THE IMPACT OF EROSION ON ARABLE LAND, A CASE STUDY OF OBUDU CATTLE RANCH, CROSS RIVER STATE.

BY

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PGD-GEO-2000-2001-189

IN PARTIAL FULFILMENT OF THE AWARD OF POST GRADUATE DIPLOMA IN ENVIRONMENTAL MANAGEMENT DEPARTMENT OF GEOGRAPHY FEDERAL UNIVERSITY OF TECHNOLOGY MINNA.

MARCH 2002.

DECLARATION

I Bassey Appolonia Ubeh of the Department of Geography, School of Science and Science Education Federal University of Technology Minna, solemnly declares that the research work presented for the Post Graduate Diploma in Environmental Management was carried out by me, under the supervision of my supervisor DR. HALILU AHMED SHABA of the Department of Geography, School of Science and Science Education Federal University of Technology Minna, Niger State.

Bassey Appolnia Ubeh

Date

DEDICATION

This project is dedicated to my beloved parents Mr. & Mrs. Bassey Benedict Bassey.

ACKNOWLEDGEMENT

I wish to first and foremost express my profound gratitude to Almighty God for his loving kindness, mercy and protection throughout my study period.

I also wish to express my sincere thanks to my project supervisor Dr. Halilu Ahmed Shaba for his constructive suggestions and correction at various stages of this project.

Similarly, my sincere appreciation goes to the H.O.D. Dr. M.T. Usman and other lecturers in the department of Geography Federal University of Technology Minna like, Professor, Adefulalu, Professor Baba, Dr. Appolonia, Dr. Nsofor, Dr. Odafen, Dr. Akinyeye and the host of others.

Worthy to mention are my guardian, Mr. & Mrs. John Udeshi Angiating who by their efforts and encouragements made me to complete this programme.

I am also indebted to my brothers and sisters especially, Jude, Scholarstica, Akomaye, Undie, Eremi, Benedict and Rose.

I am also indebted to my friends & course mates who advised me during this period. Josphine, Ijeoma, Okpanachi, Musa, Ruth, Rahinatu, Naomi, Danlami and the host of others.

Finally, my special thanks goes to Mr. Shimayina Adugh whose prayers and moral support made me to complete this programme successfully.

ABSTRACT

A field study was conducted on the impact of erosion on arable land in Obudu Cattle Ranch of cross River State. Soil samples were collected at three (3) different erosion sport transversely labeled A.B. & C. at each spot. And this soil was analyzed to know the level of nutrients component in the eroded soils and to determine the particle size distribution in the soil. The result from both physical and chemical analysis shows that this eroded soil was low in P.H., Nitrogen, Potassium and Phosphorus. Also, photographs were taken to ascertain the types and levels of erosion up Ranch.

TABLE OF CONTENTS

LIST OF TABLES & PHOTGRAPHS

CHAPTER ONE

1.1 INTRODUCTION

Erosion can be describes as a process of the detachment of soil materials as well as its transportation by water, wind or ice.

Generally, erosion may assume the form of sheet, rill or gully. Indeed, soil erosion is a natural process, but a distinction is usually made between geologic and accelerated soil erosion. The former involves denudational agents such as water, wind ice and waves under natural environmental conditions (strahler 1973). However accelerated soil erosion mainly occurs where man has tempered with the environment especially through the removal of vegetation. Because of the spectacular nature of the accelerated soil erosion and its devastating effect on the environment. It is the type that attracts man's attention.

Infect, man activities such as mining, over cultivation and overgrazing can all leads to erosion especially in urban areas (Chisc 1981, Jeje1987, Ofomata1987). Erosion has become an endemic problem causing loss of Agricultural productivity. Thus uncontrolled exploitation of land resources for whatever purpose can lead to accelerate erosion problems.

Soil erosion on farmland should be given proper attention for optimum Agricultural production. Soil erosion depletes the soil of the essential nutrients. The topsoil which is very necessary for crop growth is progressively eroded and subsequently transported down the slope through erosion. Water and wind are the two main denuding agents on farmlands in Nigeria. Water erosion affects all farmlands through out Nigeria but the effect is more pronounced in the sourthen part.

The amount, frequency and intensity of rains as well as the temperature have profound effects on sheet, wash and wind erosion. These types of erosion are therefore more wildly spread and incipient in their effects. A high intensity rainfall is more likely to erode faster than a low intensity rainfall in southern Nigeria rainforest zone, high annual rainfall tends to accelerate soil erosion including the flooding of riverbanks and sediment transportation. In addition, the geology on lithology of an area is useful index for gauging the erodibility of an area for example, it has been suggested by Ofomata 1956 that, the soils of Easter Nigeria by their texture infiltration patented and parent material (subject to easy weathering) are highly erodible.

The majority of studies on soil erosion particularly in Nigeria have focused on human activities as the primary causes of erosion. They point to misuse of land resources, in appropriate agricultural practices, bush burning, uncontrolled tree cutting and deforestation for fuel wood, as well as major socio-economic development projects such as dams, road construction, power station urbanization and general infrastructure. The rapid increase of population and long-term over- exploitation of kind without its judicious management and conservation would obviously result in large-scale erosion.

Human activities accelerated rather than initiate erosion and to that extend there is drastic reduction in land productivity for agriculture.

In case of gully erosion the land may become sub marginal and no longer useful for any purpose. It is estimated that over 1.5 million tons of soil may have been lost annually to erosion in southeastern Nigeria (FOS 1984)

1.2 PROBLEM OF SOIL DEGRADATION

The pressure on soil has been intensified by increasing human and livestock population and by human activities to the extend that the resulting soil related problem have undermined the sustainability of Agricultural land use. In particular, erosion and soil fertility, decline remains the major problems that have contributed enormously to environment degradation.

Soil fertility has been defined as the ability of soil to supply nutrient and water on sustained basis to enable crops maximize the climatic resources of a given location (Kowal et al 1978). Thus the fertility and productive capacity of a soil depends strongly on the maintenance of it physical chemical and biological properties.

Some fertility problems are encountered in two forms either as inherent low fertility or decline in soil fertility. Both forms are present in Obudu cattle Ranch.

Decline in soil fertility is frequently caused when human impact on ecosystem leads to erosion, biological degradation and lose of nutrient (Young 1989).

When equilibrium conditions of a natural ecosystem remain undisturbed, risk of soil erosion are minimal, for example Samaru (Nigeria) rainfall is 1150mm. Annual soil erosion from fire protected plots was found to be negligible due to absence of surface run off (Kowel 1970).

Through this action surface runoff depletes the nutrient content of the surface soil and alters its texture. With the subsoil compaction poor particles aggregation and high gravel concentration Babalola, and Cheda (1975).

1.3 STATEMENT OF PROMBLEM.

Erosion is a problem because it involves continuous or intermittent removal of soil including plant nutrients from the land surface and its deposition in another location. These action will lead to land degradation and exposure of land.

The rich topsoil will eventually be washed away leaving infertile soil, which cannot support plant growth.

Erosion can also promote land sliding in the case of Obudu cattle ranch. Overgrazing in this area is the key factor of erosion. And with time the place be subjected to earth quake because of it mountainous nature. Through erosion the surface of the earth is constantly being sculptured into new form. The shapes of continents are continuously changing, as waves and tide cut into land while silt from rivers build up new land. As rivulet, streams and river cut their channels deeper, gullies become ravine and ravines become valley.

1.4 AIMS AND OBJECTIVES OF THE STUDY

The aim of this project is to examine the impact of erosion on Arable land and also to determine the causes and consequences of soil erosion on arable land.

The major objectives of the research are to

- Examine the present state of erosion on arable land in my study area.

- Highlight problem associated with erosion on arable land interms of the physical and chemical properties/Analysis
- To proffer solution to mitigating soil erosion on arable land.

1.5 SIGNIFICANCE OF THE STUDY

Erosion is a severe problem that is growing with population growth as much land is put under use. These lead to shortage of land and in some areas intertribal conflict. In the face of population increase, it could be so severe that the government must intervene.

Also with population growth, an eroded land cannot support plant growth and also yield of crops will be affected and this will encourage competition due to population factor.

1.6 SCOPE AND LIMITATION

The study is mainly concern with the impact of erosion on arable land in Obudu cattle Ranch of cross River State.

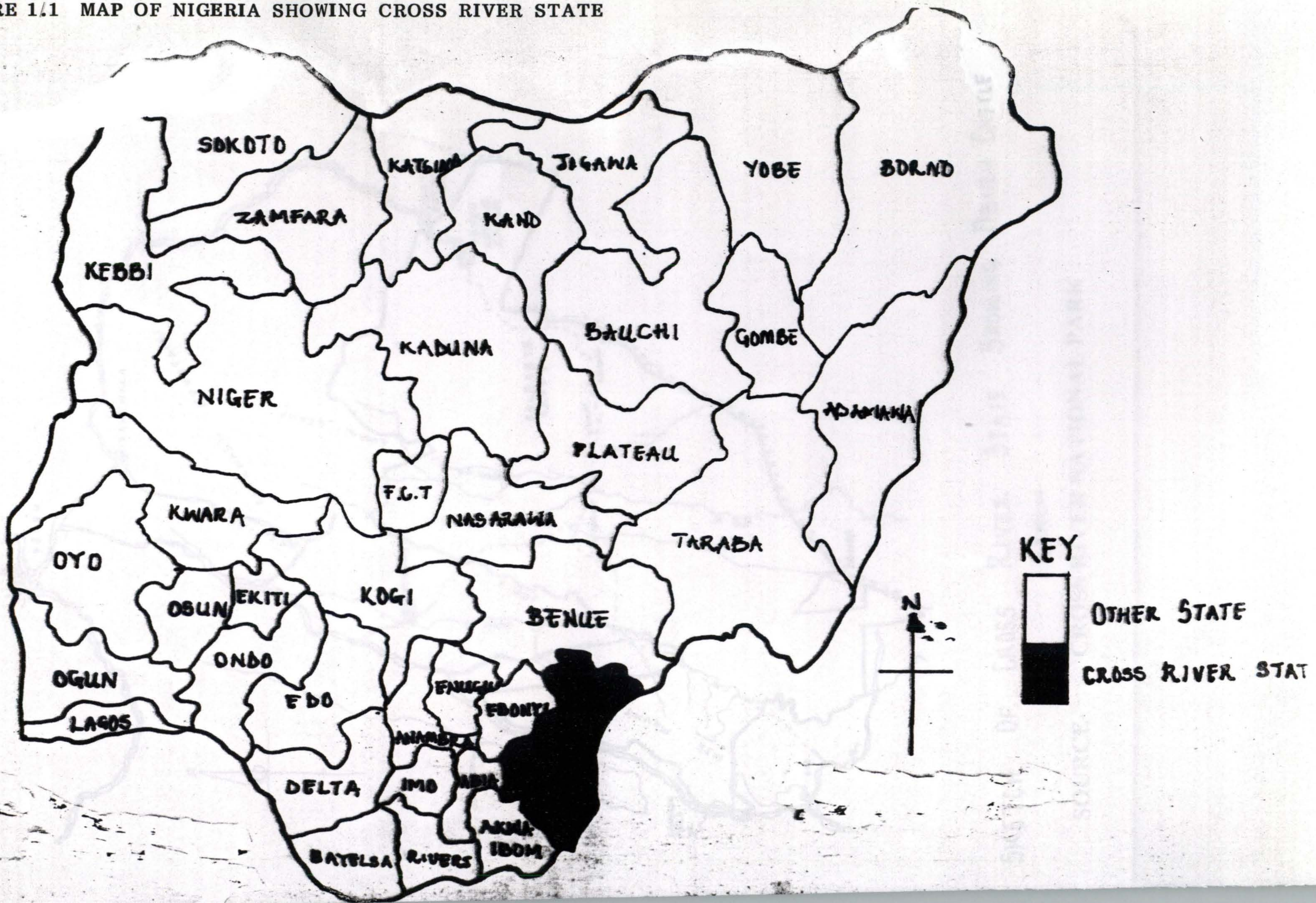
Ranch takes the visitor up a winding road giving spectacular views of the Benue lowlands and the surrounding highland. Before arriving at the Ranch and Hotel facilities on the plateau at an elevation of approximately 1, 500 meters above.

The area of land consists of approximately 25 hectares of which 60% is montanes forest, 25% is scrubland regenerating forest farmland that will be allowed to regenerate. The area of forest is typical of that found on the plateau being characterized by its concentration in sheltered valley with the grasslands on more exposed higher area. This has been accentuated by the grazing of cattle from the grasslands into the edges of the forest area degrading the natural transition area between the two habitats are forcing the forest edge backwards down the hill slopes further into the valley.

The climate is seasonal-tropical with a distinct rainy season (March-November) and dry season (December-February). Rainfall is heavy up to 4280 mm distributed unevenly within the nine months. Ambient temperatures are high but lower temperatures (14^{o}c-16 ^{o}c daily minima; and 18 ^{o}c - 25 ^{o}c daily maxima) are recorded on the highland areas of Obudu Plateau and Sankwala mountains.

The vegetation is broadly of two types; lowland rain forest in the low areas of the park (with Montane elements on high ground) and grassland on the higher peaks of ObuduPlateeau and Sankwala Mountains and Ikwete hills.

FIGURE 1.1 MAP OF NIGERIA SHOWING CROSS RIVER STATE



CHAPTER TWO

REVIEW OF RELATED LITRATURE

2.1 INTODUCTION:

Soil erosion is the removal of soil by forces of nature more rapidly than the various pedological processes can replace it. It occurs mainly through the processes of sheet wash, riling and gulling.

The first which involves the gradual removals of soil in thin sheets over a large area by surface runoff is far less spectacular than other forms of soil erosion especially gulling which occurs in form of deep trenches on the land.

Various aspects of soil erosion, particularly gulling have been observed and or studied all over Nigeria especially in the watershed areas of Kaduna State and schemanzar valley in Jos Plateau (Grove 1952 part of mambilla plateau (Badden and Tuley 1960). The scarp and dip slope of Nsuka, Okigwe and Awgu- orlu (Vestus ofomata 1965,1966,1967 1978, and part of Ondo State Jeje 1982).

In most of these study attempts were made to identify factors and processes of soil erosion and describe the morphology of the erosional features.

2.2 SOIL EROSION ON ARABLE LAND AND ITS ASSESSMENT:

Morgan 1979 stated that, In the last decades, there have been a growing awareness of the potentials hazard of soil erosion on arable land. However, a dichotomy in the perception of the problem exist between those studying soil erosion and the farmers who experience the impact. It appears that the majority of farmer view soil erosion as something minimal to their productivity, although, it may be a management hazard, particularly when harvesting crops.

As a result, soil erosion is rarely seen to be of sufficient importance to warrant change in soil use or management. In contrast, those studying soil erosion have examined the balance between soil loss and formation, this should be of concern to the farming community (Evans et al 1986). However, the existence of this imbalance must first be demonstrated. The development of a reliable method of estimating rates of soil erosion provided a relevant and important challenge to the geomorphologist.

The most obvious sign of erosion is clearly the gully, although, at the Ranch, rilling is the most frequent visible indicator of erosion on arable land. The frequency of occurrence and the importance of rain splash and sheet erosion are less easy to assess, because of lack of instrument parameters for assessment. The contrasting patterns and attribute of these processes impose constraints upon the design of an effective method for monitoring soil erosion (Evans and Cook 1986)

2.3 WATER EROSION ON ARABLE LAND:

There is an increasing interest in soil erosion by water on arable land. It is arguable whether or not this is due to an accelerated erosion rate. Many changes in agricultural land scape during the twentieth century (e.g. The enlargement of field), removal of field boundries, changes in rotation of crops, land use, drainage pattern and change in tillage practices) have increased the susceptibility to erosion (Alstron and Bergman 1988a; Anderson 1967).

Another explanation of the increasing interest in water erosion is an awareness of the environmental problems and off farm effects caused by surface run off erosion. Most of the losses of phosphorus from arable land are transported to ocean. With intense surface run off, both as dissolved phosphate bound to the soil particles (Alstrom and Bergman 1988b). This emphasizes the importance of surface run off and erosion as contributor to non-point pollution from arable land.

2.4 THE EROSION PROBLEM

In the last 1970s and 1980s, there was a sharp rise in the number of recorded causes of erosion on agricultural land. The considerable body of evidence that has now been accumulated may however be a function of increased activity. Although this has certainly occurred, there are good reasons to believe that the recent increase in erosion is real.

Surveys of current erosion in specific areas have considered the evidence for the recent increase and have concluded that the number of incidents and the rates of erosion have increased perhaps by an order of magnitude (Spiers and frost 1985) Boardman and Robison 1985.

Nevertheless larger areas of the country have been monitored in detailed or systematic manner, and these include areas that in terms of topography, land use, soil would be expected to be subjected to erosion (Board man 1988a).

Thus, it is suggested that although the full extent and scale of the erosion problem is known only in outline, it is clear that agricultural land in certain areas are eroding regularly and that some of the rate are such as to give cause for concern. The National soil map and legend identify areas at risk of both wind and water erosion and these total about 44% percent of arable land in the country (ENDS, 1984).

There is a general agreement that erosion is a regional problem confined at present to certain identifiable areas and that prevention and amelioration action could be targeted on these areas (Bullock, 1987 and Board man 1988a)

The reasons for increase in erosion differ to some extent, in different area. The general explanation is that a series of technological changes occurred in agriculture, which are usually referred to as intensification of the industry. (ENDS 1984).

Erosion occurs under a variety of crops such as raw crops, sugar beet and potatoes gives high rate of erosion as a result of rainfall. Rates of erosion under sugar beet are higher than any other crops (Evans and cook 1986). Similarly high rate have been recorded under salads and vegetable crops (Board man and Hazel don 1986) strawberries (Board man 1983) and under maize (Board man 1983).

However, of greater significance, because of the larger areas involved, has been the sharp rise in erosion associated with the increase in the growing of autumn planted cereal (winter cereals). Evans and Cook 1980 note a threefold increase between 1969 and 1983 in area under winter cereal. In many part of the country most erosion occurs during the autumn and winter on wheat and barley fields (Evans and cook 1980). The role of other factors seems to varying from area to area (e.g. the increase in size of field and finer tilths compaction, a move unto sleep slopes, soil erodibility and the declining organic matter content of soils.

2.5 IMPACT OF EROSION ON ARABLE LAND

The impact of erosion on farmland in the short term has been minimal. The area of individual field damaged by either erosion or deposition has rarely been in excess of 5 percent. In the worst case, that of 10 ha field at about 10 percent of total volume of the soil was eroded, with the coarse fraction being deposited on valley Sid foots lopes and most of the times being carried out on field. Robinson and black man (1990).

The longer-term implication of erosion for farming is more difficult to evaluate.

Thus, even modest rates of erosion represent depletion of the soil resources. At the same time, under intensive farming systems with generous application of fertilizers, soils of only 20cm depth are capable of giving yields of 6+ ha 1 of winter wheat (Robinson and Board man 1988).

There is also the problem that American experienced suggests that farmers opting into such schemes are very likely to relent arable cropping on erodible land. When that again becomes profitable (Napier 1990). The future is therefore uncertain and it is unclear as to whether erosion is likely to continue to deplete these soil to the points at which many slopes become unfarmable.

2.6 LAND USE CONTROL ON SEDIMENT PRODUCTION IN A LOW LAND CATCHMENT:

The stream sediment and associated nutrient load is of major Importance in water quality control. Although the stream sediment load is derived from non-point inputs from the surrounding catchment, sediment sources may be highly localized (Hodges and Ardenclar, 1986, Morgan 1980, Reed 1983). Agricultural land use is one of the major controls on the sources and magnitude of sediment transfer to the stream.

In UK agricultural land use, there is evidence for the large scale conversion of grassland to arable land, with increase livestock (mainly dairy) number in the remaining grassland areas. First, lowered soil organic matter levels in arable areas (Reed 1979, Morgan 1980). Organic matter is critically in soil particles conversion and in the maintenance of soil structural stability once organic level falls below 2 percent, the soil becomes structurally unstable (Green land et al 1975) and subject to staking livestock number may accelerate erosion through comparation of the soil surface and the removal of the vegetation cover in heavily grazed area.

In quantification of soil erosion in the UK, much of the research has focused on the conversion of grassland to arable as the source of increase sediment transport. (Board man 1984; Reed 1979 of grazing in sediment transfer, the emphasis has been on upland area Evans 1977).

Lowland Agricultural catchment in UK and in particular, Southwest Devon traditionally have grazed permanent grassland on steeper slopes or adjacent to stream. Therefore it is important to examine the implication of increased livestock number on a reduced grassland area for sediment and associated nutrients transfer to the stream system.

2.7 CONSEQUENCIES OF SOIL LOSS

Since land cultivation began, the world has lost on estimated 2000 million hectares of crop land due to soil erosion. Erosion occurs when farming practice are used which fail to take account of the ease with which soil can be washed or blown away.

An example of inappropriate farming techniques which causes erosion is deep ploughing and harrowing two or more times to produce annual crops. Therefore realistic and careful planning of land development and the choice of appropriate technology should receive the utmost consideration if vast area of agricultural land is to be developed and their productivity maintained.

Agriculture is that branch of national economy which is most affected by the erosion processes. The detachment and transportation of soil particles often occurs on a large scale. There are frequent cases of the denudation of the subsoil causes by intensive rainfall, which washes away the shallow to soil layer. This has extremely infavourable consequences for agriculture considering the long-term process of soil formation. The decrease in soil fertility resulting from the loss of soil particles depend on type of soil and on the depth of the soil profile. Surveys carried out in deep soils in the grain growing area of U.S.A. have shown that the loss of 50 – 80m of soil reduced fertility by 15%, 101.6mm by 22%, 152.4mm by 30% (Milos 1980).

Obi 1980 stated that soil fertility is reduced by the removal of plant nutrients. It is very difficult to determine the quantitative values of this removal. This is because decreased soil fertility resulting from this removal depends on the amount type and form of nutrients supplied and on the properties of the respective soils. Investigation carried out in various countries, showed that the loss of nutrients from agricultural land is considerable and has become a serious problem for agricultural production. The loss of plant nutrient not only reduce crop yield but also worsen the quality of the crop lower intensity erosion processes causes the loss of fine soil particles.

This changes the soil structure and texture and reduces the water quantity capacity of soil. In high intensity water erosion processes, a considerably proportion of the topsoil is washed away and rainwater does not as a rule reach the lower permeability; they have an adverse effect on the development of the vegetation.

The removal of soil particle by wind erosion often denudes the roots of the vegetation, which then wilts of efficient mechanized tillage.

Deep rills and gullies caused by water erosion cut agricultural land into an even plots reducing the possibility of efficient mechanized tillage.

2.8 EFFECT OF SOIL EROSION ON PHYSICAL PROPERTIES OF SOIL:

Obi and Asiegbu (1980) and lai 1979 working on two separate soils of Southeastern Nigeria and South-western Nigeria respectively concluded that topsoil is lost, exposing the gravel and layer and the less productive subsoil. According to Obi and Asiegbu 1980, the transportability of sand particles of silt, clay and other colloidal material are carried away leaving the more coarse sand particles, which do not support crop growth. It is evident from the results of the work of (lai 1979, Obi and Asiegbu 1980 and Obi 1982) that a general statement could be made on the physical properties of soil of eroded zone of Southern Nigeria. The profile is deep with little gravel in the subsoil. The texture of the exposed surface soil is sandy to fine loaming or claying. The profile is deep with little gravel in the subsoil. The texture of the exposed surface soil is sandy to find loaming or claying.

Okusami: et al 1983, concluded in their characterization of soil on an erosional topo sequence in the guinea savanna of Nigeria, that more landscapes, especially the sandy ones; are continuously being eroded. The erosion in effect, causes a cover up of the relatively fertile lowland hydromorphil soil and exposes infertile subsoil horizon on the upper part of the landscape.

Obi 1982 in the assessment of soil loss under different covers (various management practices) observed that the average soil loss under bare fellow management was 5.5kgm^{-2} with average rainfall 177mm a month and compared it with another loss in the same plot in the proceeding year of 3.5kgm^3 corresponding to 55 and 35 tonse/ha respectively.

2.9 IMPACT OF CROPS ON SOIL

F.A.O. 1979 reports that when an eroded land is cultivated, 2-5mm of the top soil layer is lost in a heavy storm or runoff in a matter of hours or days when soil is saturated.

Mbagwu (1986), while referring to the eroded soil of southern Nigeria observed that, under forest savanna vegetation, most of the soils in the erosion site exhibit low bulk densities, reflected in high void ratio. The bulk densities generally increase with depth. Badly eroded soils with little or no erosion. Also, following land clearing and subsequent cultivation, there is a rapid increase in bulk densities. This is primarily due to compaction by high intensity rainstorm and resulted in structure deterioration as reflected in drastically reduced water intake capacity.

F.A.O. (1965) stated that gullies cut field into irregular sections, often making them unworkable, and continually engulf more and more kind. Trees and grasses may due and the area may be completely abandoned. Examples of such bed lands exist in Agulu, Ekwegbe Nanka-Oko axis, Amucha and Ohafia etc. all in Anambra and Imo states respectively.

A comparable physical deterioration without net loss has been called paddle erosion because it can take place in a puddle. This physical break down of structure by rain, and the washing into depression of the fine soil and choked soil surface whose productive ability is much lowered. Another physical translocation is the washing down less pervious layer down the profile. There are two possible implications: the loss of fine particles at one point and their increase at another point.

In coarse sandy soils an appreciable reduction in colloids and clays can result from vertical erosion with a consequent reduction of fertility. The point at which the fine material accumulates is also likely to have some undesirable effect when the result is the formation of a layer less permeable to both roots and water (Hudson, 1971).

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter deals with the research design, population and sample of the study area and research instrument, sources of data and method of data analysis.

3.1 RESEARCH DESIGN

It should be noted that the design of a research is the basic plan of how this research should be done and it guides the data collection and analysis phases of the research. The design used is descriptive statistics. This serves as a master plan specifying the method and procedures for collection of data and also describes the impact of erosion on arable land and both physical and chemical analysis of the eroded soil.

3.2 POPULATION AND SAMPLE:

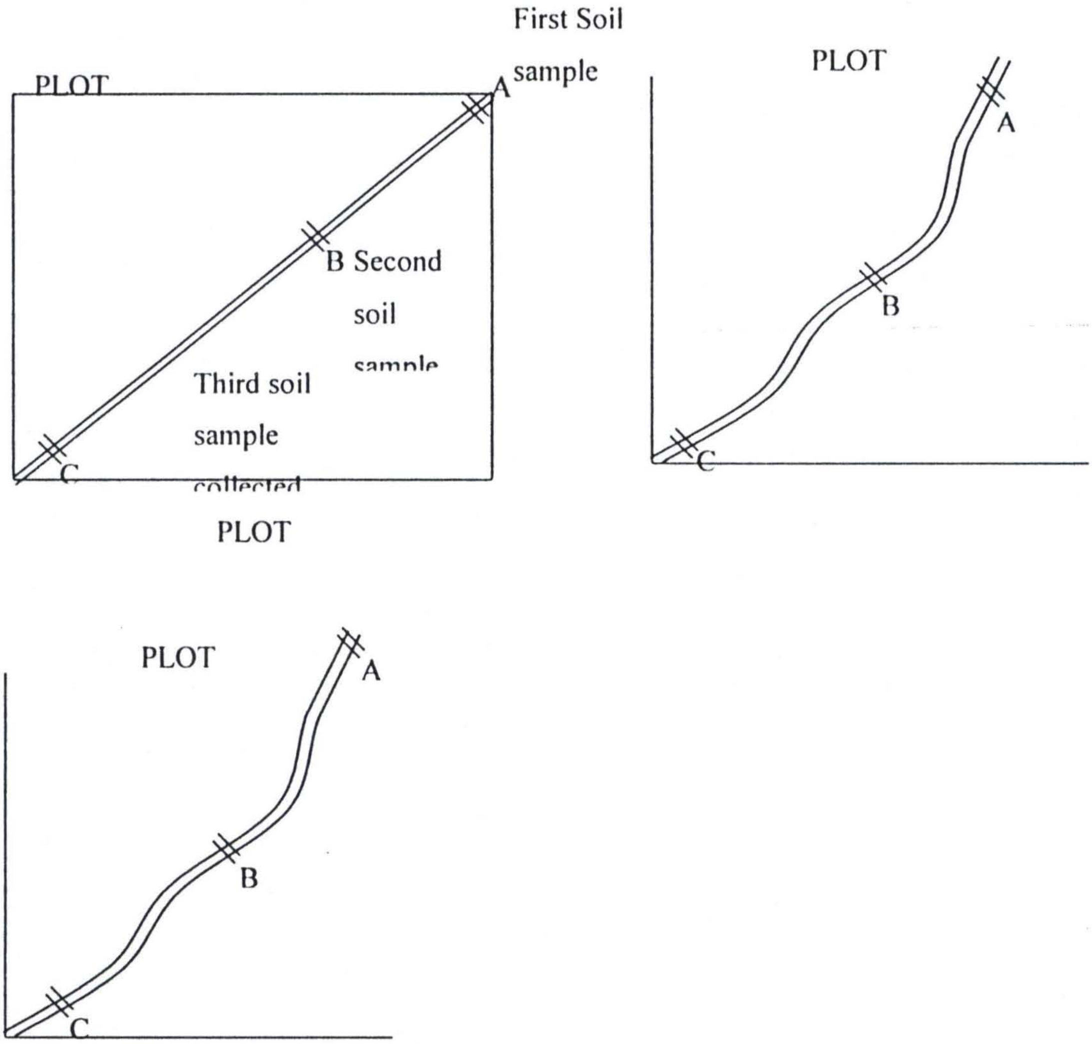
The researcher undertook the study of the Obudu cattle Ranch environs in respect to their erosion problems

The researcher sampled three erosion sites and various soil samples were collected and both physical and chemical analysis were carried out.

3.3 RESEARCH INSTRUMENT

The instrument used for this research work are, personal interview, direct observation, both physical and chemical soil analysis which include, particle size distribution P.H. value, Nitrogen, Phosphorus and potassium analysis and text books.

Soil samples were collected from three different spot in each erosion sites as stated below using various graphs.



Source – field survey

This sections were tagged A, B and C in each plot.

These soil samples were collected with soil Augar at each point of collection and were being put in a polythene bags and labeled appropriately.

3.4 SOURCES OF DATA COLLECTION

Data was sourced from primary and secondary sources.

3.4.1 PRIMARY SOURCE

This deals with direct observation and physical and chemical properties of the soil. Oral interview was conducted coupled with personal observation and soil analysis to support the inadequate information.

Soil samples were taken transversely from three (3) selected erosion sites and analysis was made on the P.H. level, their particle size distribution and density. Also chemical analysis of the soil Nitrogen, phosphorus and potassium was determined during the analysis. And also photographs of the selected sites were taken.

3.4.2 SECONDARY SOURCE

This deals with information obtained from published and unpublished documents e.g. seminars, conferences, lectures and textbooks.

3.5 METHODS OF PHYSICAL & CHEMICAL SOIL ANALYSIS

3.5.1 METHOD OF DETERMINING SOIL P.H.

Soil P.H. can be determined with colorimeter P.H. indicator. The indicator method is used primarily as "quick text" in the field and can measure soil P.H. to within +0.2 unit of the true value. This method is based on the principle that some or a combination of dyes change colour with increase or decrease of P.H., thus making it possible within the range of the indicator to estimate the H+ ion concentration of a solution.

To determine the soil P.H. colorimetrically, saturate the soil sample with a dye e.g. an organic dye and stand in contact for some few minutes Ru a drop of the liquid out and observe its colour using a P.H. colour chart read out the P.H. of the soil.

PROCEDURES

To calibrate the P.H. meter, (which is always necessary before the soil P.H. is read) the P.H. meter is adjusted or standardized with buffer solutions of known P.H. like P.H. 4.0 and P.H. 7.0 solutions.

A soil suspension is first created before the P.H. is read. For the suspension distilled water, 0.01m $CaCl_2$ or IN KCl solution. Instead of distilled water for suspending the soil in order to mask any variability in the salt content of the soil. The result is a lower P.H. value.

APARATUS:

P.H. meter, 50ml beakers and stirring rods and thermometer.

REAGENT

0.01m $cacl_2$, IN KCL, P.H. 4.00 and 7.00 buffer.

Steps followed when determining soil P.H. 10g of 2mm – serve air-dry soil into each of four 50ml beaker.

To the soil in one beaker, add 10ml of distilled water. This gives soil solution ratio of 1:1.

To the soil in the second beaker, add 20ml of distilled water. This gives a soil solution ratio of 1:2.

To the soil in third beaker add 19ml of distilled water and 1ml of 1.0N Hcl acid i.e. added to demonstrate the buffer capacity of the soil.

Add 20ml of 0.01m $CaCl_2$ solutions. The use of this salt solution will demonstrate the effect of a neutral salt on the P.H. of the soil suspension.

Stand for 30 minutes with occasional stirring using a glass rod. This allows time for soil aggregate to break down and equilibrate with solution and atons Co_2.

Read the P.H. of the soil suspension in each beaker with the P.H. meter.

3.5.2 PARTICLES SIZE ANALYSIS

SIEVING METHOD

This method is further subdivided into dry sieving and wet sieving.

Dry sieving was used in this analysis. Dry sieving involves, the sieving of dry soil through a series of sieved with different mash size, each corresponding to the diameter of the soil particle to be determined. The amount of the soil particle to be retained in each sieve after shaking is collected and calculated as a percentage of the total amount of soil used originally.

The sieving method has serious limitation particularly, when used to analyse soil high in clay particles.

3.5.3 DETERMINATION OF "AVAILABLE" PHOSPHORUS IN SOIL

Plants depend mainly on the phosphorus present in soil solution ($H_2 Po_4$ and Hpo_4^{2-}) for their phosphorus uptake. Phosphorus forms insoluble compound with ions like Ca^{2+} Fe^{2+} and Al^{3+} in soils. Because of this, the amount of phosphorus in soil solution at any time is very small (commonly about 10^{-15} to 10^{-6} ppm depending on soil P.H.).

3.5.4 DETERMINATION OF AVAILABLE NITROGEN IN THE SOIL (SEMI-MICRO KJEL DAHL

Much of the Nitrogen in the soil organic matter and plant tissue exists in the form of protein, in which Nitrogen is present mainly as the amino acid group ($-NH_2$) attached to carbon ($-C-NH_2$).

In the kjel dahl procedure this form of Nitrogen is oxidized to $(NH_4)_2 S0_4$ by Conc. H_2S0_4.

APPARATUS

800-ml kjeldahl digestion flask distilled apparatus, analytical balance.

STEPS

Weigh out 2g of 100-meshed soil into 800ml kjeldahl digestion flask.

Add 25 ml of conc. $H_2 SO_4$.

Add about 11g of kjeldahl digestion mixture using a long stem funnel.

Swirl gently to throughly mix acid and sample splace the flask of the kjeldahl digestion apparatus and turn on the switch.

Digest at low heat until frothing ceases. Turn off the heat, remove the flask, cool and add 100ml of water slowly and with shaking.

Measure out 25ml of 4% of boric acid (plus indicator) and 25ml of water into a 500ml Eilenmeyer flask.

Place the 500-ml flask under the receiving tube of the distillation action unit in such a way that the end of the tube is below the level of the $H_3 Bo_3$.

Open the value of the cooling water on the right of the distillation unit.

Add 2 or 3 pieces of mossy zinc or boiling chips and immediately attach the flask to the still.

Turn the heat on low and swirl the flask to mix the contents.

Titrate the distillate with standard acid (0.025 N $H_2 So_4$) until disappears.

Run the blank without soil sample.

The blank gives the amount of Nitrogen present in the reagents.

3.5.5 DETERMINATION OF AVAILABE POTASSIUM IN THE SOIL

APPARATUS:

Flame photometer, centrifuge, and 100ml volumetric flask.

REAGENTS:

Acetic acid, glacial and NH_4 OH Conc.

PROCEDURES:

To 5g of sample, add 30ml of 1 N NH_4 OAC and shake on a mechanical shaker for 2 hours.

Centrifuge (2.000 pm for 5-10min.) carefully decants the clear supernatant into a 100 ml volumetric flask.

Add another 30ml of NH_4 OAC solution and shake for 30 minutes centrifuge and transfer the supernatant into the same volumetric flask.

Repeat step 3 and transfer the supernatant in the same volumetric flask.

Make up to mark with the NH_4 OAC solution. Determine K, Na and Ca on a flame photometer. Determine mg. Ca and Al on an atomic absorption spectrometer.

CHAPTER FOUR

DATA PRESENTATION AND DISSCUSSION

4.0 INTRODUCTION

Data collected from the survey are on the impact of erosion on arable land in Obudu cattle Ranch of cross River State for clear and logical presentation and analysis, the data was presented in tabular manner. This will enable the researcher present the fact in a define form.

TABLE 4.1 PRESENTATION OF AVERAGED CHEMICAL ANALYSIS RESULT IN PLOT A, B, and C.

	P.H	NITROGEN	POTASSIUM	PHOSPHORUS	REMARKS
PLOT A	4.3	0.050	0.24	1.76	Low
PLOT B	5.6	0.65	0.16	1.58	Low
PLOT C	5.2	0.061	0.09	1.57	Low

Source: Laboratory test 2002

The fertility of the soil is generally so low from (Table 4.1) the Nitrogen ranges from 0.050 to 0.065. This is an indication that the Nitrogen content of the soil is low. Like the other Nitrogen, the potassium is also low with ranges from 0.09-0.14. The same could be said for both P. H and phosphorus, which ranges 4.3-5.6 and 1.57-1.70 respectively. This is an indication that the topsoils washed away and depleted of nutrient for cultivation, due to the impact of erosion on Arable land. So this soil could not support Agricultural production except, little vegetable production as shown in plate 4.1

TABLE 4.2 PHYSICAL ANALYSIS TABLE

	SAND	SILT	CLAY	TEXTURE	NAME
PLOT A	84.6	5.0	5.0	Loamy	Sand
PLOT B	8.36	7.2	6.6	Loamy	Sand
PLOT C	55.8	7.6	4.6	Loamy	Sand

Source: Laboratory test 2002

The particle size distribution of the soil is generally high from (Table 4.2). The Sand particles ranges from 55.8 to 84.6. This is an indication that the sand particles are pure gravels that the fine loamy soil has been eroded away. Like the sand, the silt particle is also high with ranges from 4.6 to 5.0 to 7.6, the same could be said for clay, which ranges from 4.6 to 6.6 respectively. This is an indication that the topsoil is washed away leaving gravel and sand particles on Agricultural land which cannot support food cultivation.

4.2 PROBLEMS OF EROSION IN OBUDU CATTLE RANCH

The problems associated with erosion on the Obudu plateau is that of overgrazing by the livestock. The cattle ranch is a rangeland where livestocks are kept. This livestocks are mostly left on a free-range systems (extensive). These animals feed intensively on the grasses and when ever there is heavy rainfall, it easily erode the top surface of the soil, which will eventually lead to erosion and soil degradation.

Also another problem is that of farming systems. The inhabitants of these places are involve in Bush fallow system and crop rotation. Here the small scale farmers are involve in Bush burning as a method of cleaning their farmland for next cropping season. Bush burning helps in killing some microorganisms in the soil, which support plant growth and also helps in exposure of the surface grass land to surface run off.

Farming in the cattle ranch is usually along slope instead of contour farming. Slopes generally accelerate erosions, which will easily lead to gullies.

More so, settlements around the cattle ranch have contributed greatly to the erosion problem. The inhabitants of these areas are engage in Deforestation either for building materials or as fuel wood. After deforestation, the land is open (left bare) which eventually will lead to erosion on farmlands. (See plate 4.2) Gullies are the result of the deforestation.

Plate 4.1: Shows Vegetable farming at the Cattle Ranch

Pate 4.2: Shows Gully as a Result of Deforestation due to settlement

Another problem of soil erosion on the Obudu cattle ranch is that of topography (Slope). The farmland or the land, generally, is a menteuneus area that has steep slope running from the top to the bottom of the mountain. During rainy season these slopes are easily eroded because of their steep nature. (See plate 4.3 and 4.4 the slopes are gradually eroded from the top bottom forming ditches at the bottom of the mountains.

Nevertheless, the rainfall Patten/distribution is normally very high cutting across 8 months of the year. (i.e March to November). Rainfall is intensive in this area and these accelerate erosion in the study area.

Rainfall helps in eroding the farm land gradually, leading to soil nutrients depletion.

Lastly another problem of erosion on the cattle Ranch is that of roads. This road is constructed, cutting across different mountains with sharp valleys at the sides. The valleys along or by the sides of the road necessitate fast run off which give rise to erosion. Another cause of erosion on the roads is that of heavy vehicle, which ply the road.

Plate 4.3 Shows Gully Erosion along Slope at the Ranch

Plate 4.4 Shows the bottom of the Gully as it turns into Ditch

4.3 DISCUSSION OF THE RESULT

The findings of these research work shows that the fertility of the soil is low, indicating that the soil nutrient components are so low

These can be as a result of the types of erosion found at the cattle Ranch, which ranges from sheet Rill to gullies

The Gullies are predominantly found along slopes due to run off from the hills to the bottom of the mountain. The land in the cattle Ranch is mountainous (undulating) at the bottom of the mountain large ditch is found. The gullies start from the top of the mountain to the Foot of the mountain. The gullies predominantly cut along mountain and also along slops. The gullies have a length of about 10m long and width of about 2m wide (see plate 4.3 and 4.4). The gullies are relatively narrow at the beginning and getting wider and wider at middle to the end of the mountains. As these gullies continue down wards, some other new ones are form cutting across the former ones. These makes this gullies look as if it has been the nature of the land from time immemorial.

The same thing is applicable to Rill erosion; the arable land is continuously washed away. Rill erosion is normally found where there is gentle slope at the Ranch. The velocity of run off becomes sufficiently high, and this gradually removes the soil nutrient and leads to soil nutrients depletion and soil degradation in the study area. The rills are about 60cm wide and lm long. The Rills are generally small from the onset and continue to erode the sides gradually from the middle to the points it terminates. (See plate 4.5).

More so, sheet erosion have made the topsoil to form hard pans and the soil becoming sterile. This is because the topsoil that supports plant growth has completely been washed away.

Sheet erosion in the study area is wide, it has no define form and the length and width is rarely quantifiable, because it occurs on large expanse of land. Also the valleys that are found at the end of each slope can accelerate sheet erosion due to the topography of the land. (See plate 4.6. and 4.7).

4.4 IMPLICATION OF THE FINDINGS

It was observed from the findings that

- Rain fall in the cattle Ranch was heavy, up to 4280mm distributed unevenly within the nine months. Because of this, soil nutrients were being washed away, leaving unfertile soil, which could not sustain plant growth behind. The fertile soil that has been carried away by erosion will be deposited on another land making it very rich in fertility.
- The in fertile land left behind will form colloidal particles resulting into crakes and hard pans.
- The low fertility of the soil in the cattle Ranch can lead to famine. Also low fertility will lead to poverty, as the farm produce will not be up to what it ought to be. And poverty can bring problems like pestilence and diseases.
- Also, if the Government fails to do Tree planting campaign or encourage people to plant trees, the cattle Ranch areas will be prone to earth quake, land slide and volcanic eruption.

Furthermore, the impact of erosion will reduce the countries per capitals income.

Plate 4.5: Shows Rill Erosion on the Cattle Ranch

Plate 4.6: Shows Sheet Erosion as a result of Topography

Plate 4.7: Shows another Sheet Erosion

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