 km^2, with fresh grasses shrubs; occupied 7.35km^2 and trees occupied 3.15km^2. The transition zone between the rain forest in South and savanna was either not too obvious, for the area has a mixed wood land the central area has descious trees with considerable regional variation in the type of wood land. The grasses are as tall as 80cm to 1m. In general but in rich alluvial plane they may be much taller.

1.1.9 **SOIL.**

The soil type is primarily the result of the interaction between climate, flora and fauna, parent materials and geomorphic factors over varying period of time. Soil are developed from the Precambrian basement complex rock comprising granite, schist, gneiss an amphiboles.

The soil belongs to the Minna association, which occur on undulating rolling dissected plain, developed on undiferential basement complex consisting mainly of granites rock, gneiss and schist. The surface soils are usually loamy sand to sandy loam. Most of these soils are gravely except the soils formed on colloidal materials. The sub-soil texture is sandy clay loam to loam.

CHAPTER TWO

LITERATURE REVIEW

2.1 GENERAL OVERVIEW

No construction project on earth is possible without changing the patterns of sequence of the ecosystem around the site. So is the effect of the drainage, downstream channel location on the microenvironment not minding its small scale is considered.

Over the years geomorphologies and hydrologists have devoted time and effort through various methods and techniques to the study of drainage downstream and their evolution.

Hydrology involves the movement of water on and under the land surface that depend upon the storage and movement of water. The reasons for such studies were mainly two: Firstly, there was obvious point that drainage system is a major feature of the physical landscape and it does much in determine the essential character of the landscape.

Secondly, evolutionary studies of drainage system may afford valuable, information about the denudation history of the area. It is useful to attempt a reconstruction of the initial form of a river system in order to have evidence of the nature and mode of origin of the land surface. Present day landmasses may be inferred as such from a study of drainage evolution surface deposits left by the sea.

Environmental effect of manipulation of Federal University of Technology channel on the drainage downstream channel must be given attention in terms of inter-related morphological and ecological changes in channel and in low terrace, with the mean depth, width, and height of the gully mouth at the downstream location of the drainage system.

2.2 The Drainage System Downstream Channel

Todd (1970), has illustrated the effectiveness of selected drainage within the United State as sediment traps. While an interesting case study of drainage sedimentation has been presented by Thomas (1954). It is only more recently that downstream areas of drainage system have began to receive appreciable attention. In a comprehensive review of Mrowka (1974), has summarized the work of downstream areas. And broad areas of interest could be recognized. Such as Federal University of Technology Minna drainage system downstream location.

Firstly, degradation of channels drainage system have been reported by Devries (1968), and Komura and Simon (1967 and 1969), while changes in mean channel depth, mean channel width, channel cross - sectional area and meander wave length caused by drainage channel have been discussed in Leopold *et al* (1964) and by Mrowka (1974) and schumm (1971b and 1971c). In many cases channel degradation have been observed to undergo complete, Metamorphosis involving floods plain formation and colonization by vegetation and great modification in their aquatic ecosystem (Leopold and Wolman 1957, wolman 1967, and schumm 1971).

The second area of interest is the research on the effect of channelized drainage system stream flow. For example Rutter and Engstrom (1964) have stated that drainage system stream flow discharge in downstream areas, but that the impact of channel on stream regimen are variable such impact depend on individual operation schedules of drainage system. Furthermore, they have argued that the effects of several channels within a single drainage basin may be extremely complex in downstream location.

Vannote *et al* (1980) propose that the structure and function of stream communities adjust to change in physical habitat, it is thus important to consider the type and direction of change when evaluating the condition of a stream channel. As Bovee (1982) Mentions a habitat and instream flow evaluation based on the assumption that the stream will remain in its present form will be invalid if the stream is not in an equilibrium condition. Rutter and Engstrom (1964) have stated that reservoirs generally lower peak discharges in downstream area, but that the impacts of drainage on stream regimen are variable since such impacts depend on individual operation schedules of drainage system Furthermore, they have argued that the effects of several drainage, within a single channel may be extremely complex in down stream location. Leopold and maddock (1954), moore and Morgan (1969), linsley and Franzini (1972) and Oglesby et al. (1972), among others, have also stressed that drainage and it channel behind them lower the peak discharges and lengthen the duration curves of flow in downstream station.

In a related view, Coates (1958) in Leopold *et al,* (1964) observed characteristics valley - side slope on sandstones and course - Frained limestone to be 20^0, 38^0 on siltstone and 15^0 on shale. The work of the likes of strahler (in leopold *et al* b,d, p. 364), indicates that Lithological contrast might not be an exclusive factor of difference in slope angle. He observed significant differences in angles of hill slopes of similar rocks in the verdujo Hills, in California. Also those developed on different rock types were the same. The view here was that basal channel erosion was more significant factor than other controlling factors Melton (1958) in Leopold *et al* (Op. at P. 366) observed the relationship existing between valley - side slopes and infiltration capacity. High infiltration capacity gives rise to low surface run-off, low rate of erosion and adjacent channels receiving clear seepage water from beneath the surface with which they erode their channels and steeper valley side slopes.

Fluvio geomorphic theories and sciences were also advanced early to provide some morphological explanation of landforms. Such were evidenced in the work of Targioni-Tozetti (1712 - 1784) John play fair (1802), Dukes (1862), powell (1975), Gilbert (1880) and Davis (1909).

In Thornbary, Targioni - To zetti (1712 - 1784) observed the power of streams to erode. He also observed that irregular courses of streams were due to differences in rock in which they were being cut.

Friedkin (1945), Fisk (1951) and Leopold & Wolman (1957) among the others.

Three channel patterns could be identified as they differ in formation, shape, discharge and how they effect sedimentation problem or indicate sedimentation such patterns were meandering Straight pattern and braided pattern.

Russel (1936) explained meandering as a result of change in the developmental stages of a given river. He observed that when river ceases to down-cut, particularly at "maturity" and "old age", it side cuts and thus meanders.

A Schokhtsch (1937) Von Englen (1942) and Shulits (1941) had contrary view about meander formation they associated meandering to rivers having excessive slope and discharge or energy. Where existing slope exceeds the slope required for the transportation of bed-load, the stream meanders to increase its length and thereby decrease its gradient and energy. Where bend-line irregularities occur to disturb stream flow, meandering is consequentially initiated. To ascertain the behaviour of meandering alluvial rivers, flume experiment was conducted by Friedkin (1945) and arrived at some conclusion such as

1 The primary cause of meandering was local bank erosion, resulting in local over-loading of an deposition by the stream of heavier sediments which constitute obstruction to flow.

3 Uniform bank materials and slope evolves uniform meander bands

4 Areas of easily erodible bank materials are prone to relatively wide, shallow and less sinuous channel development

5 Differential bends evolves where bank materials were heterogeneous

6 Deep and relatively narrow channels evolved in areas with resistant bank materials.

While dependence on walle-length on discharge is indirect, the dependence on channel width is direct. This is so because when slope is constant "channel width follows from discharge as a dependent variables". Leopold and Wolman (1957) asserted that characteristics of braided reaches streams are increased width of water surface, increased slope and decreased mean depth. They maintained that braiding is not exclusively a function of aggradations but is also a response to changes in the controlling factors within the channel. Different channel patterns along the stream constitute a continuum and simply represent responses to changes in the controlling variables such as discharge, slope and particle size. Where braiding decreases, the depth of flow at initial stages increases roughness and turbulence. Braiding can best be explained in term of "the proportion of bed load to available discharge" (Morisawa,).

Channel cross-section forms may be greatly influenced by either discharge or nature of the materials over and through which a given river flows. Broad, shallow channels are reported to be best cross-section form for the transportation of large bed load stream, Griffith (1927).

When velocity is more than required for transportation of materials brought into sub-grade channel, flowing water may scour a channel bed, depending on the strength of the materials it is composed. Lane also discussed the relationship between the velocity on the sides and that at the bottom. He contended that the ration between velocity acting on the sides and that acting on the bottom was a function of the ratio of bed width to its depth. Width: depth ration (if high =100) increases velocity at the sub grade (bed), bed velocity decreases with bank velocity as the gets smaller (if w: d=5.0). Width: depth ratio is always required to bring about proper ratio of velocity acting on the bottom to that acting on the sides to obtain a stable. Fine, friable bed load material will require a very high velocity along the bottom to transport the bed load. Therefore the ratio of the bed velocity to the permissible side velocity can be smaller and so a lower width: depth ratio will be required. Schumm (1971) contended that the width ratio (F) is dependent on sediment load (m). He explained that the width: depth ratio of stream channel (F) will be related to the amount of bank full (abf) and the amount and type of debris storage in the channel.

Leopold and Maddock (1953) using stream cross-section with equal discharge frequencies, advanced that width, depth, velocity and suspended load increase downstream with discharge in a following manner.

W = aQb

D = cQf

V = kQm

Where,

W = width

D = depth

V = velocity

Q = discharge

a, c, k, = constants

b, f, m = exponents

Values of which vary at the different cross-sections.

The stable channel adjusting dimensions, gradients, pattern and shape rapidly and progressively to changed condition. Morisawa (1968).

Olofin (1982) confirmed the assertion of Schumm in his study of Tiga Dam and concluded: That "Channel and alteration of cascade channel have led to the formation of flood plain from deposition of suspended load at post-dam peak discharge has been deposited to form a silt and clay (post-dam) layer of about 12cm thickness".

Ologe (1973) in explaining the contrasts in channel pattern between the lower Kaduna and the lower Gbako that are highly sinuous and braided respectively was quoted saying braiding is best suited in rivers with heterogeneous load while meandering was of homogeneous and fine textured.

CHAPTER THREE

DATA AND METHODOLOGY

3.0 INTRODUCTION

The method used in this study are discussed based on the method of analysis describe below.

As already stated in chapter one, the main approach to the study is the one adopted from Chorley and Kennedy (1971) known as "system approach" This main focus has largely determined the type of explanation sought in this study. It must be remembered that Harvey (1969) based on suggestion of geomorphologies before him, and give types of explanation in geography as cognitive description, Morphometric analysis, and cause and effect analysis.

3.1 DATA SOURCES

There are two principal sources of data for any research project, which are:

i Existing data, either directly available in numerical form in libraries, offices, or indirectly available as potential data on map, air photography, and (these days) satellite imageries,

ii Empirical data gathered in the field by the researcher in the present work existing data on the study area.

iii The terrestrial photographs taken during the wet and dry season period covered the study area. Such as velocity of the flowing water and ascertain the erosion of both season, the photographs shown different human activities along the channel the vegetation and the channel character.

3.2 RECOGNISANCE SURVEY

The terrestrial photographs were taken during the wet and dry months. Human activities along the channel where highlighted especially farming during the dry season period this has resulted in the destruction of the vegetation along the flood plains of the River Bosso.

The character of the channel was also highlighted to show the downstream effect of the drainage, which has manifested itself in a vegetative way. The increase in the width of the River channel has also been indicated as a result of bank erosion and consequent deposition of the eroded material into the channel, which are transported away from the source. However, there is a syndrome of ecological successions in the channel, which it is observed that fern and mosses (Algae) predominates also grasses, weeds, water lilies are prominent flora in this channel, which extending all the length of the drainage system.

Field observation was embarked upon to give first hand information about the study area, downstream location of F.U.T., Minna drainage system. The observation was base on the aim and objective of the research work. The field observation was conducted in 2002/2003 dry and wet season. The level and extent of land degradation was also observed which brought about erosion activities along the downstream location of the River Bosso. Measurement was also taken for both width and depth in the downstream location.

CHAPTER FOUR.

ANALYSIS AND DISCUSSION OF RESULTS.

4.1 INTRODUCTION

This chapter presents and analyses the data on the effect of the drainage basin on the channel cascading system in the study area.

The specific aim of this research project, stated in chapter one as follows.

To assess the effect of the Bosso chanalized River in the Federal University of Technology, Minna on the cascading system of river Bosso downstream. The methods employed for the investigation and data analysis have been discussed in the preceding chapter. Essentially the stream flow has been regulated this was the action of the running water. The stream at

Federal University of Technology, Minna has been protecting to eliminate erosion and deposition of debris.

Most of the loads carried through the upstream channel are deposited along the downstream channel that is hampered by low discharge velocity, corrosion activation and channel cascading. The channalization of the stream by surface runoff is a clear indicator of depositional activities going on along the stream. Though the up stream was channalized and protected, the ecological in balance created by the concretization has not been considered in the downstream, because of the shift in human activities from the upstream to the downstream, the ecology of the area has been distorted. The pressure on the stream downward has been increased. Because of the channelization up stream, at Federal University of Technology, Minna drainage system, its flow had been increased to carry most particles down stream. The end of the channelized drainage is characterized by erosion activities. It has also been deepened by erosion while the edge is collapsing and cascading one is aware that the changes highlighted in this chapter are generally expected and that literature is rich in speculative and references to such changes is perhaps the main contribution of the answer to the first question of the study.

It has been seen in the last chapter that the construction of channalysis drainage have affected the discharge and channel flow negatively in the downstream area of River Bosso during the wet season.

4.2 THE LOW TERRACE GULLIES ALONG RIVER BOSSO.

The final data in relation to the measurement of the morphometric properties of the ten low terrace gullies identified in the drainage basin are presented in Table 4.1 and the mean dimensions of the ten low terrace gullies are presented in the table.

S/NO	WIDTH	DEPTH
1	8.54	2.25
2	10.30	2.27
3	12.25	2.24
4	12.40	2.26
5	12.45	2.27
6	13.99	2.29
7	14.00	2.26
8	14.20	2.26
9	14.35	2.27
10	15.26	2.27
Total	127.74:10	22.64:10
Mean	12.774	2.264

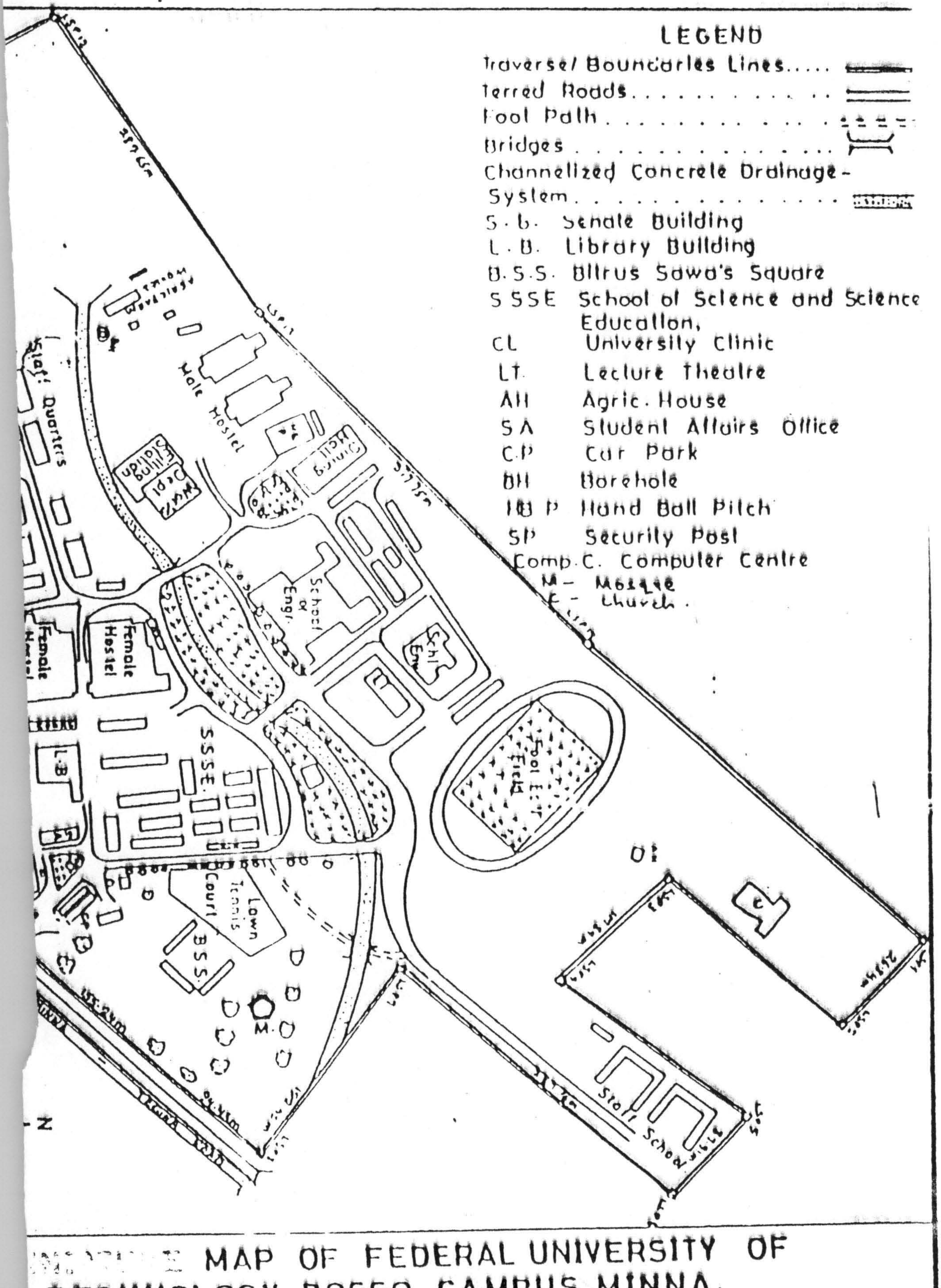
TABLE 4.1

Depth and width of the low Terrace gullies along the drainage basin of River Bosso in meters.

From the table above, it will be seen that although the final data represent conditions for the 2001/2002 dry season, they are the actual dimensions for most of the gullies in 2000/2001 dry season. This is so because incision had ceased before the 2002 wet season in some of the gullies and by the 2001/2002 dry seasons, vegetation had grown all over the profile of the most gullies within the low terrace area. The mean gully mouth depth has increased in the downstream area. And the width has increase with about 12.77m.

The study area indicates that initial and rapid incision most have follows the lowering of the drainage down stream channel. As a result, the low terrace gullies along the River Bosso have undergone a phase of incision, which has yielded an increase in the mean depth of the gully mouth to 2.26M from 2000/2001 dry season Morphology on the low terrace and formed alluvial fans at the edge of the channel. In many cases, including gullies, which do not form part of the original samples, the gullies have been extended over the parts of the channel near their original mouths, cutting into the form channel deposits.

Table 4.1 illustrates these result as well as other characteristics of the low terrace gullies along the Bosso River (at the 2001/2002 dry season). The system structure is a control system resulting from the manipulation of man. It



MAP OF FEDERAL UNIVERSITY OF TECHNOLOGY BOSSO CAMPUS MINNA.

SOURCE OMOTAYO J. O

shows a time when vegetation had not appeared either on the channel or at the gully mouths. This has resulted in a different set of inter-relationship among the components of the system. Which makes the component decide positively for gully erosion, but negatively against the storage of debris and water. Further, the inputs from the gully side increase because of the falling mean of the water table in the valley side areas, which results in the withdrawal of part of the soil moisture. It appear depth of incision increases in the gully down stream of Bosso River due to the concretizes upstream of the channel.

4.3 EFFECT OF THE DRAINAGE SYSTEM ON THE CHANNEL MORPHOLOGICAL DEBRIS

It has been stated earlier that the channel of a river and its discharge constitute a process response system, which is an open system where the discharge is at some variable and the debris storage of the channel. This is particularly true of alluvial channels which are free to adjust dimension, shape and gradient in response to hydraulic change (Schumm, 1977) In order to move towards steady states (Langbein and Leopold, 1966). From the above facts concerning the hydrological variables of River Bosso can be obtained.

The discharge has an overall negative change as result of the construction of the Federal University of Technology Minna drainage system. The debris entering the channel downstream of the drainage system has undergone some modifications, though the direction of the initial modification has not been determined. For example, it has not been shown weather the temporary increase in the debris. Input from valley side slopes at the time of gully incision was equal or not, to the amount of sediment trapped in the downstream drainage basin. What is certain, however, is that the final modification in sediment transport downstream of the River Bosso, after the initial incision has ceased, is a negative change.

These changes in the ceaseding input must affect the morphological and other components of the channel because the channel of the Bosso River was an alluvial type. More over, it has been argued that discharge is an independent variable that largely determines the size of stream channels and their morphometice properties (Schumm 1971a p. 4.22).

4.4 DOWNSTREAM MORPHOLOGICAL CONSEQUENCES OF RIVER CHANNELIZATION IN BOSSO.

The effect of man on rivers and river channels has been wide spread in Nigeria throughout the period of habitation, but it is only since 1970 that the geomorphological study of river has been increasingly concerned with channel adjustments which are of significance in relation to practical problems. This has arisen because of the extensive distribution and in many cases the intensive nature of environmental problems and because of the realization that geomorphologist can extend and understanding of the fluvial system. Although engineers have acknowledged direct effects of engineering structures for many years, the more widespread effects of these structures were less well appreciated. Connectively in the fluvial system means that repercussions of any man. Induced change at any given location can be transmitted over a wide area, especially in the downstream direction. Geomorphological research during the last decade has revealed a series of effects upon river channel morphology which can persist for very considerable distance of River channels (e.g Petts 1980).

This research indicates that downstream consequences can be divided into those effect associated with construction, and characterized by the release of excess amount of sediment, and those which occur during the years following completion of the drainage system in response to changes in the frequency and magnitude of discharges.

A study was also made of the significance of downstream sedimentation to the channel morphology, and the exact location of deposits was found to be conditioned by a number of factors. Sedimentation was greatest at the downstream of the drainage system declining with distance downstream, while at a more detailed level deposition was found to be at a maximum in areas of least velocity. There is no evidence to suggest that deposits survive and Persist as long-term morphological features well after the period of construction since they are typically unstable. Being composed of unconsolidated silt. Survival of the material appears to be determined by the hydrological condition prevailing at the time of construction were found to important since flow determined the amount of sediment released. Frequently this downstream trend was distorted by trees, roots which had locally restricted bank recession, thus causing the erosion to be selective. A further type of channel change observed at a number of sites was the accentuated erosion of the outside bends, but with out the associated point bar the position characteristic of natural plan form change. The length of natural channel over which erosion had taken place ranging from a minimum of 80m on the River Bosso to maximum of 160m for the River Bosso.

4.5 GENERAL ENVIRONMENTAL EFFECT OF CHANNELIZATION.

Channel straightening leads to an immediate increase in bed gradient and may result in a natural deepening and widening of the channel downstream location. Losses of habital resulting from straightening can be substantial, reduction in the length of a low land reach of the Bosso River, increasing the flow carrying capacity of a river channel generally results in an increase in flow velocity and this may have direct ecological implications in stream since many aquatic organisms have specific requirement of water velocity. In addition to local increases in amplitude of river flows resulting from channelization, such effects may also be manifested in reaches downstream of the engineering scheme, broadening the area of ecological disturbance.

Where Channelization in up land rivers results in a simple trapezoidal shaped channel the immediate effect is to produce a channel devoid of typical pool-riffle sequences and without vegetation and in stream cover, which may be of considerable importance to many organisms. In a national system, channel width and depth are also adjusted to flow regime, probably to bankfull discharge and its recurrence interval, and any destruction of this equilibrium may lead to the erosion of bed and bank material, with elevated concentrations of suspended materials in the water column and subsequent sedimentation. In particular, the removal of bank-side vegetation and decreased soil stability are likely to lead to increase in sediment loads to rivers.

The removal of shading bank-side vegetation, for access by machinery or in order to reduce frictional effects, may lead to in-stream temperature change, as can changes in water depth, since most streams receive their chief source of energy in the form of allochthonous organic matter, often as tree leaves and terrestrial invertebrates associated with tree canopies, losses of bank side vegetation may also substantially reduce energy flow in the aquatic system. Additionally, the loss of trees, scrub and vegetation and the general disturbance during channelization is likely to have a substantial effect on birds and mammals and the predominant vegetation.

Plate 1: The drainage channel that cut across the Bosso camus of F.U.T, Minna, Was concretized to protect the Bank against collapsing.

Plate 2: The flow of the channel during wet season, that cut across the Bosso Campus of F.U.T. Minna.

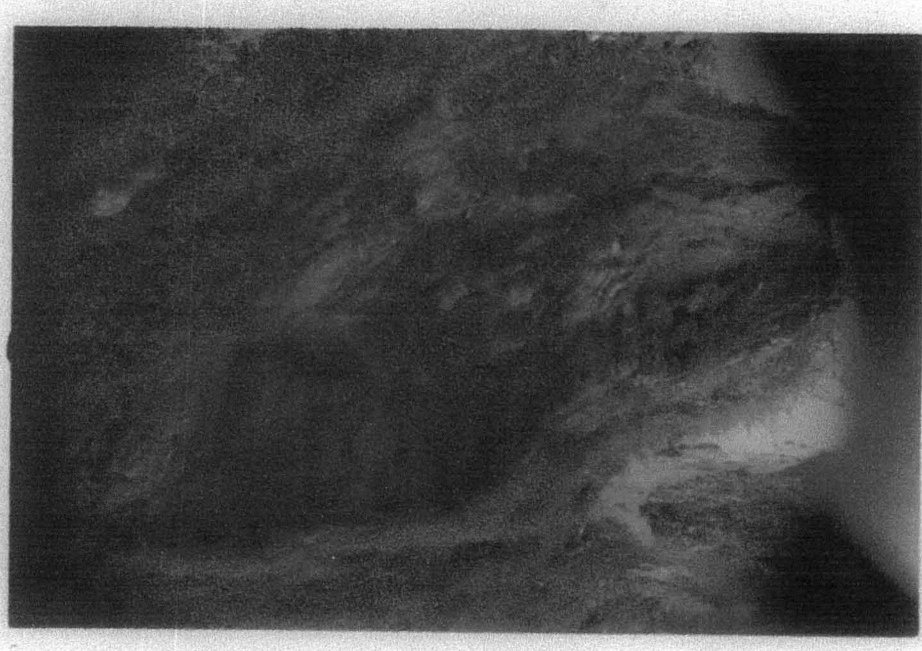


Plate 3: Down stream location showing areas liable to bank erosion.

Plate 4: Gully erosion in the down stream due to human activities In the down stream location.

Plate 5: Dry season low flow pattern April, 2003.

Plate 6: Down stream location showing human activity excavation of sand during the dry season period.

Plate 7: The mouth of a gully erosion during the dry season November, 2002.

Plate 8: Material transported from the up stream to the down stream location that is debris deposit.

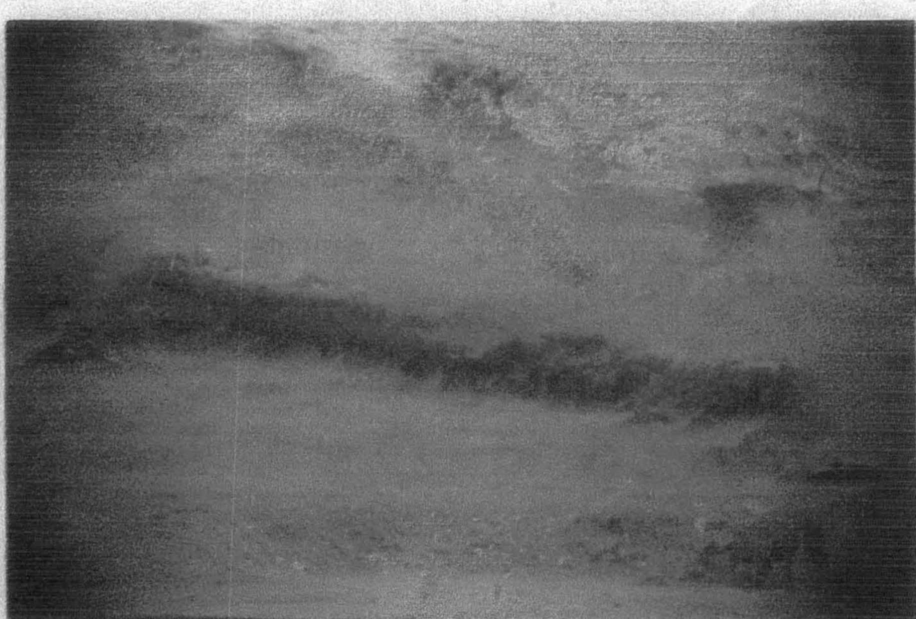


Plate 9: Low terrace gullies along F.U.T. Minna drainage system (that is thick gully floor vegetation).

Plate 10: Measuring the depth and other morphometric variables of F.U.T., Minna channalized drainage system.

Plate 11: Wet season Bank Full flow pattern June, 2003.

Plate 12: Gully erosion in the down stream due to human activities in the down stream location.

Plate 13: The down stream location showing the meadering pattern in the channel of river Bosso.

Plate 14: Down stream location showing the alluvial deposit pattern.

CHAPTER FIVE

5.1 SUMMARIES, CONCLUSION AND RECOMMENDATION.

The discussion so far should have made it clear that the change measured in the variables of the Bosso River fluvial system are consequent on hydrological changes caused by construction of the drainage, particularly the down stream of the River Bosso. The upstream was channelized and concretized to center for both particles coming in and going out. It was graded to avoid deposit and erosion. These erosion and depositional activities are transferred downstream. The regulation upstream is affecting the downstream by regulation of flow that has lead to meandering.

i Land pressure that was supposed to be shared by both Federal University of Technology, Minna drainage system and the downstream are all transferred to the downstream, thereby creating a lot of pressure on the land and creating more erosion problems.

ii The banks of the downstream have also experience land pressure and different cultivations that is also leading to increased erosion and land degradations.

5.2 CONCLUSION

It is obvious from the research to see the impact of channelization of the Federal University of Technology, Minna drainage system on the downstream. The downstream is facing great problem of pressure that is leading to erosion and deposition. Due to the discharge velocity of the running water in the channel, which is widening, the channel of the downstream location.

It could be concluded that most of the stream flow activities, human activities and stream morphologies are concentrated at down stream as a result of their shift from the upstream. Channelization has direct impact on riverine birds and, where such works are related to land drainage schemes, changes in water status of the catchment and subsequent land used substantially reduce areas 'managed' rivers support fewer species at lower densities than adjacent natural reaches.

Channelization often devastates bank side tree and ground cover though there are few objective studies of such effects. These is increasing awareness of the need for engineering schemes to be more sensitive to the importance of this bank side habital. There is an urgent need to document the exceedingly rich vegetation characterizing river banks.

Aquatic vegetation forms an intimate part of the ecology of rivers and stream yet the effects of channelization on in-stream vegetation are poorly documented.

5.3 RECOMMENDATIONS

Following the result and conclusions of the research one would want to make the following recommendations.

1. The downstream should be protected against human activities endangering the course of the river and ecological species.
2. The refuse dumping and excavation of sand along the river flood plain should be discourage against the occurrence of flood which could be felt much downstream than upstream.
3. The rate of deposition and erosion of the area to be studied, while intensive awareness should be address, on the change of the river course.

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APPENDICES

A GLOSSARY OF KEY TERMS USED IN THE THESIS

Systems language (see also charley and Kennedy, 1971, Particularly, Chapter 1.

Cascade - The mass and energy that fuss ("Fall") through a system e.g. water, sediments. e.t.c.

Cascading system - A system composed of a chain of sub systems of cascades which.

Has both spatial magnitude and geographical location. The system is defined by the path followed by the throughput of energy or mass; e.g. surface, runoff, or the hydrological cycle.

Morphological system - a system comprising formal geometric) and static properties

Integrated to form a recognizable part of physical reality, it consists purely of a network of structural relationships among the component parts; e.g., the valley - side slope, or the hydraulic geometry (Channel dimensions).

Process - response system - A system formed by the intersection of morphological and

Cascading system, it represents the linkage of at least one morphological and one cascading system, demonstrating, through a common component, the manner in which form is related to process e.g., the river channel and its discharge.