ASSESSMENT OF RESOURCE POTENTIALS OF PART OF ERO-CATCHMENT BASIN IN EKITI STATE USING SATELLITE IMAGERY

BY

OMOTAYO JOSHUA OLU
M.TECH/SSSE/613/2000/2001
(OND, HND,B.TECH.URP)

BEING

A DISSERTATION SUBMITTED TO POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA. IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER DEGREE OF TECHNOLOGY IN REMOTE SENSING APPLICATIONS.

DEPARTMENT OF GEOGRAPHY SCHOOL OF SCIENCE AND SCIENCE EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE, NIGERIA.

MARCH, 2002.

MARCH 2002
CERTIFICATION

The dissertation entitled "assessment of Resource Potentials of Ero-Catchment Basin Using Satellite Imagery for Sustainable Development in Ekiti State" by **Omotayo Joshua Olu** Meets the regulations governing the award of the master degree of the Federal University of Technology, Minna and is approved for its contribution to knowledge and literary presentation.

A.A. Okhimamhe
.... 05/04/02
Dr. A.A. Okhimamhe
Supervisor
Date

.... 5/4/2002
Dr. M.T. Usman
Chief Examiner
H.O.D
Date

.... 7/11/03
Prof. J.A. Abalaka
(Dean P.G.S)
....
Date

.... 11-03-02
External Examiner
(Prof K O Ologe)
Date

DEDICATION

This dissertation is dedicated to my wife and children and above all, to God Almighty who made it possible for me to see the dawn of these days.

ACKNOWLEDGEMENT

I registered my profound gratitude to God Almighty for seeing me through and more importantly, for given me understanding in carrying out this work. I wish to acknowledge with gratitude my indebtedness to various persons who have contributed in no small measure to the successful completion of this work. My first gratitude is to my supervisor **Dr. A.A Okhimamhe** whose constructive criticisms and valuable suggestions have been very much useful at every stage of this work. I commend her motivation painstaking efforts and readiness to help at all times. In deed, I am most grateful for all she did for me. Equally, I am very grateful to other members of staff of the department people like **Prof. D.O.Adefolalu** for providing the satellite image used for this works; **Prof J.M.Baba, Dr.G.N. Nsofor, Dr, Odafen, Dr.M.T.Usman, Dr.Akinyeye, Dr.A.Shaba, Dr. A.S.Abubakar, Dr.Akinyeye, Dr. A. Shaba, Mr.Saliu, Mr. Abubakar Bassa** and other administrative staff for their contributions.

I also appreciate immensely, the valuable contributions from **Mr. John Bayo Alabi** and the student of Ilejemeje High School for helping me in the administration of questionnaires during the field survey for data collection. I also wish to register my sincere appreciation to the management and staff of Ero. Dam water works in Ekiti State.

I am highly indebted to my parents and relations particularly my late father who put me in school and made me what I am today and what I shall be in future. Who could not live to see his good handwork, may his gentle soul have perfect peace and eternal rest Amen.

To my family members, my best half, **Mrs. Bukola Omotayo** and our children **Olusola Olakunle, Olatunde** and **Olalekan** for their love, endurance, moral and spiritual support, I profoundly expressed my sincere gratitude. Above all I am very grateful to God Almighty that gave me the power to become and the inspiration to write and accomplish the great task.

ABSTRACT

The study is aimed at assessing the resource potentials of Ero-catchment basin with the use of satellite imagery. The study also focus at extracting useful information or data from satellite imagery SPOT Xs 2 as an earth resources inventory/assessment tool. Its adequacy and efficiency as a single system tool for resource assessment for catchment basin studies was appropriately examined using Ero catchment basin as a pilot study location. The conventional remote sensing as well as computer aided method of analysis was adopted. The study vividly reveals that the use of SPOT xs satellite imagery data products makes detection of environmental features and their interpretation easier. The study had also identified, existing landuse, such as existing settlement, cultivated land, fallowland, water body (Reservoir), oil palm plantations, fishing camp, precious stones (rock out crops) and river channels/wooded land. The study had also established that the Ero catchment Basin has potentials for agricultural development such as large scale production of popcorn, sugarcane, cassava and oil palm, development of fish farming, tourism development, establishment of starch factory, provision of potable water for over 62 towns and villages both in Ekiti and Ondo states; the possibility of converting Ero Dam to hydropower dam through inter-basin transfer to check the problem of power outages in

the catchment areas. The study proposed one hectare rainfed fish farm for would be potential fish farmer in the area. For the identified potentials to be properly harnessed, there must be an efficient safe and comfortable means of transportation via a good network of roads. Therefore, it is imperative that all the roads within the catchment basin must be tarred to facilitate development and to encourage investors to invest in the development of the resource potential for a sustainable development.

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CHAPTER ONE

1.0 INTRODUCTION

11 BACKGROUND

Natural resources constitute the greatest percentage of the wealth of the world and therefore of a nation, region or state. They are essential for the creation of the products that man finds necessary in order to live, his food, clothing, possessions, power and machinery. In geographical terms, these resources can be defined as the commodities that nature provides under, on and above the surface of the earth: minerals, rocks, soils, water, plants, animals and air. In fact., they can be seen as the one link between man and his environment. The greater the exploitation of these resources the stronger is the man-environment relationship.

However, resources are not limitless. Some are being used, others are latent and not being used to their full potential, but all are said to be ultimately limited in supply. Even those that are renewable are limited in supply at any one moment. Indeed, as population increases, man's natural resources are becoming relatively more scare still, in that the inexhaustible resources (water and air) are being polluted.

Thus the importance of natural resources is taking on a new dimension in Ekiti State. Not only do they underline man's activities but also, through their excessive use, they are giving rise to concern about the assessment of resources potentials of Ero-Catchment Basin for sustainable development.

Every country aims at improving the quality of life for its people. The use of local resource may help to achieve this lofty aim. From a human point of view, resources can be internal and of a spiritual or it can be external as the collective means possessed by any country for its own support or defence. In the external case, it consist essentially of the assets of the environment. However, the external or environmental resources cannot be fully realized by man or group of men who do not posses the internal assets especially intelligence, imagination, push , capacity for work and technology.

Thus the term 'resources' is currently be defined culturally as an abstract concept which hinges upon man's perception of the means of attaining certain socially and economically values goods, within the limits of the bio-physical environment. In the context of this work, the emphasis is on the external or environmental resources or natural resources such as rangeland, Fadama land for the propagation of sugarcane and arable farming; water site for tourist development land for oil palm large scale farming and reservoir for hydro-power generation as well as for irrigation farming all these and others are open.

These resources are often utilized in several ways. The most important of these according to Flawn (1970) are:

For materials for energy and for direct consumption, to sustain life directly. In summary, resources are defined by mankind perception and attitude, want, technology, legal, financial and institutional arrangement as well as by political customs so, what is natural resources in one culture, may be a neutral stuff in another culture and what is a neutral stuff in another culture today, could be become a resource in that same culture tomorrow

1.2.1 RESOURCE POTENTIALS ASSESSMENT AND SUISTAINABLE DEVELOPMENT

1.2.2 SUSTAINABLE DEVELOPMENT

The origin of the term sustainable development (SD) has been traced to the UN conference on the human environment; held in 1972 at Stockholm. The UN Conference's report; Our Common Future, 1987, revolutionized and popularized the idea of sustainable development. It defines sustainable development as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. From the above definition therefore, two concepts have emerged viz:

(1) "The concept of needs in particulars, the needs of the world's poor, to which overriding priority should be given and (2) The idea of limitations imposed by the state of technology and social organizations on the environments ability to meet present and future needs.

Economically, sustainable development (SD) means development "that is likely to achieve lasting satisfactions of human needs and improvement of the quality of human live" By ecological sustainability, it means a development that does not only prevent the depletion of the earth's non-renewable resources but that also preserves the earth's regenerative capacity and prevent damage to earth's resources.

In summary, sustainable development (SD) is a development that improves the quality of life, within the carrying capacity of the earth's life support system.

1.2.2.2 RESOURCE POTENTIALS ASSESSMENT

The total resource – base available to man can be assessed and calculated through the use of elemental abundance of such a mineral. What is being measure in gram-per metric form is multiply by the total weight of the earth crust to the depth of 1km. For instance, the elemental abundance of Gold is said to be 0.05g/metric tonne and the total weight of the earth crust is 24 x 10^{18}. Therefore, Resource Base – Elemental abundance of mineral x total weight of the earth crust = 0.05 x 24 x 10^{18}

= 244.68g/metric

It has been argued that only a small fraction of the element will be exploitable or extractable in practices given the available technological innovation at that point in time. It is equally argued that resources base is not as important as the rate of consumption because this will determine what will remain in the future for posterity, that is why sustainable development (SD) is very important and hence, the need for resource assessment is a result effort were shifted and focus on calculating life expectancy of resources. This is calculated base on the assumption that the technology for its development will occur to allow all available elements to be exploited or extracted at a very low cost that will be enough to maintain demand level.

In assessing the resource potential of a river catchment, other approaches that can be employed include among others, reserved or proven resources, hypothetical resources speculative resources, condition reserve resources and ultimately recoverable resources. Apart from the above, assessment of resource potentials of a catchment basin must be focussed on three aspect: Distribution in space, variability in time and stability.

Environmental factors differ with respect to these characteristics (Young, 1974) The distribution patterns of geology, landforms, ground water, soils and regulation which can readily be represented on maps often show some degree of spatial co-variation. On the other hand, climate, surface water, fauna and disease each exhibits spatial variation and some properties of soils vary very little while groundwater and vegetation show substantial but fairly predictable seasonal variations. Finally, climate and surface water exhibit larger and less regular variations in time.

The stability of an environmental factor refers to its resistance to change induce by landuse. Geology and macro-climate have high stability in forms of landuse. Similarly, landforms are moderately stable except where there is a severe impact of gully caused by accelerated erosion.

Other environmental resources such as groundwater, soil vegetation and fauna are the most unstable, or fragile, being relatively easily modified or totally destroyed. This suggests that natural resources survey and assessment in any region or state is not solely a matter of mapping static distributions. It is equally important to establish the nature and magnitude of variations in time to determine the functional relations between present landuse and resources and to estimate the effects on the resource base of planned future changes in use.

This study therefore, had taken cognizance of these parameters in assessing the resource potentials of Ero-Catchment Basin for the sustainable development (SD) of Ekiti State as a whole and Nigeria in particular. Since resource potentials assessment has gained widespread acceptance in the literature of resource planning. Resource potentials assessment can be defined as the assessment of the reliability of land for man's use in agriculture, forestry, engineering, hydrology, regional planning, recreation and industrial development etc. In the context of African countries the central problem of land resource evaluation is the assessment of the productive potential of land. This involves the capacity to grow crops both food and non-food, to support livestock by pasture or fodder crops and to produce timber from materials wood land or forest plantations.

This study had therefore, offered solution to this seemingly insurmountable problems by the introduction of satellite derived information and as swell as carefully adopted the two primary techniques of resource evaluation and assessment. The first of this was the description of the resource available in the study area and this is usually called that natural resources survey. Secondly, there was the evaluation or land –classification in which the resources offered by the environment of the catchment basins are assessed in terms of their potential production.

Basically, the reservoir/dam constructed along Ero-river, its potentials for hydro – power generation had been assessed and recommendation made towards its being converted through re-design and re-construction to meet the criteria for hydro-power generation.

Secondly, the vast land (fadama land) within the catchment basin have been assessed and tested and found suitable for the production of sugar cane on a large scale. Thirdly, the potential of the catchment basin for large-scale arable farming or cropping had been assessed and found economically feasible. Most especially in the area of Popcorn production for potential Popcorn commercial seller far away from Ibadan and Lagos. Efforts have been place on the above three major areas others such as tourist potentials, fishing, oil palm, large plantations, burnt bricks making from vast land association with clay up stream etc are good potential s that can be developed for a sustained development.

1.1.3 REMOTE SENSING AS A TOOL FOR EARTH'S RESOURCES INVESTIGATION

The ultimate goal of remote sensing is to reach the stage of maturity when reliable information can, as a matter of routine, be generated for the management of our fragile planet. Lintz and Simoneth (1976) state that "remote sensing is the acquisition of physical data of an object without touch or contact" Howard (1982) defines remote sensing as " the acquisition of data and derivative information about objects or materials (targets) located at the earth's surface or in its atmosphere by using sensors mounted on platforms located at a distance from the targets and electromagnetic radiation".

Satellite remote sensing offers synoptic data at a selected scale and resolution. Although, there are a number of remote sensing tools ready to be used for environmental studies, there are few ecologists that actually use them. There is extensive literature on the potential of utilizing satellite remote sensing in resource potential assessment and other environmental studies but few examples where satellite data have actually been used to detect environmental parameters at an operational scale for practical applications.

By and large, which ever definition is adopted, to apply for understanding remote sensing, the essential focus is to note the purpose of this study is that remote sensing have been considered as an investigative tool for earth resources potentials assessment. It is a technology that has divers applications.

It usage has gone through a number of human endeavours which include invention, and utility of aerial photography with the advent of satellite remote sensing, the applications of usable and other positions of the electromagnetic spectrum both in the military and civil target analysis has expanded into information gathering, mapping and analysis of environmental science problems and issues.

For instance, in 1980 LACIE was replaced by a larger monitoring program called Ag RISTARS (agriculture and Resources Inventory surveys Through Aerospace remote sensing). This program uses air born remote sensing data, satellite remote sensing data and a cunning blend of visual and machine interpretation techniques to achieve seven operation goals. These goals are (I) the early warning of changes affecting production and quality of renewable resources (ii) Forecast of commodity production (iii) inventory of renewable resources (iv) classification and inventory of landuse (v) estimation of land productivity (vi) assessment of conservation practices and

(vii) detection and evaluation of pollution (LACIE) is Large Area Crop Inventory Experiment.

The 1980s and 1990s saw the launch of the second generation of Earth resources satellites. Like the landsat satellites they carried optical sensors but these sensors are controlled by linear arrays made up of microchips that can be pointed in any direction to obtain stereoscope images. The French satellite system probatoire del'observateion de laTerre (SPOT) with the literary meaning the earth observation test systems, is the first earth resources satellite to be launched from Europe. It is being operated by the French Centre National d'Etudes Spatial (CNES) with participation from both Belgium and Sweden.

To date two SPOT Satellites have been built and launched in 1986 and 1987 respectively. The first of these, SPOT –7 have a near polar , sun – synchronous, 832km high orbit which re[peat every 26 days. It has two push- broom scanner, two tape recorders and telemetry –equipment to transmit data to earths. The push broom scanner is a new generation of multi-spectral sensor (Wharton et al., 1981). These two identical pushbroom scanners are called High Resolution Visible (HRV) scanners and can be used to record in either pancromatic or multispectral mode (Begni 1982). The multispectral mode are used for environmental studies ranging from importance of natural resources in human endeavours. Indeed, natural resources and their products such as crops, water, livestock, minerals etc form the indispensable base upon which civilizations are built. Becht and Belzung (1975) have point out that social achievement within any country, region or state whether advanced or relatively backward is dependent to a large extent on the resources in that country. The urgent need to rapidly developed Ekiti State created in 1st October 1996 is informed by the fact that all the resource potentials of the state must be assessed and evaluated for sustainable development (SD)

Now, that the state has been broken away from old Ondo State where they enjoy derivation from oil revenue coupled with high level manpower but with low resources from national allocation. The big question then is where is the way forward? The state has to look inward and revitalize her economy by diversifying the economy through the assessment of the resource potentials of Ero-Catchment basin which cover about 30% of the total land area of the state. The existing resources essential for human survival and sustainable development are increasingly being depleted and scarce, the human population and demand for these resources are growing by leaps and bounds.

One beging to wonder and ask how to identify and up-date the information on the inventory and distribution of the natural resources in the state consider and encourage the use of natural resources on a long-term sustainable basis, and if possible, build into development projects the length of time necessary to replenish used resources being careful to consider the demands other than those being placed on the resources. The present study, however poses an additional question of whether we can effectively utilize the positive attributes of remote sensing technology, particularly, the SPOT Xs-2 to rapidly and more consistently assess the natural resource potentials of Ero catchment basin (ECB) for sustainable development in a place like Ekiti State. To see the possibility of using satellite imagery to assess the resources potentials of Ero-catchment basins for a sustainable development.

The general aim of this study therefore, is to conscientiously seek to assess the resources potentials of Ero – catchment basin using satellite imagery with a view of achieving sustainable development in the state. In view of the fact that numerous resources abounds within the catchment basin, this study has concentrated on a few but very important ones that each serve as development accelerators and generators These includes: the possibility of converting the existing Ero-dam into hydro-power dam, assessment of land for arable cropping (Crop specific, popcorn production land for arable cropping (Crop specific, popcorn production and sugar cane production), and water resource development for fish farming in order to increase the protein value and level of our life supporting system.

1.3 AIM AND OBJECTIVES

The primary aim of the study is to assess the resource potentials of Ero-Catchment basin using information derivable from satellite imagery SPOT Xs2 for sustainable development in Ekiti State. The objectives are:

a. To seek the possibility of using satellite remote sensing in assessing the resource potentials of Ero-catchment basin.

b. To use satellite imagery (SPOT Xs –2) to identify resources potential within the study area and make proposal for their development.

c. To recommend economically viable resource potentials within the catchment basin for long term investment with a view of achieving sustained development in Ekiti State..

1.4 JUSTIFICATION FOR THE STUDY

As a result of the accelerating technological development, population growth, urbanization, insatiable needs and the urgent task to develop and use water resources more efficiently, to consider the particular aspects of decision making, the process of implementation and operation and maintenance issue. The charging social and technological conditions and the widening range of alternatives require more comprehensive resource potentials assessment of catchment basin such as Ero for more flexible planning and implementation strategies for sustained development.

In addition to the focus on resource potentials assessment as such, emphasis is now also placed on a sustainable development of water and land resources and the equitable sharing of these resources by society as a whole.

This underscored the need for this study as being timely and not only that justified, since there are more salient potentials of Ero watershed that needs to be harnessed. They are most evident in the large fadama purpose which can be re-designed to serve as hydro-power generating dam, vast land for arable and other major tributaries that can serve as earth dam for fish farming etc. The world bank in some of its major reports about Nigeria observed that the issue of inadequate data for planning remains one of the most important bottle-neck militating against sustainable development in all sectors of the nations economy.

Nduaguba (1996) while commenting on the draft solid minerals document observed that no adequate earth resources data management systems has been put in place in any where in the country to ensure sustainable economic planning programming and planning for the nation's vast natural resources. This study is justified given the fact that resources data are not readily available and when they exist in the country, they are not accessible in a useable format to the intending user. Therefore, users of data set must appreciate the shortcomings of the data sets they intend to use before applying them for scientific studies.

Remote sensing and in particular SPOT Xs imagery data set provide important and potential source of data for resource potentials assessment for sustainable development of our environmental resources. This study is therefore justified in the sense that if SPOT Xs data set is found valuable for the assessment of resource potentials of Ero – catchment basin, we can be assured that we have a powerful tool for assessing and planning sustainable during the formative years of Ekiti State. Remotely sensed data have been in use in African for quite some decades now, most importantly in the field of aeronautical meteorology and telecommunication. In other areas of application, due primarily to cost constraints, manpower and generally poor –expertise, the utility value of remote sensing is still in its "infancy" on the continent. It has been established that five major areas of remote sensing applications in national development which have, hitherto, not been seriously utilized in the planning process of most African countries are in such activities relating to agriculture, urban planning, pollution control, weather prediction (not forecasting) and natural resources assessment. Usually, the neglect is blamed on prohibitive costs. But the underline salient reason is perhaps due to lack of awareness on the contributions which result oriented research using satellite data (backed by proper GROUND –TRUTH observation) can generate in national planning since these may not “catch” public attention.

In Nigeria, which is a microcosm of most developing countries, the last 40 years as an independent nation have shown that more problems have been created due to poor performance associated with inadequate data input which could have been better handled if remotely sensed data (that are now common place) had been available for forward planning at that time of independence in 1960. One of such problems is the inadequate assessment of resource potentials of our major river catchment basin, even at the eave of the establishment of River basin Development Authority (RBDA) IN 1976.

This study shows what remotely sensed data can contribute to sustainable development in Ekiti State in particular and national building in general. To this end, the research adequately addressed the most important aspect of remote sensing applications in assessing the resource potentials of Ero-catchment basin using SPOT xs imagery.

1.5 THE SCOPE AND LIMITATION OF STUDY

This study focuses it attention on the possibility of assessing the resources potentials of Ero-catchment basin using satellite imagery towards achieving a sustainable development in Ekiti – State. The study is limited to the delineated area within the catchment basin ($80km^2$) the scope can be highlighted as follows:

a. Assessing the viability of Ero-Dam for possible hydro – power generation to easy power outage in the state and its environs.

b. Mapping of the existing resources such as vast land for arable cropping popcorn and fish production on a large scale.

c. Finally, to recommend viable resource potentials for a sustained development and rapid transformation of Ekiti – State.

The general limitations and constraints encountered during the course of this study were not in any way differ from those any researcher in developing countries could come across in his/her efforts to carry out research works. It is imperative therefore, to summarize the constraints and limitations which were encountered in the course of the study as inaccessibility to some data such as Radar Image (SAR) , TM, MAPPER, and ERS 1 & 2 data, which could have been more adequate from their point of view of their vantage of day and night data acquisition ability to penetrate into clouds, rain and nights because they are independent of sunlight. Radar provides oblique illumination and can record information at different polarization. Moreover, the appropriate software for interpretation and analysis were not available for digital interpretation. The degree of reliability and the extent of being current of those reached; poor response from some respondents, and most importantly was that posed by the poor transportation problem due to bad condition of the road networks of the catchment basin. This invariably means that it actually costs many more hours of productivity to travel from one settlement to another than would have hitherto, cost in an area with a better transportation arrangement in terms of quality and efficiency. It worth mentioning that the author was financially handicapped in carrying out intensive and an indepths survey of the study areas. Instead, on the spot survey and assessment of the existing resources potentials were undertaken using the satellite imagery. The adoption of this method made it possible for me to able to surmount the seemingly in –surmountable.

These constraints and limitations not withstanding, the information that were obtained from both primary and secondary sources during the course of this study normally formed a good bedrock on which future and further works could be based in the study area with the required updating of the facts and figures given in the present work.

1.6 THE DESCRIPTION OF THE STUDY AREA

Ekiti State of Nigeria was created on October 1, 1996 along with six other states increasing the numbers of states in the Federation from thirty to thirty six states. Ekiti State was carved out of the former Ondo state of Nigeria and with little modifications as a result of boundary adjustments, the state cover exactly the original Ekiti province, from which the name of the state was derived see figure 1.1.

As of the time in question, Ekiti province now, Ekiti State had four administrative divisions from which the present sixteen (16) Local Government were created. The said former four divisions head quarters were the most urbanized centres as of now which can be attributed to concentration of developmental inputs in them over the years. This also implies the non-availability of resources inventory for their possible development. Hence, there is the urgent need for the assessment of the resources potential of the young state to bring about even development and poverty alleviation.

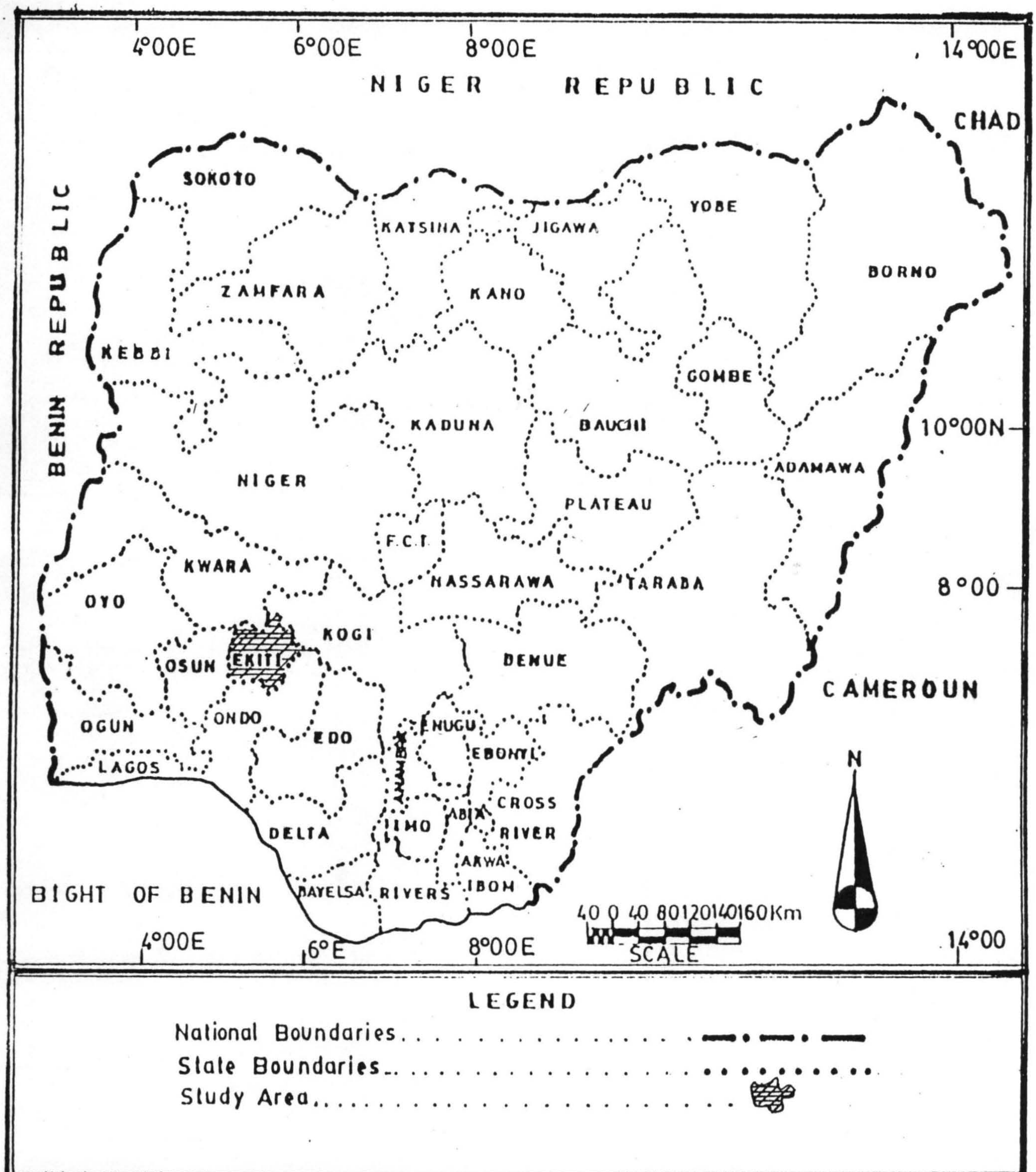


Fig.1.1: MAP OF NIGERIA SHOWING EKITI STATE

Source: Adapted from Map of Nigeria (Political) 1999.

The former four divisions and the present sixteen local government areas as well as their respective headquarters are shown in table 1.1 and 1.2 respectively.

Table 1.1: FORMER FOUR ADMINISTRATIVE DIVISIONS IN OLD EKITI, PROVINCE AND THEIR HEADQUATER.

DIVISIONS	HEADQUATER
1. Ekiti Central	Ado - Ekiti
2. Ekiti North	Ikole - Ekiti
3. Ekiti South	Ikere – Ekiti
4. Ekiti West	Ijero - Ekiti

Source: Ekiti State Information Division

TABLE 1.2: THE EXISTING SIXTEEN LOCAL GOVERNMENTS AND THEIR HEADQUATERS.

S/N	LOCAL GOVERNMENT AREA	HEADQUATERS
1	Ado	Ado-ekiti
2	Efon Alaiye	Efon
3	Ekiti East	Omuo Ekiti
4	Ekiti North	Ikole – Ekiti
5	Ekiti South West	Ilawe Ekiti
6	Ekiti West	Aramoko Ekiti
7	Emure	Emure Ekiti
8	Gbonyin	Ode Ekiti
9	Ido/osi	Ido Ekiti
10	Ijero	Ijero
11	Ikere	Ikere Ekiti
12	Ile jemeje	Edaoniyo
13	Irepodun/Ifelodu	Igede Ekiti
14	Isokan	Ise Ekiti
15	Moba	Otun Ekiti
16	Oye	Oye Ekiti

Source:- Ekiti State Information Division

The sixteen local government areas constitute the state as shown in figure 1.2. The study area is located between longitude 7°45' and 8°00' North, and latitude 5°02' and 5°22' East. Ero-catchment basin falls within the tropical zone. In the regional context the study area is bounded in the North by Kwara State, in the west by Oshun State, in the south by Irepodun/ Ifelodun Local Government of Ekiti State and in the East by Oye Local Government Area. Ero River has its source from Orin Ekiti according to the people who lives within the catchment basin.

From the ground truthing, it was found that the river course narrows from Aiyede Isan-Iludun and Ipere areas to Ewu where it becomes wider. There are lots of minor tributaries joining the main river on its courses from the source as shown in figure 1.3. Notable among the tributaries are those found in Ipere, Isan Itaji etc.

At Agama, the tributary is called Ero which means the actual Ero river not as wide as Ero dam reservoir starts, the reservoir extends for over six kilometers in a straight line from Ewu to Ikun as shown in the image one of the major tributary flows from Ikun as different from the one flood plains of Ero catchment basin generally, the drainage pattern is of the basin has a symmetric shape.

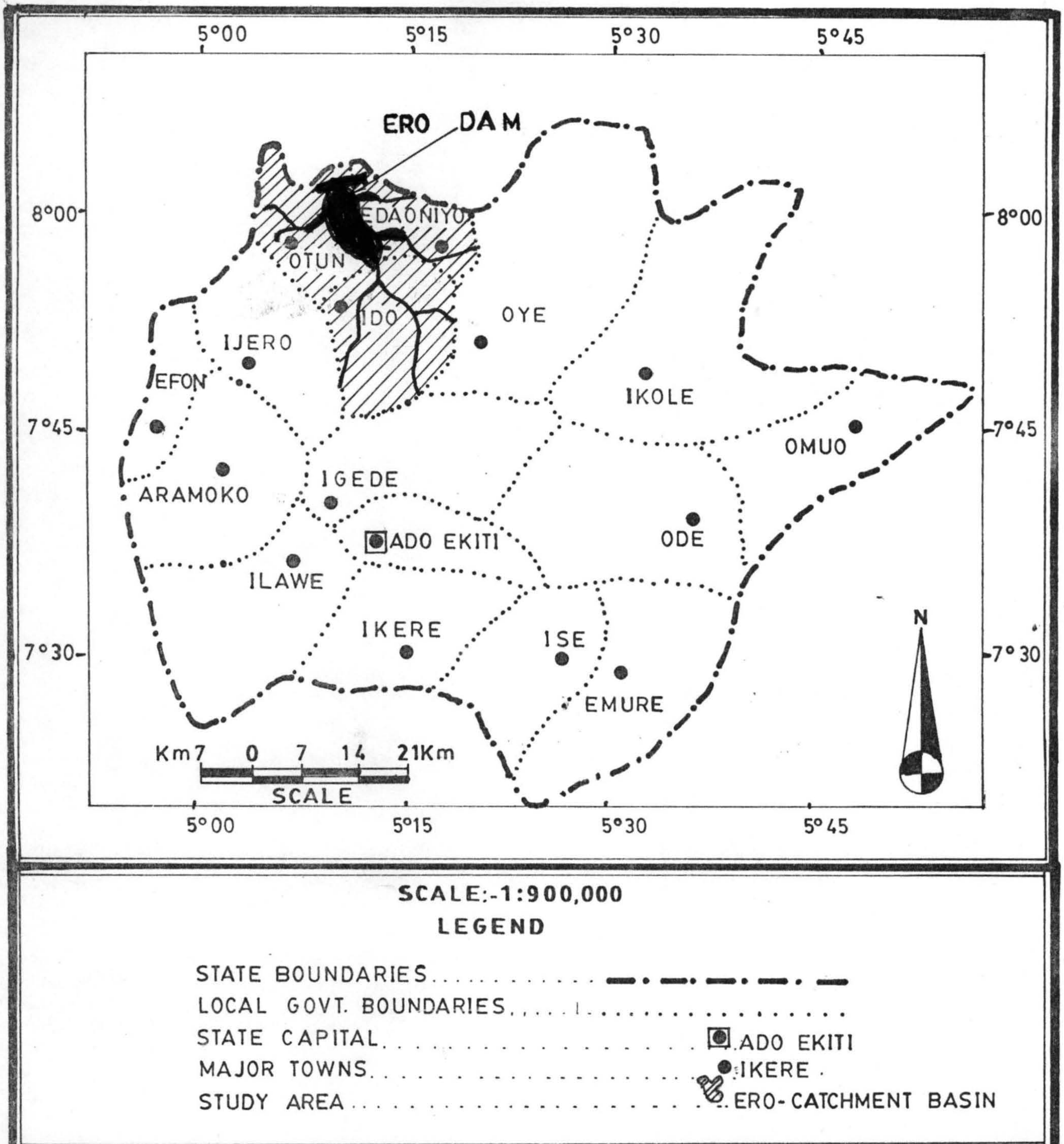


Figure : Map of Ekiti State showing the study area

Source :- Adapted from Ondo State map of 1994 with modifications.

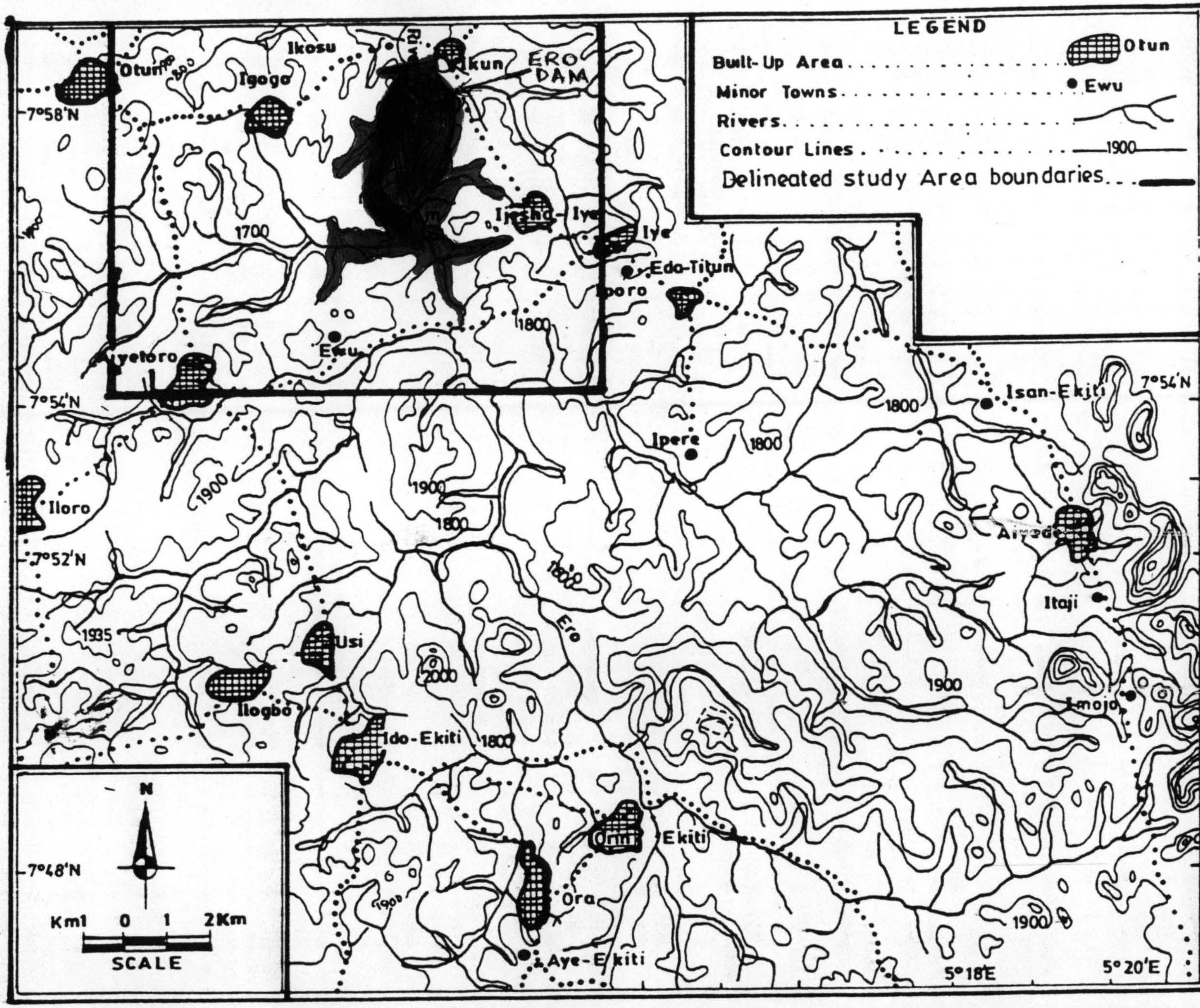


Fig.1.3:MAP OF THE ERO CATCHMENT BASIN SHOWING DRAINAG PATTERN.

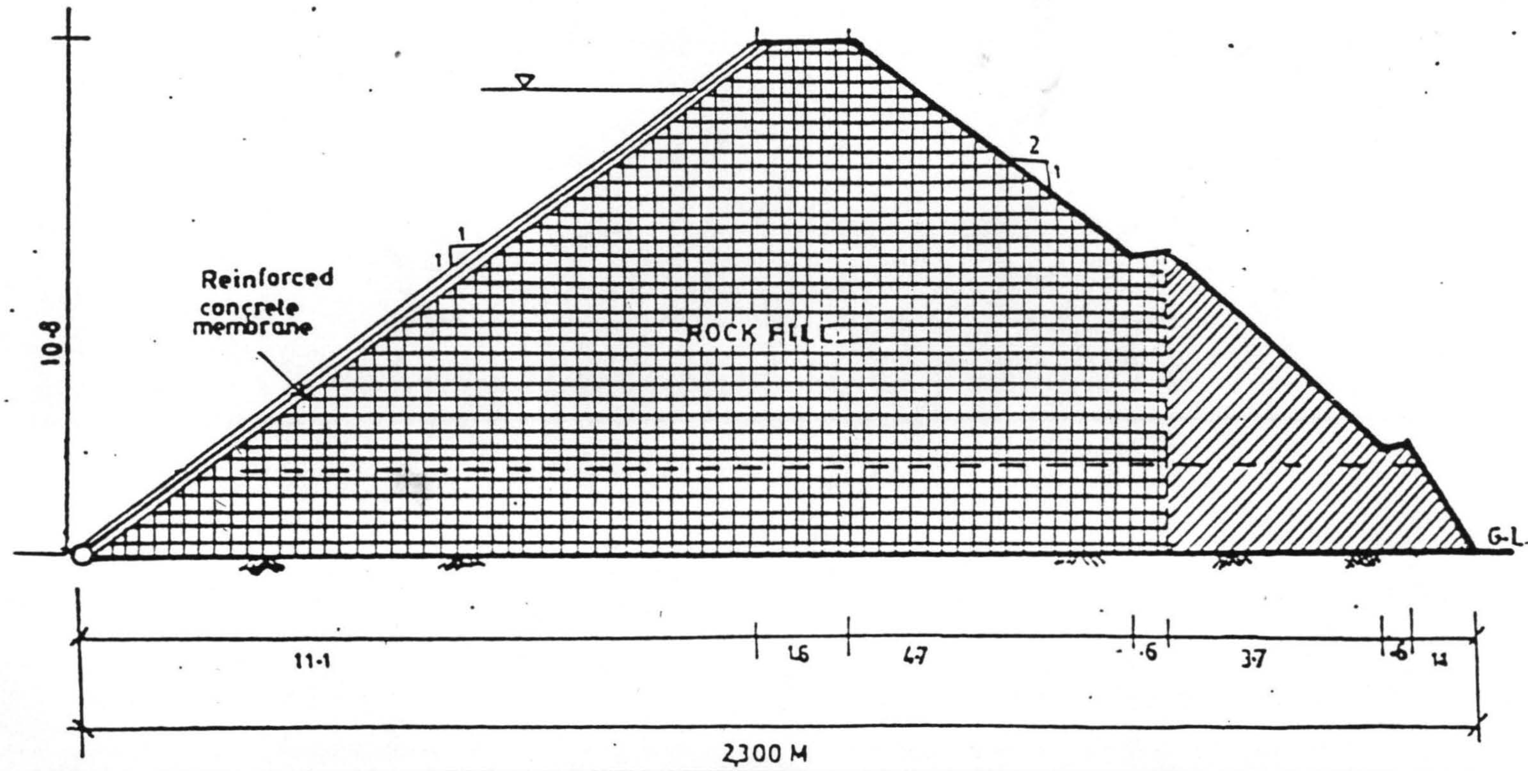
The flooded areas are also located at the banks of the river which happen to be a good breeding ground for fish see plate 1.1 and 1.2. When water is release through the dam, its flows down stream through floodable areas and valleys to Ikosu and other villages in Kogi and Kwara State. With time, the whole town will eventually move away from the river, because fears are usually expressed during heavy down pours and at the peak of rainy seasons. As of now, the only secondary school in the town located close to the river/tributary there has been abandon as a result of the rivers extension to the main land. The dam has three major materials components namely earth fill, Rock fill and concrete fill respectively see Figure 1.4 showing a typical section of the dam. The dam crest is about 1.5km. The dam has a capacity of about 26 million m3 per day for domestic water supply to about 62 towns and villages both in Ekiti and Ondo state respectively. By and large, an area of about 80km^2 have been delineated for this study.

1.6.1 RELIEF AND DRAINAGE

Generally, it could be observed that the catchment basin is located on basement complex associated with lowlands and undulating plains. The land rises form the south towards North. Isolated steep highlands are found in the western corridor.

PLATE 1.2: POTENTIAL FISH GROUND FOR LARGE SCALE FISH FARMING
SOURCE: FIELD SURVEY (2002)

PLATE 1.1: FLOODED AREAS ALONG RIVER ERO BANKS
FIELD SURVEY (2001)



SCALE:- 1:100

Fig.1·4 : A TYPICAL SECTION OF THE DAM

Source Field Survey (2002)

Four major land units have been identifies in the area, hill slopes, alluvial foot plains ground water woodland, and from river each unit has its own associated geological and ecological characteristics steep hills-slop (including) pediments and small hills) borders to the steep slopes having potential visual impacts. Accumulation of materials from the upper hill-slopes due to weathering forces has created coarse texture colluvia deposit, which usually results into high sedimentation of the dam. Ground water wooden land surrounds the seasoned/perennial tributaries in some pockets to the river. The seasoned streams flow in direct response to precipitation. The climatic condition of the study area is generally muild of the tropical type.

1.6.2 RAINFALL

The rainy season span between March to November. Mean annual rainfall ranges between 1,300mm to 1,400mm. The highest rainfall is recorded between the months of September and October. There is always a perennial "dry spell" in the month of August, September and October are the peak of the rainy season therefore, term the wet season. At the southward March of the solar heating regime from the tropic of cancer with the suns. Autumnal Equinox occurring(on the equator) in September, the retreat of the monsoonal rains is observed to be much faster than its northward movement between March and July (Adefolalu 1992).

Rainfall during the months of September and October are similar to April and May respectively that is why we have double maximal in the study area. That is two periods of wet seasons. By classification of Griffrith (1972) and other authorities on climate, a month with less than 60mm of rainfall is a dry month in the tropics. The amount by itself even though small is not the critical element in this classification what is given weight is residual soil moisture implications which will be negative because tropical areas with high temperature tendencies is prone to equally high evaporative power with result that little or no soil moisture can be derived from such low rainfall amount.

Mean monthly rainfall distribution patterns for January and February, confirm that these two months are DRY. Rainfall is generally between 20 – 50mm in most places except for Otun/Ido-Osi in January, that is Ero catchment basin due to the impact of Ero Dam on the microclimate. This shows its potentials in underground water supply.

- Phenologically, it is therefore not so much the amount of rainfall that matters, it is how much of it is available to dissolve soil nutrients (minerals which yield protein, sugar fat and carbohydrates as end-products) that plants require from the soil. A soil, which is very rich in nutrients, can only release them to plants if they are in solution. Where the amount of water in soil is in sufficient amount, there is a good level of certainty that plants will obtain adequate nutrients for good growth and possible high yield. But in a situation where plants do not have access to these nutrients, the resultant effect is crop failure.

Discharge and re-charge of impoundment's cannot take place effectively before March 21 at least, flooding/Erosion should be expected in the month of maximum rainfall (September and October). Due to this situation, irrigation scheme was integrated into Ero Dam Project as an alternative means to rainfed agriculture along the catchment basin. This is one of the major resource potentials of the catchment area but this potential is under utilized or not even addressed at all.

During the month of December to January, the cooler continental winds from the interior of the continent prevail. The temperatures are between 28°C and 32°C maximum and 26°C minimum and the humidity is very high during the rainy season and very low during the dry season.

1.6.3 VEGETATION

The vegetation of the study area can be described wholly as a typical derived Savannah with some wooded land vegetation in few pockets characterized by mixture of trees, oil palm and tall elephant spear grasses and mostly upertorium in the southern corridor. The flora of the remaining forest patches which is similar to that of the tropical rainforest due to the river tributaries, while the Northern part is associated with purely derived Savannah with scattered locus bean trees. Plant such as Kolanut, oil palm, Cassava, Yam and most importantly Maize inter-crop or inter-planted with sugar cane are predominant. See plate 1.3a and 1.3b for oil palm plantation.

1.6.4 EXISTING LANDUSE

Broadly speaking, all the major landuses are found at the down stream of Ero dam and at the periphery of the reservoir. These activities ranging from residential, commercial, transportational, agricultural, public and semi-public utilities etc.

There are pockets of fishing camps located along the bank of river both up stream and down stream by the Hausa and Nupe's. The transportational networks are very poor. Most of the roads were not tarred slippery during rainy season and highly dusty during the dry season see plate

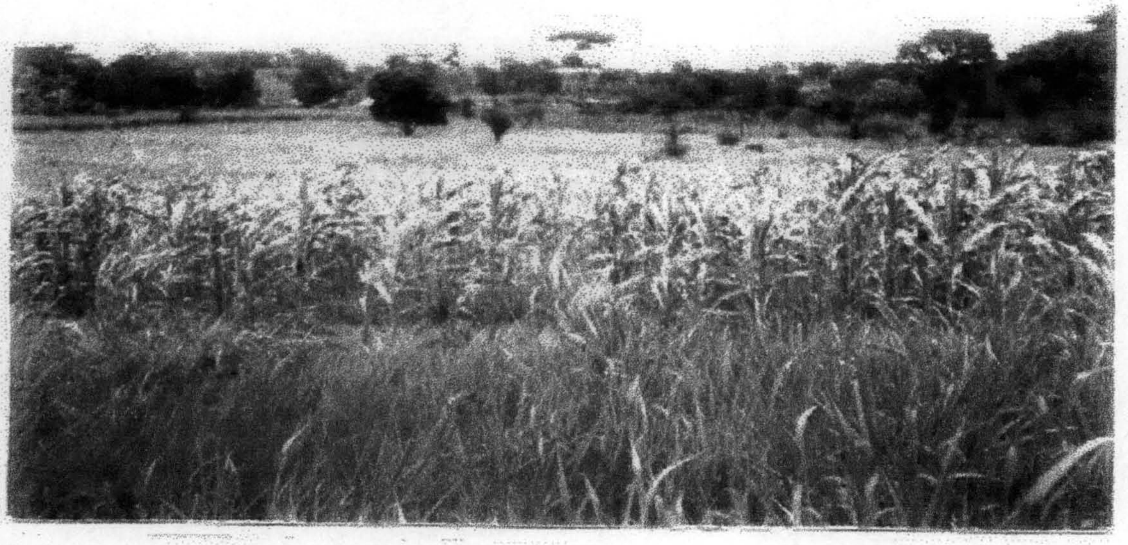


PLATE 4.1A: CULTIVATED MAIZE FARM
SOURCE: FIELD SURVEY (2001)

PLATE 4.1b: OIL PALM PLANTATION AT ILEJEMEJE
SOURCE: FIELD SURVEY (2001)

This poor accessibility has contributed in no small measured toward the backwardness of the study area. Since transportation is a function of landuse. Most potential investors cannot invest in harnessing the potentials of the catchment basin due to poor conditions of the roads. This poor condition notwithstanding a lot of popcorn buyers troops into the study area from places like Ibadan, Ife, Ilesha and Lagos to scout for popcorn.

Infact, popcorn production and cassava are the major crops growth in the area. Agricultural landuse predominate while un – developed land or land under fallows is quite large. The built-up areas inform of notable settlements includes Igogo, Ikun, Ikosu, Ewu, Otun, Ilejemeje, Iye, Ipere etc.

1.6.5 POPULATION

Population is the starting point in planning as well as in resource allocation and development. Population gives adequate input into forwards planning towards wealth creation sharing and distribution of social amenities amongst others for a sustainable development. Among the settlements found within the catchment basin (Ero) Igogo – Ekiti, Ikun, Ewu, Iye, Ilejemeje, and Ipere are moderately populated. Otun the headquarter of Moba local government areas is thickly populated.

1.7 ORGANIZATION OF THE THESIS

This thesis is divided into five chapters. The first chapter introduced the general concept of resources, assessment of resources, it's relevant to sustainable development. The subject of remote sensing was introduce as one of the tools for assessing resource potentials of catchment basin. Brief description of the study area is also highlighted. The objective, scope and justification of using satellite imagery for resource assessment studies are also discussed.

Chapter two gives a general overview of remote sensing and its application in resource potentials assessment. Chapter three discusses in brief the methodology used in carrying out the research and the interpretation of imagery used. While chapter four focuses on the analysis of findings as well as the description of result. And finally, the main findings of the research are summarized in chapter five and recommendation and directions for further research suggested.

CHAPTER TWO

2.0 LITERATURE REVIEW

Introduction: All countries, state or region in the modern day economy strives for cost effective approaches of optimizing the uses of its resources by assessing the potentials of such resources on the land and water so as to enhance food productivity and to avoid the natural hazard consequent exposing a hitherto protected soil. In an attempt to do this, many countries have adopted and opted for different developmental arrangements. Nigeria for instance, opted for the river basin development authority concept for the development of its water resources and the land area through which the rivers flow. What makes up a river basin therefore is not only the qualities and quantitative parameters of the river and its tributaries within the catchment but also the varied land related salient parameters upon which the optimization of the uses of the river will be based. These salient parameters include amongst others landcover, soil types terrain elevation, bedrock geology, surface hydrology, subsurface hydrology, zoning (Landuse plan) districts, irrigation areas, natural and man-made lakes, water and sewer districts, census tracts (socio economic data), transportation system, recreational resources) etc. All these can be regarded as surficial and non-surficial features, areal, linear and pivot features.

Before a resource is said to be effectively or properly assessed for its optimal utilization and management, there must a good information base on what is existing on the land. This data which is primary in decision making is what is seriously lacking in developing countries including Nigeria and Ekiti State in particular. It is not enough that such information gathered does not vary too much from the time it was obtained to time of decision making. Time scale noise is introduced between these stages; hence the information at the time of decision making is different from the information on the land at collection. A near real time information gathering system will be such that would attempt to annul the noise of the varying information on the catchment basin.

However, it is only in highly developed economics and more often for research purposes that a multidate photography at near real time basis for river basin surveillance can be approved. Aerial photography has been useful in vegetation, land cover, landuse, water quality, groundwater and surface water mapping, the major problem is that it is made once in a while. In Nigeria for example we have 1959 and 1975 air covers of the country.

A time scale of 16 years is rather poor for use in monitoring catchment basin resources on which effective planning and projections are based in view of the dynamic nature of the environment and charging technological advancement. The power of satellite remote sensing to provide repetitive coverage of some positions on earth in less than 1 month is perhaps a way out of the cumbersome conventional methods and costly air photography.

2.2 OVERVIEW OF REMOTE SENSING

Remote sensing generally involves data collection, analysis and interpretation that is, collecting (e.g. images) with sensors from airborne or satellite platforms processing and analyzing the data and converting the data to useful informations. Okhimamhe (1999) coined and defined remote sensing as a set of techniques (aerial photography and satellite imaging) used for obtaining information about the environment (earth surface and atmosphere) at some distance from them, usually by means of sensors which detect and record electromagnetic energy. The "task" of remote sensing is to complete these steps. The aim of remote sensing is to produce information, which can be applied in decision making or problem solving. In other words, the actual or ultimate problem is need of a solution.

The primary objective of remote sensing is to obtain environmental resources data relate to the earth in order to enhance our knowledge of the earth surface made up of lithosphere, biosphere and atmosphere; the utilization of the acquired knowledge for the benefit of humanity as well as sustainable development; the recognition and identification of varied developmental input potentials; reconnaissance information for braod base planning and comprehensive information for feasibility studies and project planning (large scale information). The research is to employ the use of SPOT Xs 2 imagery in assessing the resource potentials of Ero-catchment basin for sustainable development of Ekiti State.

2.3 SPOT (System Probatoire del'Observation de la Terre), Literary meaning the Earth Observation Test System.

The majority of the investigation so far carried out on resource explorations have been the use of earth resources technology satellite later known as landsat. Most importantly, greater percent of the projects in the literature review on hydrological and landuse investigations have been done using either landsat alone or singly or landsat in combination with aerial photograph.

Though the landsat offers a good synoptic view and a repetitive coverage of the catchment basin yet it has the major problem of resolution which is 78m along track and 57m across track directions. Likewise, its inability to give a stereoscopic coverage of a point on the earth surface reduces its chances of being used to produce cartographic work at an acceptable level of accuracy. The launching of SPOT by French Government in 1986 solved these two deficiencies. The SPOT panchromatic has a pixel size of 10m and Xs resolution of 20m. Three spectral bands are used in the SPOT in image detection recognition and analysis. These are Xs1 (0.51-0.73), xs2(0.62-0.68), xs3(0.79-0.8) and panchromatic (0.51-0.73) all in micrometers in the electromagnetic spectrum. In addition the SPOT has the stereoscopic capability by steering its rotated mirror in across track direction (to a maximum of 27°). This creates two viewing perspectives of a position on the earth and hence a stereoscopic coverage – the depth of which depends solely on the base: Height ratio (where base relates to separation of distance between the 2 taking position in the orbits and the height relates to the altitudes of the satellite – normally 832km). This not only makes it possible for us to produce planimetric and elevational dimensional characteristics of features at scale of 1:50,000 but also to produce digital elevation model of the river basin for further geographic information system (G.I.S) manipulation of the features in the basin. Thirdly, the different levels of images in SPOT aid wide varieties uses and instrumentation application.

Measurements of basin morphology are possible from the space, most especially with SPOT which revolves generally between 4 to 8 times of landsat, hence providing physiographic mapping over large area. Finally

SPOT which has a swath of 60km provides synoptic views over a large area of the catchment basin. This eliminates the tedium of making photomosaic from aerial photographs for regional study of the catchment basin.

2.4 REVIEW ON APPLICATION OF SATELLITES REMOTE SENSING TO RESOURCE POTENTIAL ASSESSMENT.

For catchment basin surveillance. The is extensive literature on the potential of utilizing satellite remote sensing in resource potentials assessment but few examples where satellite data have actually been used to detect different parameters at an operational scale for practical applications. In this study, effort has been geared towards the review of several previous studies in which remote sensing data have been used. The focus is on possibilities and limitations in identification of specific land for arable cropping, fish farming and collection of terrestrial environmental information for hydro-power project within the catchment basin that is, the possibility of converting Ero-Dam to hydropower dam and agricultural development.

Downan (1987) has shown the information capability of SPOT. Ononiwu (1989) supported the view. SPOT is yet incapable of use for mapping stream channel contours which allows estimate of stream channel depth and slope. However, with a combination of Digital Elevation Model

(DEM) which is extracted from the SPOT Imagery, a qualitative and to some extent quantitative estimate could be made both of depth, slope and channel widths. All these are always put into consideration in dam design.

Ononiwu (1987) noted that inventorying of our surface water in the River Basin is one of the easiest applications of satellite products. Water bodies by their shapes, and tone/colours are usually distinct and are not subject to serious geometrical deformation due to instability of image capture platforms. Even when they are. Their detection and interpretability are not seriously hindered.

This view is corroborated by Moritz Deutsch (1976) and Edwin (1970). Engman, (1983) and Albert Rango (1983).Quantitative estimates of surface flows using landsat have been discussed by Este F. Hollyday and Edward Plunowski (1976). The use of landsat for monitoring lake fluctuation and thereby calculating the capacity of the lake at any instant of image capture has been discussed with reference to Qomplaya (West Central Iran) by Daniel Kingsley (1976) also lake fluctuations in the Shiraz and Neriz Playas of Iran by Daniel Kingsley (1976).

These have provided useful data for the assessment and management of the water in their basin on real time basis. Different spectral values which waters in same basin have exhibited most especially in the lake systems have suggest the calibration of spectral categories on the false colour composite for monitoring and assessing water quality. Ononiwu (1989) while analyzing supervised classification of Lohja lake (Filand) suggested such possibility. How far this can go beyond physical analysis has been a subject of debate (contentious)

Lillesand (1978) emphasized its short comings to the physical aspect of water resources monitoring and potential assessment and maintained that because the remote sensing applications are limited to those characteristics that can be "seen, this approach is also restricted to water characteristics that can be detected in the visible and near infrared region of the spectrum" Water quality indicators such as colour, turbidity, chlorophyll and suspended solids have been successfully used in many applications. Albert Rango in his "Runoff synthesis utilizing landsat hydrologic landuse data soil conservation model has developed a good model for estimating erosion.

Epp et al.,(1983), was able to produce land capability map, forest cover map, wood assessment maps and habitat map for Kenya using remote sensing techniques. Adeniyi (1988) assessed the capability of landsat MSS for identifying, classifying and monitoring the impact of dam construction in the Sokoto Rima Basin. Landuse and Land cover types were identified, classified using maximum likelihood procedure and the standard visual interpretation techniques to investigate the changes in dam site areas. He found that landsat MSS was suitable for rapid classification, assessment and monitoring of the agricultural resources of the area at a regional scale. He suggested that the combined use of digital and visual analysis of a higher resolution data such as SPOT image would provide a baseline data for detailed agricultural resources planning and management.

The possibility to separate vegetation communities in semi-arid areas from satellite data (SPOT) has been shown to depend mainly on the difference in plant morphology and seasonal changes (Franklin et al., 1993), (Saplovic), Ducan et al., 1993). They asserted that, if a plant is subjected to some form of stress that interrupt its normal growth, it may decrease or cease chlorophyll production. The result will be less chlorophyll absorption in the blue and red wavelengths.

In case of soil, high organic content or iron oxide in soils decrease reflectance and the soil appears darker (Larsson and Strömquist, (1991). The reflectance curve for soil shows less peak and valley variation compared to the curve for green vegetation. This is because the factors that influence soil reflectance act over less specific spectral bands. Lillesand and Kiefer, (1991).

Identification of water bodies or water content in soil and vegetation is done most easily in near infrared wavelength because water absorbs most of the energy in this part of the spectrum.

This study therefore, went further to use satellite imagery SPOTXs 2 with the integration of some other parameters to assessed the resource potentials of Ero-catchment basin. Literature review is vital not only that the researcher is better educated on various research findings and methodologies but enables him to identify gaps or missing links in the existing body of knowledge, it also supplied useful information that enables the present research to be identified more clearly and easily too.

Hence, the next stage in the work is the utilization of the knowledge and information acquired to assess the applicability of SPOT Xs imagery in assessing the resource potentials, of Ero- catchment basin for a sustained development in Ekiti-State.

CHAPTER THREE

3.0 DATA AND METHODOLOGY

In the pursuance of the aim and objectives of the study therefore, two approaches have been adopted as to the ways and means of obtaining the relevant information needed. The first approach was through the resource of published and unpublished information relevant to the project with reference to the region (catchment Basin) as well as the research problems. The information that were obtained from such secondary sources includes topographical maps show the relief of the place where gradient, floodable, tributaries, roads and existing settlements were derived. The sources were acknowledge.

The second approach focus on the establishment and identification of existing resources such as vegetation, soil, water, landuse location of stream channels and area liable to flooding (for irrigation purpose and the development of land for sugarcane production).,the identification of agricultural land for crop production such as popcorn large scale farming. This have been done through the interpretation of the satellite imagery 1992 (SPOT xs1) procured for the study.

To compliment this effort, ground truthing to establish some resource that could not be interpreted via the satellite imagery on the "SPOT assessment" of maize farms, located in various part of the study were carried out. A mini questionnaire was administered to ascertain the levels or the degree of involvement of people in the growing of popcorn, fish cropping and sugarcane production.

In line with the objective of this study the method which involves the adoption of SPOT(xs) at resolution 30m were used to determine the extent of landuse of the study area in terms of farmland,, settlements, reservoir, drainage channels etc.

3.1 MATERIALS

The materials cum instruments that were used in the course of this study includes amongst others the followings:

i. Topographic map of Ado-Ekiti Sheet 244, reprinted 1981, with a scale of study, within the entire catchment area.

ii. Administrative map of Ekiti State.

iii. Satellite images of the study area representing three years 1992,1993/1995 Spot .Xs respectively

iv. Hewlett (Packard) design jet 640c coloured printer.

v. The software used are Idrisi operating on Windows 98 and a personal computer. The images were obtained from the Climate Change

Centre, Federal University of Technology Minna and Federal Department of Forestry Coordinated by FORMECU Abuja. The images had already been calibrated processed for restoration and enhancement that are usually carried out before image classification .

vi. Earth resources data acquisition system(Idrissi for windows) as software.

3.2 FIELD DATA COLLECTION

The coordinates of the catchment basin were imported to dip out the scene of the delineated area from the satellite scene. Idrissi software were employed to import the imageries from CD and display on the screen (Idrissi) is a remote sensing software that made it possible for the imageries to be moved around on the computer.

Image Processing

Data Capture

Data capture means the process of digitization by which analogue map data are transferred into digital format for proper storage, documentation and analysis in the computer system. This is done with the use of the mouse of the computer to digitize the imageries on the screen through the help of Idrissi tools, making it possible for the classification of landuse and features into polygons and possible interpretation. All the levels of information interpreted and digitized in Idris for windows were edited, developed as lines and polygons coverage's.

Signature File

The establishment of signature file followed immediately after creating training site. Signature file has some statistical data (information) about the reflectance value over different bands for these sites. To create signature file therefore, Idrissi was used. As it was running, it would ask for the identity of the file and the name of each of the various landuse classes to which identities or value were assigned.

Classification Routines

Both manual and visual interpretation were adopted and made use of along with computer classification, in the process pattern of predominant category within the area were labelled. In a situation where smaller unit were encountered, no option than to generalized such pattern.(Adefolalu, 1992)

3.6 THE 4 QUADRANT PIXEL METHOD FOR GROUND TRUTH OBSERVATION OF FARMLAND TO ASSESS POPCORN PRODUCTION. (Adefolalu's Model).

In the 4-quadrant, pixel method, each location is created as a point focus with an imaginary circular path (360°) drawn at the viewing horizon. This 'circle' is bisected norths, south, east-west into four (4) equal quadrants. The pixel is thus the area of the circle with location (point-focus) as centre. An observer monitors and estimates the percentage cover of each crop type, land under fallow and bare ground in each of the quadrants. Averaged values of the 4- quadrants for each crop type is computed for each pixel as follows.

$$P(c, i) = \frac{1}{4} \sum_{q=1}^{q=4} P(c, iq)$$

Where	c	=	Crop type
	i	=	pixel number
	q	=	quadrant
	p	=	percentage crop type.

3.7 MONOSCOPIC INTERPRETATION OF STUDY AREA

In an attempt to characterize this part of Ero-catchment basin, in terms of cultural features, and catchment characteristics a manual image interpretation of the linear features (including the urban area) was made from the hard copy print of the imagery over a light table. The image detection, analysis and interpretation were based primarily on the six basic qualitative parameters of image understanding that is, shape, size, colour, texture, site, association, association and pattern. It can be shown that on the average the accuracy of this method to digital classification is about 90% (Quirk 1980). Figure 3.1 shows the traces of the linear features like roads, streams, and dam. Treatment houses for the reservoir, urban areas produced at the same scale as the topographical map. The figure is now compared with the features in the topographical map.

By and large, the result of these exercises led to the possible assessment of resource potentials of the study area and more importantly, the mapping and production of fish, popcorn and sugarcane respectively and possible conversion of Ero-dam into hydropower dam through inter-basin transfer of Oye basin to Ero –basin.

At the end of it all, logical conclusion and recommendations were made as a policy formulation towards achieving a sustainable development

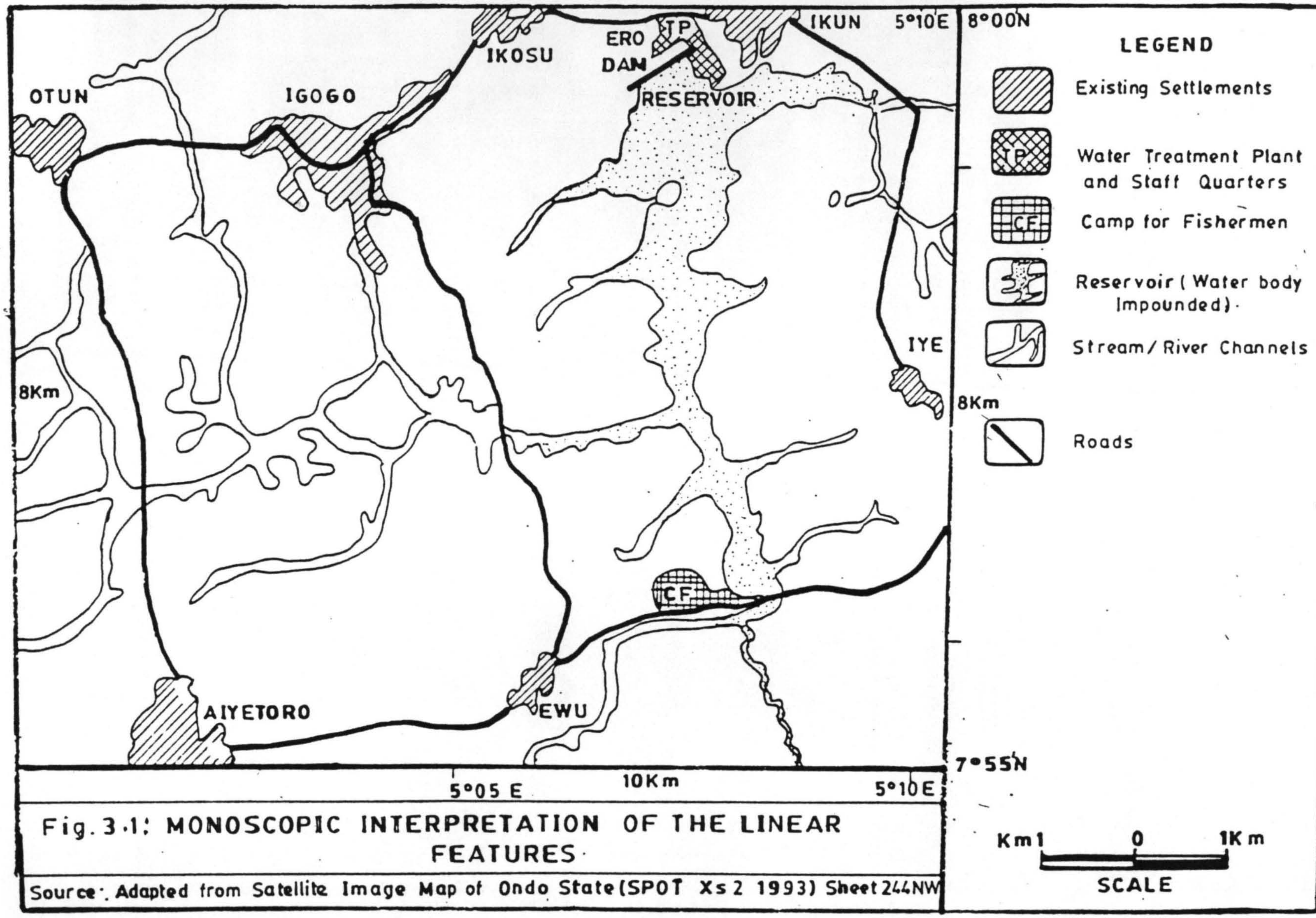


Fig. 3.1: MONOSCOPIC INTERPRETATION OF THE LINEAR FEATURES

Source: Adapted from Satellite Image Map of Ondo State (SPOT Xs 2 1993) Sheet 244NW in Ekiti State. In summary, the figure 3.2 below shows remote sensing research method adopted at glance.

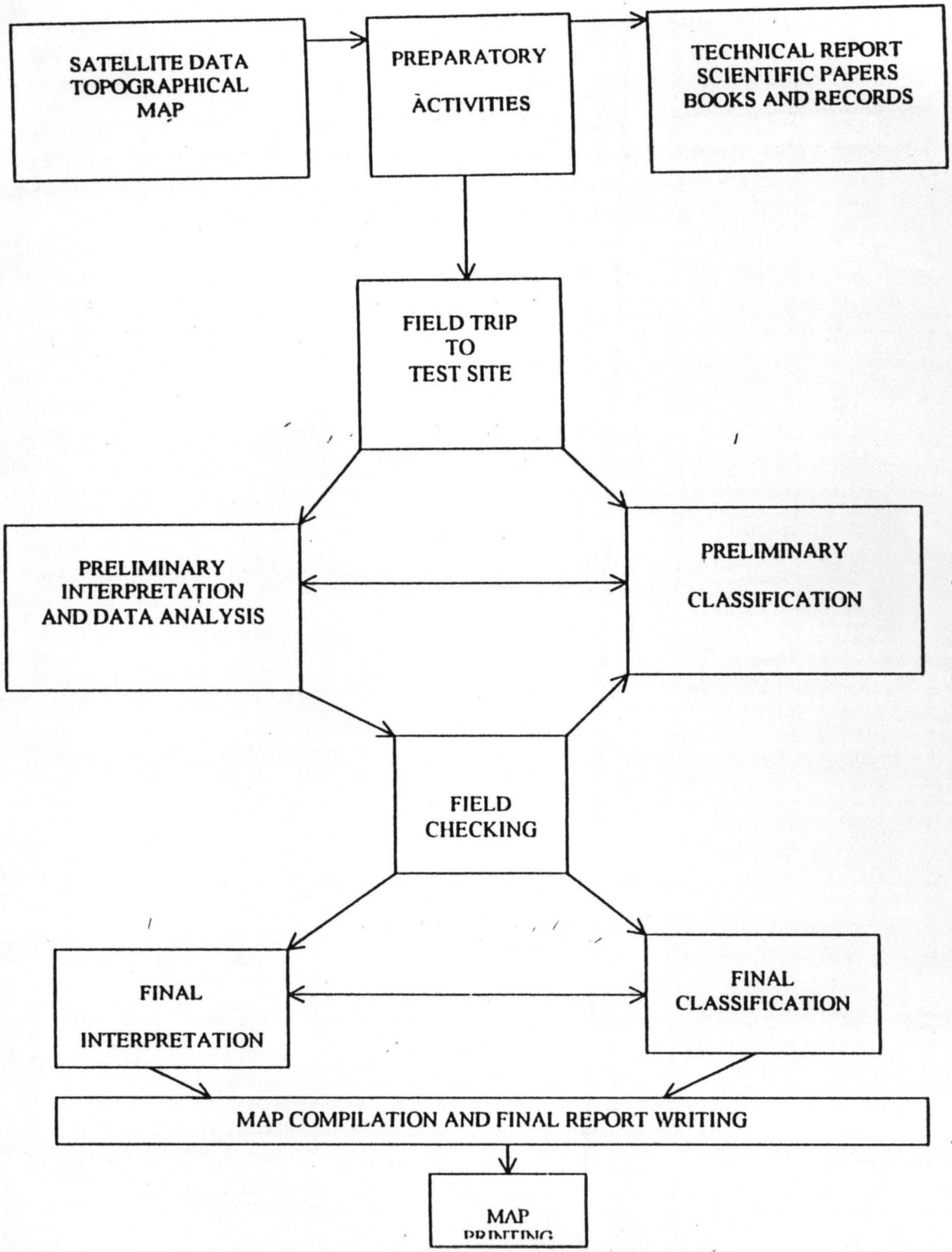


FIGURE 3.2: REMOTE SENSING RESEARCH METHOD ADOPTED (AFTER Nduaguba, 1996).

CHAPTER FOUR

4.0 ANALYSIS AND DISCUSSION OF RESULTS

4.1 IMAGE INTERPRETATION

Image interpretation is the systematic examination of images for the purpose of detecting, identifying measuring and or evaluating the significance of resolved surface features of phenomena. Evenly image is a record of surface features or phenomena at the time of exposure. On a satellite platform most remote sensors in operational system are image forming. All images have specific characteristics regardless of the sensors used to collect them or the wavelength at which the image is recorded. The most important characteristic are resolution, scale and contrast.

Resolution is the ability to distinguish between two closely spaced features on a image. In photography, it is usually expressed as the number of line pairs per unit distance that can be resolved on a photograph of a standard resolution target (Schwaar 1970). The resolution of the image used was so good that most of the image features were distinguished from one another. The water body seemed to be so apparent from other features. From the image the classes used in the classification schemes were quite distinguished.

Interpretation elements such as tone, texture and pattern as well as association were used for an accurate classification. Tone is the lightness or darkness on a photographic image and corresponds with the reflectance differences from scene features. Tone is a combination of line and chroma on colour photography. Texture is defined as the impression of smoothness or roughness on an image created by tonal variations from objects. Pattern refers to the spatial arrangement of image features that can be identified by the regularity of placement of tones and textures of all tonal variation had assisted a lot in the classification of the image and identification of the image and identification of important features such as built-up areas, water body, cultivated land and river channel/wooded land.

Other elements used were size and shape. The size of an object can be a clue to its identity: size is considered in the context of scale. The linearity of the features such as water body was used in identifying streams or river channels in conjunction with the tone to distinguish it from road or footpath. This was adopted in the mono-scopic interpretation of the linear features of the study area. A combination of one or more of these recognize image features. Interpretation keys were used to outline the interpretation process.

Surface water area measurement were made from the image data obtained. However, these measurements were done manually using grid method. Water exhibits very low reflection when compared with the surrounding landscape from what was observed from the display on computer monitor. Not only the occurrence of water was clearly visible, the image band was effective in depicting the relative sizes, shapes and orientation of the water feature.

Vegetated landscape usually have tendency for higher infrared reflectance than non- vegetated landscape and consequently did not appear similar to the surface water in SPOT Xs 2 image scene. Surface area measurement was done manually using grid method. The SPOT Xs 2 image was corrected and optically proceeded-ready for manual image interpretations. The image was visually interpreted by placing transparent acetate on the area of study on the imagery on a light table. The topographic map obtained for 1967 was analyzed to ensure that the landuse/landcover classes also reflected the situation in the study area.

The different classes of landuse were identified and drawn on the map as shown in figure 4.1a and 4.1b. In all the following landuse categories were identified and mapped out.

a. Existing settlements (built –up areas)

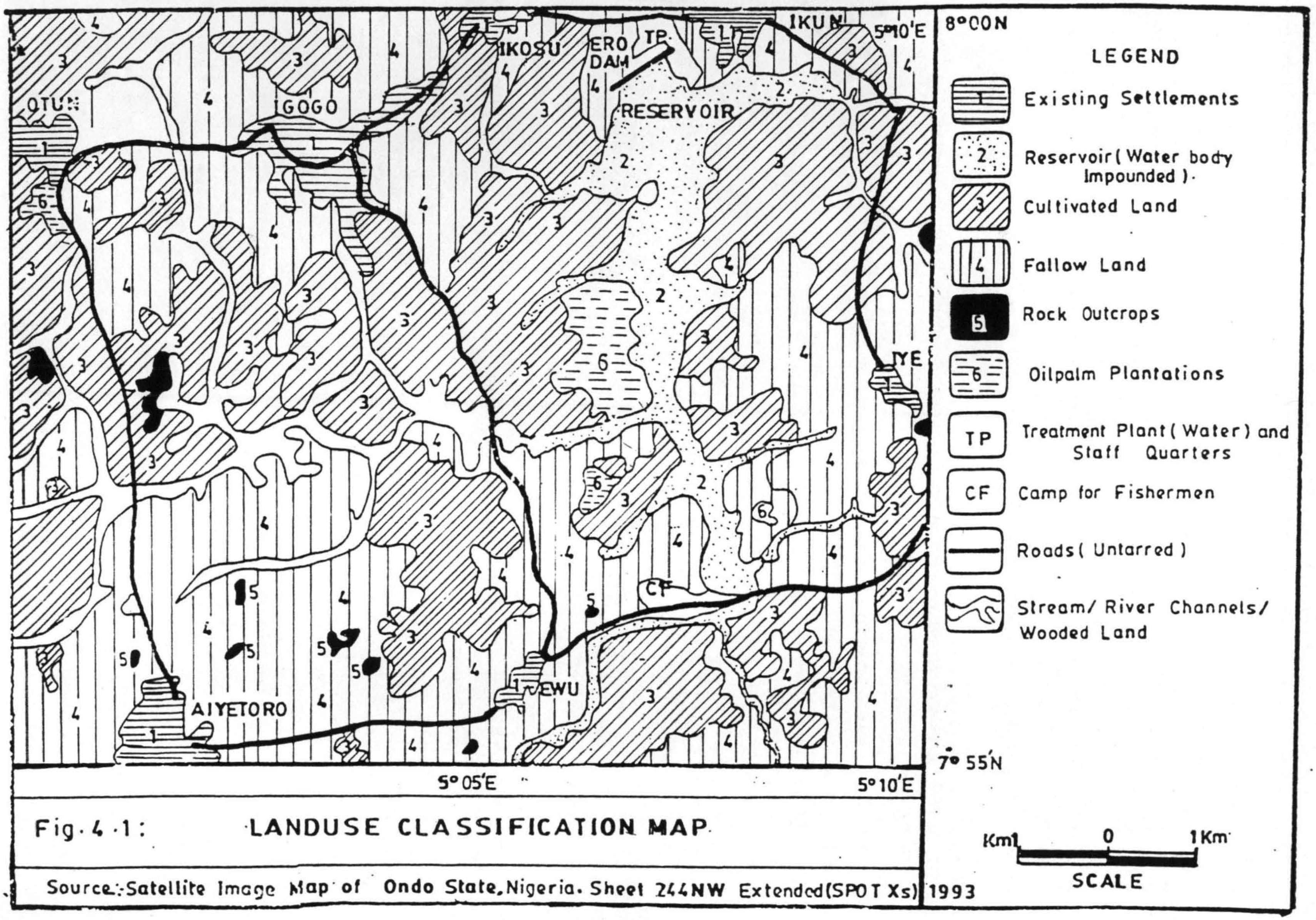


Fig. 4.1: LANDUSE CLASSIFICATION MAP

Source: Satellite Image Map of Ondo State, Nigeria. Sheet 244NW Extended (SPOT Xs) 1993

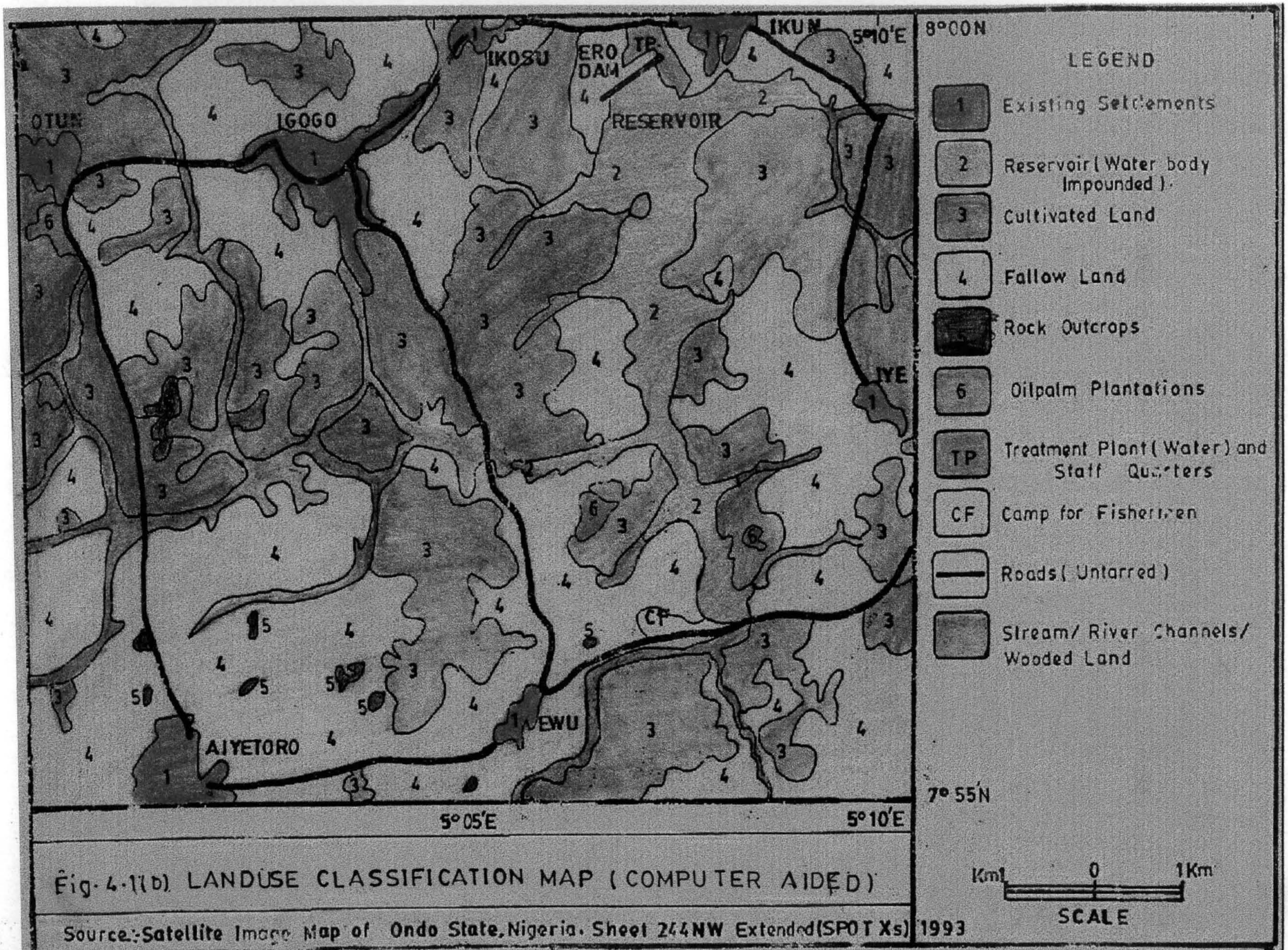


Fig. 4.1(b) LANDUSE CLASSIFICATION MAP (COMPUTER AIDED)

Source: Satellite Image Map of Ondo State, Nigeria. Sheet 244NW Extended (SPOT Xs) 1993

59a

b. Cultivated Land

c. Fallow land

d. Dam (reservoir)

e. River Channel/Woodedland

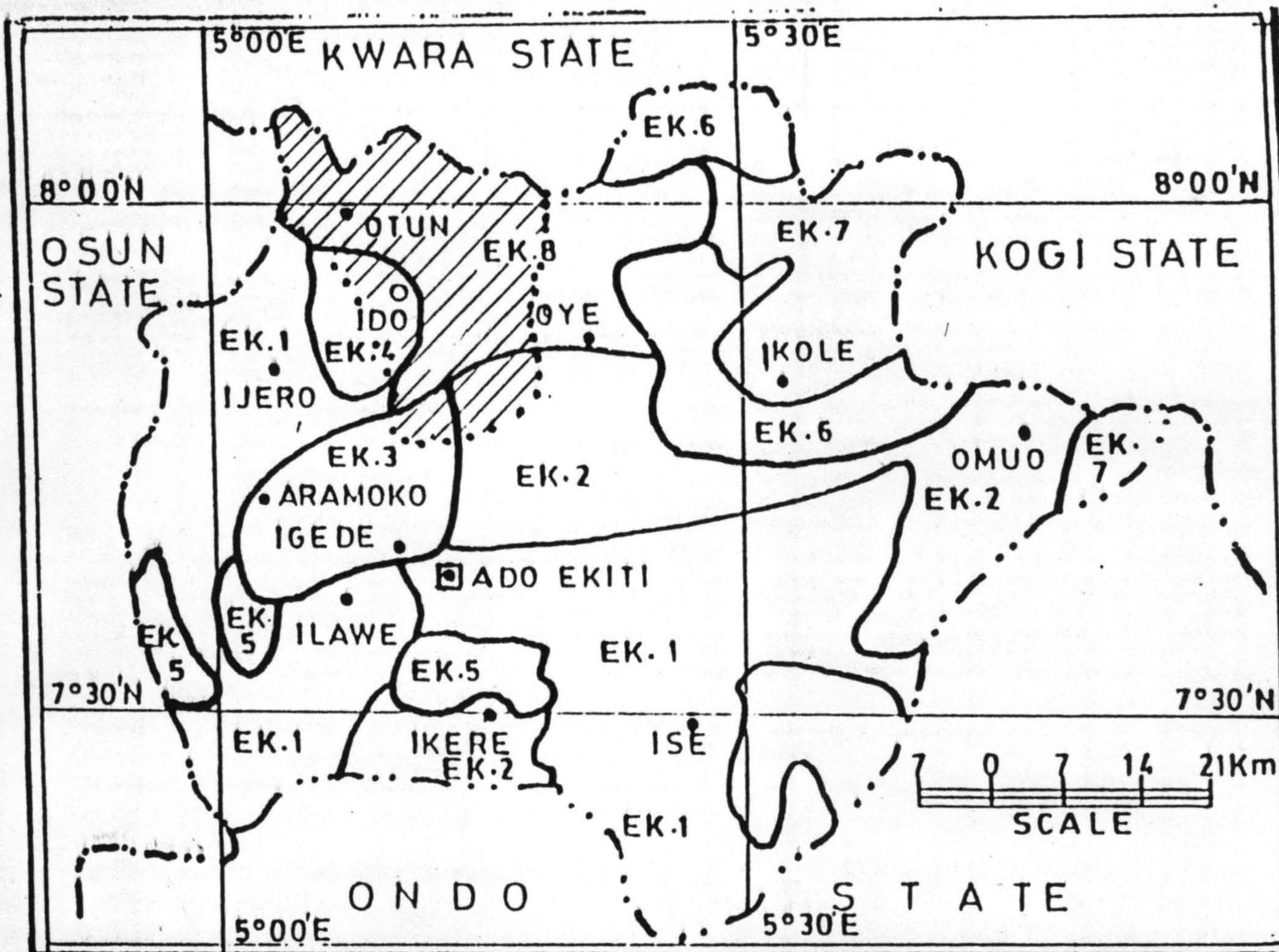
f. Oil palm plantations

g. Roads.

4.1.1 SOIL CLASSIFICATION

The study investigations cover soil association in order to ascertain the land capabilities and suitability for the major crops grown within the catchment area. From the soil profile, that is the longitudinal section of a well developed soil from the top soil down to the parent materials, it was gathered that Ero- catchment basin falls within soil association tag EK8.

Under EK8, as shown in figure 4.2, the study are associated with undulating dissected plains with scattered rock. Outcrops and hills on basement complex and iron stone. Shallow and moderately deep to well drained and somewhat to poorly drained soils. Loamy sand t sandy , loam and some times gravelly surface over sandy clay loan to sandy caly and sometimes loam subsoil.



LEGEND

EK 1	**Gently Undulating Plains on Undifferentiated Basement Complex** Moderately deep to very deep well drained and poorly drained soils, sandy loam, sandy clay loam or loamy sandy clay surfaces over gravelly sandy clay loam or sandy clay, clay loam or loamy sand subsoils
EK 2	**Gently Undulating Land with Scattered Inselberg on Undifferentiated Basement Complex** Moderately deep to very deep with some shallow well drained soils, loam, loamy sand or sandy loam surfaces over gravelly or stony sandy clay sandy clay loam or clay loam subsoils
EK 3	**Gently Undulating Land with Scattered Inselberg on Amphibolites, Quartzites and Schists** Deep well drained soils, sandy clay or sandy loam surfaces over gravelly or stony sandy clay loam sandy clay or clayey subsoils
EK 4	**Undulating Land with Scattered Inselberg on Basement Complex** Deep well drained soils sandy loam loamy sand sometimes gravelly surfaces over gravelly sandy clay loam, sandy clay or clay loam, sometimes mottled subsoils
EK 5	**Hills and Ridges on Undifferentiated Basement Complex** Deep well drained and shallow well drained soils, sandy loam surfaces over stony sany clay subsoils or bedrock
EK 6	**Nearly Level to Gently Undulating Plains on Basement Complex** Moderately deep to very deep well drained soils sandy loam to loam sand surfaces, sometimes gravelly over sandy loam to sandy clay and sometimes gravelly subsoils
EK 7	**Gently Undulating Plains with Scattered Iron Outcrops, Hills and Inselberg on Basement Complex** Moderately deep to deep with some shallow well drained and few poorly drained soils, loamy sand surfaces over sandy loam to sandy clay loam and sometimes gravelly subsoils
EK 8	**Undulating Disected Plains with Scattered Rock Outcrops and Hills on Basement Complex and Ironstone** Shallow and moderately deep to deep well drained and somewhat poorly to poorly drained soils loamy sand to sandy loam and sometimes gravelly surfaces over sandy clay loam to sandy clay and sometimes loam subsoil

Fig. 4.2: MAP OF EKITI STATE SHOWING SOIL ASSOCIATION IN RELATIONSHIP TO THE STUDY AREA.

Source:- Adapted from Ondo State Soil Association map with modifications.

This soils of this class are found on fair to good lands that can be mechanically farmed with great care. There are moderate to high erosion hazards owing to the undulating hilly disected topography with scattered rock out crops as expressed in figure 4.3. The gradient erodibility/water logging relationship map of Ero and Oyo catchment basin. The map equally express rainfall intensity value of the catchment basins in milimetres. The scope of the landscape range from 6-13 percent. These soils are also limited by their shallow depths to concretions, iron-pan, stony or gravelly subtration.

Maize, tubers, Fruits and vegetables will do well on deep well drained soils found in places like, Iye,Ewu, Aiyetoro and Iludun oil palm and Rubber will strive on deep well drained sandy loam surface over sandy clay or sandy clay soils. While sugar cane and rice will perform well on somewhat poorly or poorly drained soil places like Otun, Igogo, Ikosu and Ikun will be good for the propagation of sugarcane. Beans and other cover crops such as soya beans, groundnut and yam beans/melon will be good for soil conservation on areas with erosion hazard.

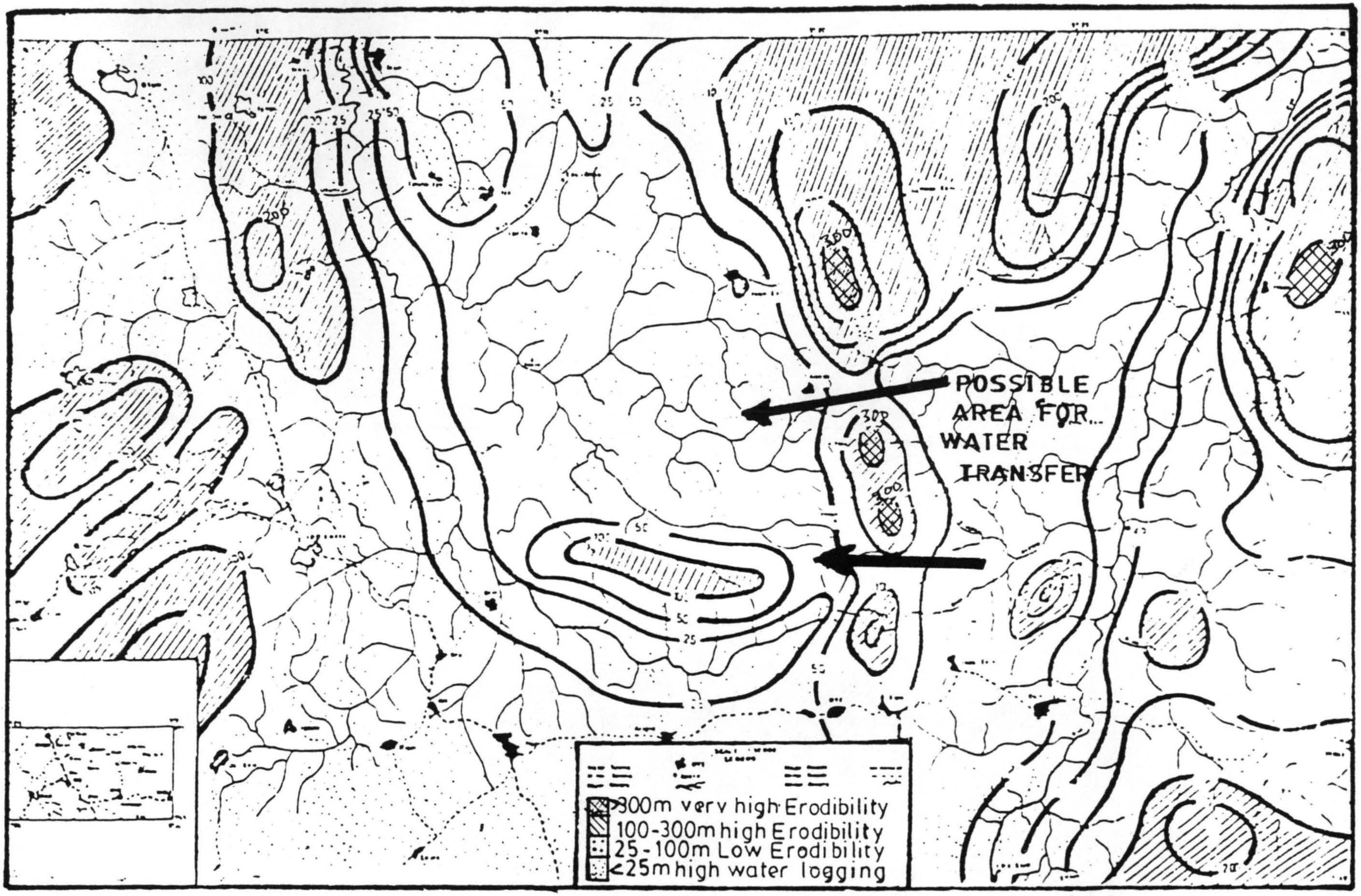


Fig.4.3: MAP OF RIVER ERO/ OYE CATCHMENT BASIN SHOWING AREA OF POSSIBLE BASIN WATER TRANSFER FOR THE PROPOSED HYDRO-POWER PROJECT.

Source Adapted from Adefolalu, D. O. (1994).

4.2 ANALYSIS OF AGRICULTURAL RESOURCE POTENTIALS OF ERO-CATCHMENT BASIN.

From the interpretation of the satellite imagery of the study area, it was found out that about 62% of the total land area were put under cultivation of various arable crops and perennial crops. And from the survey conducted about 72.69% of the respondents were farmer engaged in one farming activity and the other. Arable farming happen to be the predominant activities. Using the 4 quadrant pixel methods to synthesis/assess which of the arable crops predominate. The result of the exercise depicts that maize (zea mays) is widely grown and cultivated three times in the study area see Figure 4.4. This was followed by cassava, rice yam, usually intercrop with sugarcane and pineapple.

Table 4.3 shows order of crops grown in the study area according to premium placed on them.

CROP TYPES	ORDER	No OF RESPONDENT	PERCENTAGES
Popcorn	1	73	45.9%
Cassava	2	52	32.7%
Yam	3	16	10.06%
Sugarcane	4	13	8.17%
Rice	5	5	3.1%
		159	100%

Popcorn is a type of Maize now being produced for sale to other states of the Federation. Iye popcorn is notable in Lagos, Kano, Ibadan etc for its

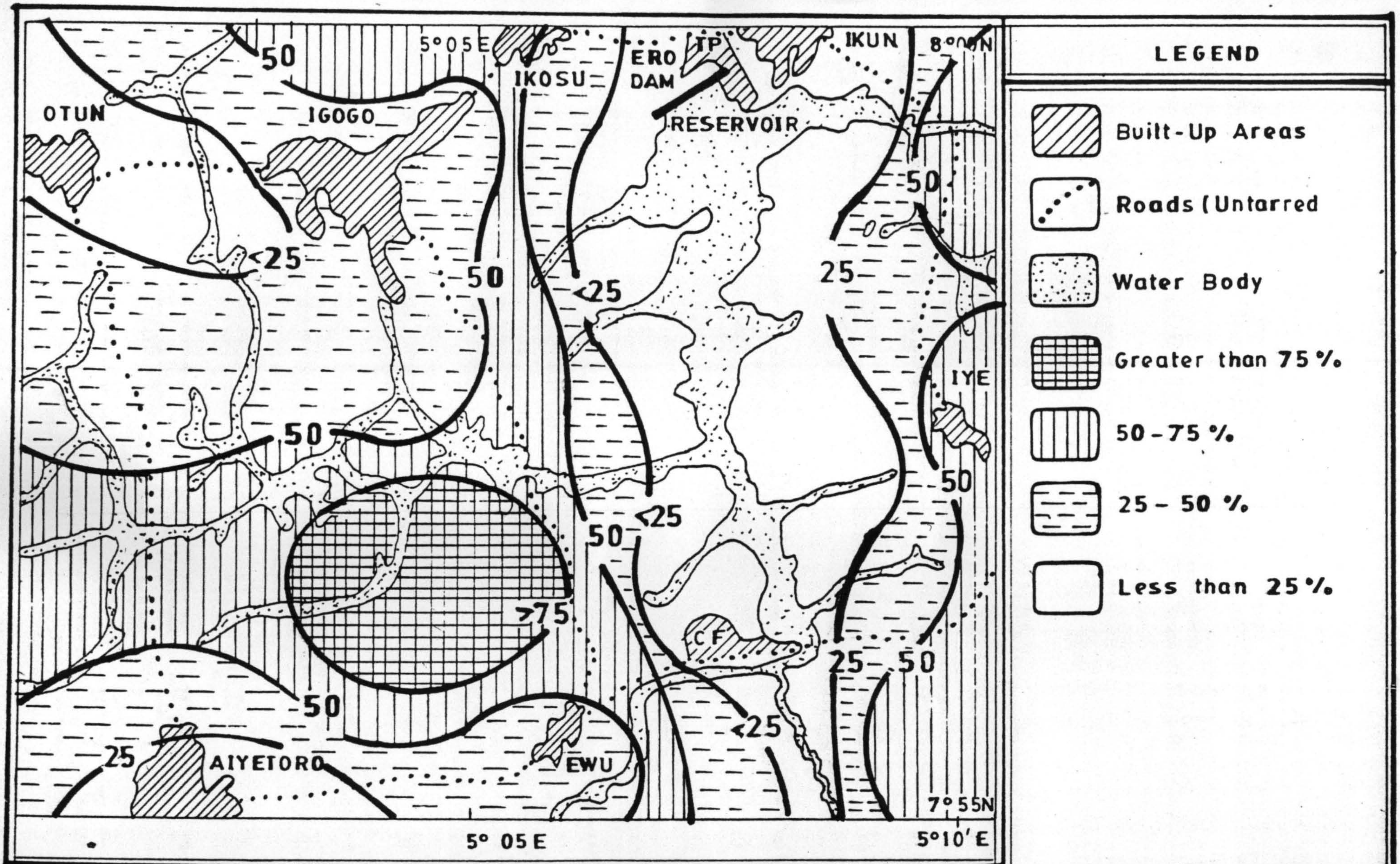


Fig. 4.4: PERCENTAGE OF FARMLAND DEVOTED TO POPCORN

Source: Designed and Drawn by the Author (2002) good popping. Hence buyers scramble for it at Iye, Eda Illudun and Ijeshamodu all within Ero-catchment Basin.

Popcorn is a popular type of corn for human consumption. The grains are very hard and small in size. Those of the rice popcorn variety have angular grains while those of the pearl-pop corn are more rounded.

Popcorn has a wide variety of uses, which may be summarized as follows:

1. **Animal feed**. The bulk of the world's corn production (as much as 75-90 percent) is used for feeding animals. In the United States, approximately 40 percent for cattle, 15 percent for poultry and 10 percent for horses and seep.

2. **Human Food**: In many parts of the world and south American, Africa, southern Europe consumed as a food grain. The American, Indians the Mexicans and many African peoples use fresh ground boiled or mixed with other foods. In United States, many large firm prepare a wide range of corn products including Cornflakes, corn syrup, grits, hominy, blancmange or cornflour and custard powder.

3. **Industrial products**: From the harvested maize industrial alcohol can be made.

After wet milling, starch can be obtained and maize is a major source of vegetable oil. Stalks are used in the manufacturing of rayon, plastic paper and well boards. Pulverized corn cobs are made into a kind of mild abrasive for removing he carbon from aeroplane engines. Elsewhere the cobs a re burnt as a domestic fuel or returned to the soil as an organic manure.

Due to the diversified and multiplicity of use of pop corn and more importantly to boost the income of the rural areas around the study area emphasis have been placed on a large scale production of popcorn. The study area is suitable for the production of popcorn mechanically. Therefore, the following towns within the catchment's area have been found good for extensive (popcorn) production (Iye, Ilemejeme, Ewu, Otun, Iludun, Eda, Ijesha-Iye and Igogo. The land of this area satisfies the growing condition for popcorn. As indicated under the soil association and soil classification. Popcorn grows in a wide range of soil types from the temperate odzols to the strongly reached red soils of the tropics. It grows best however in deep, rich topography of the Corn Belt is ideal for large-scale corn cultivation. Popcorn is a sun loving plant usually requiring 18^0-27^0C during the day and around 14^0C during the night. Popcorn requires an annual precipitation of 635mm to 1,145mm. All these climatic parameters are obtainable in the study area. Some hybrid of popcorn natured between 60-66day while the wild one stays up to 90days and above.

Internationally U.S.A is by far the largest popcorn producer. No wonder, popcorn originated from U. S. A, and cultivated largely by the American Indians.

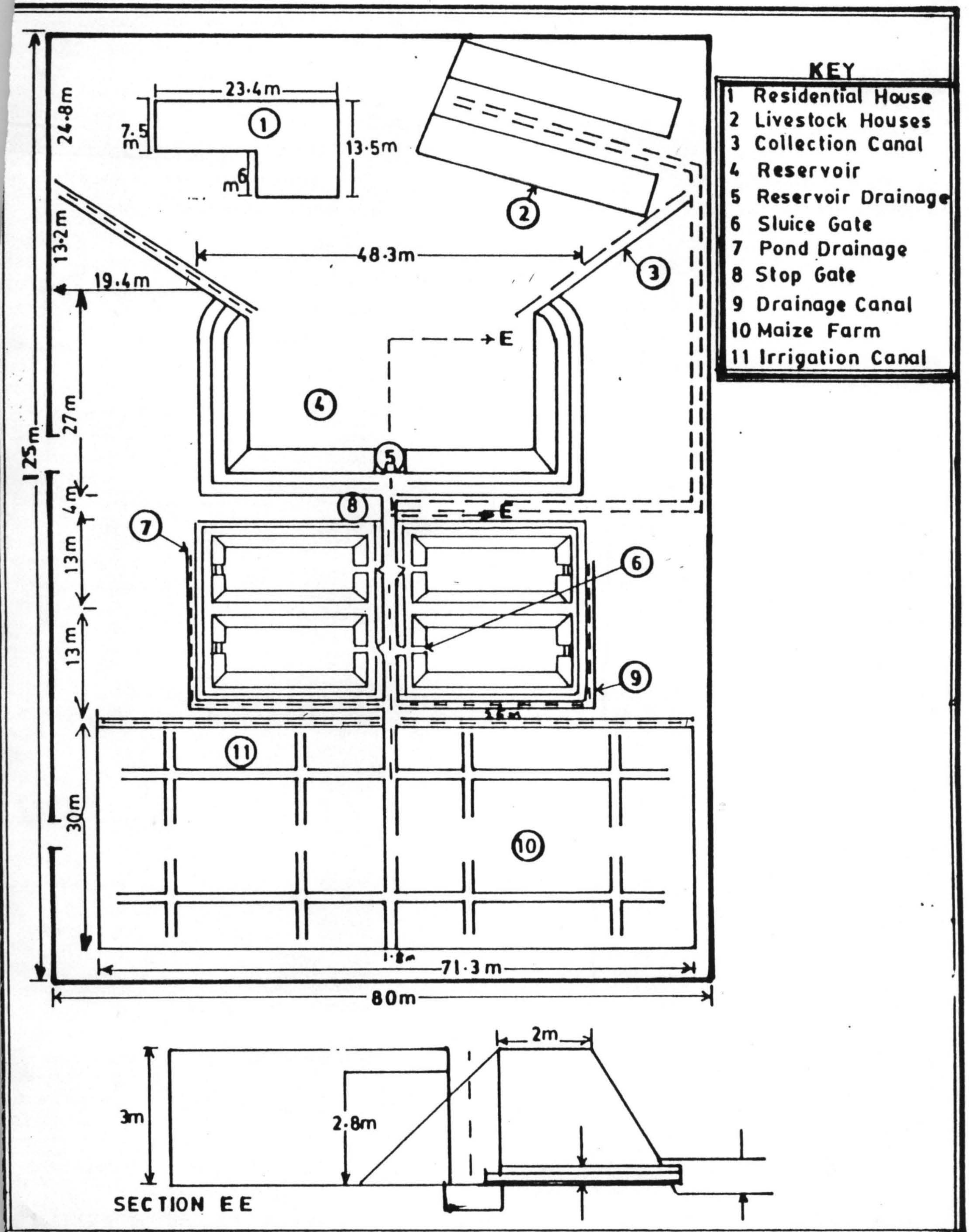


Fig.4.5: THE PROPOSED ONE HECTARE RAIN FED FISH FARM

Source : - Adapted from Nwanko, (1990) with modifications.

4.3.4 DEPTH OF FISH PONDS AND THEIR EMBARTMENT

Fish ponds should not be too deep to allow sun rays penetrate to the bottom of the ponds They may vary from 1.5m to 3.0m. In the proposed fish farm the drainage system has a chimney 2m high and with adjustable spillway which contains water leveling the pond at 1.5m from the bottom.

The design of the small-size rainfed fishponds assumes farmable conditions for simple embankment type to be an imperious homogenous fill keyed into an impervious foundation. The pond embankment design height is 1.85m with side slopes 1.5:1 upstream and 1.1 downstream. The top with is Tm. For storage of the rainwater, reservoir measuring 27m by 48.3m with a depth of 3m has been recommended. The reservoir embankment has a top width of 2m 1:1 downstream. The construction will be similar to that of the fish ponds.

An effective and efficient up slope kind surface area of 80m by 35m together with reservoir surface are of 1,304m^2 gives a total catchment area of 3,842m^2. Within which are located residential quarters, as well as livestock houses. Livestock effluent will be needed partly in the fish pond and partly in the vegetable garden down slope.

Table 4. 6: Shows Water requirement Estimates for Fish Farming

	Fish Growth Duration In Months					
Fish population per m^2 of pond area	1	2	3	4	5	6
	12	9	7	5	4	4
Estimated average unit weight (kg)	.02	.1	.5	1.0	2.0	2.5
Water requirement in mm per day per m^2 of pond area.	.48	1.8	7.0	10	16	20

Table 4. 7: Estimate on Year Round Water Requirement for fish farming.

Months	No of Days	Daily Water Requirement (mm)	Monthly Water requirement (mm)
Rainy Season Cropping			
April	30	0.48	14.4
May	31	7.80	55.8
June	30	7.00	210.0
July	31	10.00	310.0
August	31	16.00	496.0
September	30	20.00	600.0
October	31	0.48	14.00
		Seasonal Total	1,700.2mm
Dry Season Cropping			
November	30	1.80	54.0
December	31	7.00	217.0
January	31	10.00	310.0
February	28	16.00	448.0
March	31	20.00	6.200
		Seasonal Total	1,649mm
		Annual Total	3,349.2mm

Source: Fishery department, Federal University of Technology Minna

4.2.5 EVAPORATION AND SEEPAGE LOSSES

In farm pond design, 60% of the net water requirement has bee allowed for taking care of evaporation and seepage losses (Schwab. Et al., 1981). In the example, the gross quantity is given by

$$\frac{3{,}349.2x100}{(100-60)}$$

$$= \frac{334920}{40}$$

$$= 8373mm.$$

Effective Pond Area

Each of the proposed fish ponds occupies land area coverage of 13m by 25m, with embankments 1.85m high and sloping at 1.5:1, the effective area for each of the 4 ponds is calculated as:-

913-5.55) x (25-5.55) = 144.9m^2.

The total effective area for the proposed set of 4 small fish ponds

= 145 x 4 = 580m^2

The amount of rainwater to be harvested therefore can be estimated.

The volume of rainwater to be harvested for the fish culture is estimated as

$$\frac{8373}{10{,}000} \text{ x } 580 = 4856.34m3$$

The abundance of rainfall in the Ero-catchment basin up stream can be harvested and profitably utilized in fish production along with fish cropping on Ero dam flood plains, to range the income level of the rural populace and also improve the supply demand curve with respect to availability of fish protein for public consumption.

4.4.0 ANALYSIS OF THE ASSESSMENT OF WATER RESOURCE POTENTIALS OF ERO-CATCHMENT Basin

4.4.1 INTRODUCTION

The water body seemed to be so apparent from other features during the interpretation of the image. From the image, the classes used in the classification schemes were quite distinguished. This occurred because water exhibits very low reflection resulting in the darkest tones and linear meandering shape with little or no texture on the imagery compare when compared with the surrounding landscape. Not only the occurrence of water was clearly visible, it was effective in depicting the relative sizes, shape and orientation of the water features. A cluster of water bodies appeared as extremely configured lake formation which include Ero – reservoir, as shown in plate 4; water bodies comprises the Ero-dam/reservoir itself, the fresh water swamp tag river channel and wooded land, and the natural water that flow into the reservoir. It also includes the rivers and stream flowing along a spatially defined course or valley. Reservoir form large bodies of

PLATES 4.2: ERO DAM/ RESERVOIR SHOWING PART ITS SURFACE AREA.
SOURCE: FIELD SURVEY (2001)

water flowing or non flowing with no definite course of flow such as is expected to form behind the dam. Water bodies have been assessed to cover about 81 percent of the total area of the study area.

From the survey conducted it, was gathered that Ero –dam supply about 26million cubic metres of water per day. Serving about 62 towns and villages both in Ekiti and Ondo States. The survey reveal that Ero dam has potentials for the following irrigation, micro-hydro-power generation through inter-basin transfer, flood control and drainage, domestic/industrial water supply recreation such as swimming, site scene and boating, and fishery which have been taken care of in this study.

The domestic/Industrial water supply potentials of the dam have been harnessed and utilized effectively in Ekiti State as the towns and village within the catchment basin are served with portable water. Plate 4.3 bears the testimony to this fact as captured during the on the "SPOT" assessment of water supply. The only militating factor is power outages. The dam is yet to have a generating set to compliment NEPA power supply system. For optimum utilization, more networks of pipe supply system should be extended to the various parts of the towns and villages being served at present.

PLATE: 4.3: TYPICAL TAP WATER PUMP AT IGOGO EKITI
SOURCE: FIELD SURVEY (2002)

In the area of irrigation, which is the component part of the dam schemes, a lot of work needs to be done for its realization. No irrigation project was seen during the author's visit early January during the dry season. To this end, dry season, vegetable farming should be encouraged along the flood plains, since this are crops that can matures before the onset of the rainy season in March. This section will emphasis the development of a micro-hydro-power project on Ero-dam.

4.4.2 HYDRO POWER GENERATION

The potential for hydro-power generation in the humid tropics is very large due to the high river flows, and it is especially attractive in the mountainous regions. Some of the largest hydro-power plants, such as Guri in Venezuela and Itaipu in Brazil, have been built in these regions, but the potential is far from being fully exploited as in the case of erosion. A study carried out by the world bank showed that only 2% of the potential was developed in the humid tropical countries of Africa and Asia, and 7% in Latin America (World Bank, 1984). The main problem of the development of the large hydro-power potentials is, however, its geographic location relative to the power demand centres. The case of Ekiti State is different as the state witness erratic power supply always and incessant power outages.

This implies that the demand is already within the geographical area of power generation. Hydro-power development continues to be an attractive investment, particularly in the tropical countries. From 1974 to 1988, total funding of power facilities by the World Bank amounted to U.S. $ 25, 480 million, of which 26% was for hydro-power. (World Bank 1988).

4.4.3 HYDRO-POWER SYSTEM CHARACTERISTICS

Power systems with hydro power component have something's in common which must be put into consideration in power planning and operation. The energy output of a hydroelectric system rest wholly on the amount of water available at each plant of the system. Since it is virtually impossible to have a prior knowledge of future in-flowing the energy benefit associated with the construction of a hydro-electric plant can only be assessed on a probabilistic basis. Basically, availability of peak. Power is a function of plant head, which in turn depends on water volume stored. All this quantities are invariably dependent on hydrological climate conditions.

Precipitation is the most important element of climate in relation to water resources development and the key to understanding the precipitation regime is the hydrologic cycle. That is why, the draw-down of lakes and reservoir is not unconnected with large scale tapping of underground water coupled with poor rainfall replenishment in there area of locations. Therefore, there is the need to develop techniques to estimate design data under evolving conditions.

By evolving conditions, is meant the changing environment with emphasis on trends in the climatic conditions. For this reason, a prior, of the economic plans is crucial but also important are all available data on climate and particularly river regimes must be up-to-date and should constitute major input data in planning and design.

4.4.4 Some attributes of derived parameters in relation to Dam Design. A dam is a barrier built across river or stream to control the flow of water. Such a structure usually serves one of more functions. In the case of electricity supply, the dam is normally designed to raise the level of water to a normally sufficient to produce power. The type and height of any such dam depend on the geology and configuration, the level of supply intended and its cost as affected by availability of construction materials. It is very important that the viability conditions for the dam, to be self-sustaining, must be ascertained. This is a function of water yield of the river or stream to be dammed.

4.3 **EXISTING FISH FAUNA**

Fish in the Human Diet

Fish adds flavour to meals. It is the most common and popular source of protein needed by man for the healthy development of the body. A study conducted by Gregory (1982) shows that the equivalent protein content of 100gm of fish will be obtained 285gm of rice and 155gm of eggs (3 eggs).

Even people whose religious beliefs preclude meat in their diet for certain days in the year still welcome fish on such occasions. It is a fundamental fact th at after a locustrine/reverine environment is formed, upstream or down stream, some fish formerly existing in the water adapt and adjust themselves to the new environment while the remaining species gradually disappear by migrating and become replaced by different species.

During the course of investigations the following species of fish were found to be common and put for sale by fishermen (Hausa and Nupes).

Table 4.4: A Summary of the common fish fauna sample at the study rea among fishermen.

FAMILY	GENUS	SPECIES
Claridae	Clavias	Clarias anquillaries
Clchilidae	Oreochromis	Oreanchromis Niloticus
Tilipia	Tilapia Zilli	Gaklea
Savatheradon	Saratjeradon	Synodotis spp
Mochokidae	Synodotis	

Source: Field Survey 2002

These species were found to be abundant according to the order of listing them even though there are fluctuations and intensity. Fish become more available for capture as they congregate in the channels and pools of the floodplains as the water begins draining off the main channel. At this time there is a very heavy and concentrated fishery.

The clavidae and Tilapia fishes comprised about 65% of the catches by number of each of the fishermen selling them to determine it. The author interviewed the fishermen and consumers alike before arriving at this figure.

To boost the fish farming potentials of the basin, one hectare rainfed fish farming is hereby proposed.

4.3.1 PROPOSED SMALL – SIZE FISH PONDS

A set of small – size fish pond designed after the interest of low-capital farmers generally having about Iha of land is used. This investment and at the same time to test adequacy of rainfall as a source of water supply for fish farming in the study area. The idea of using rainwater as a supply source of fishponds is favoured by a consideration of (1) not to reduce the inflow of water to the reservoir by the reservoir is being considered for hydro power generation. This will affect the rate of discharges (2) the abundance of rain water naturally available especially in the southern parts.

of the country and (3) the number of prospective fish farmers that do no have land beside any perennial stream or river.

It has been observed that land fragmentation under the tenure system has commonly reduced land holdings to an average size of 1hectare-or less especially for dwellers in the southern parts of Nigeria. Considering the abundance of rainfall in these parts of the country as the bases for proposing rainfed fish farming, a typical set of fish ponds were designed for 1ha. Farm stead (figure 4.5).

The rectangular shaped fish ponds is proposed to maximized the use of land and to facilitate harvest. Ponds of different sizes have been used to produce fish provided they are deep enough. However, the larger the pond the more fish it will produce all other conditions being favourable (Hickling, 1962; Bard et al., 1976, Brown and Thoerenson 1958).

In the proposed fish farm four ponds are provided for production of table fish. Fengerlings will be picked up from larger farms for stocking. Each of the ponds occupied in area of 13m by 25m.

Ero-dam need to be redesigned in other to meet all these conditions for hydropower generation. At present, the discharge capacity of the dam is very low, height is not up to a level that can generate power. But the dam has potential for hydropower just with a little input in area of dredging at least for an interval of 20 years to remove sediments thereby, widened the reservoir surface area with the aid of inter-basin transfer with Oye basin which is so close to Ero catchment basin with relatively stable water supply. The following therefore are the derived parameters. Onset, cessation dates and length of the Rainy Season (LRS), Breaks in normal length of rainy season, Hydrologic ratio (λ) and water equivalent to avert drought and rainfall intensity. For the purpose of this study hydrologic Ratio (λ) and water equivalent to avert drought will discussed. The hydrologic ration (λ) is defined as the ratio of means annual rainfall to the potential evapo-transportation Adefolalu (1994) gave a formulation that RR= (f.EO)

(with PE=f.EO)

Where RR is rainfall, f, a constant and EO to evaporation (open water body). λ-values of less than 0.60 are said to signify semi arid conditions, which must be redressed. Thus, for a dam designed to hold water a t a certain level

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

A number of techniques and method have been adopted in this research project to assess and investigate the resource potentials of Ero catchment basin with a view of achieving a sustainable development in Ekiti State. This chapter concludes the research by summarizing the vital findings and the proposal made towards developing the potentials of the catchment basin for the upliftment of humanity in general.

5.2 SUMMARY OF FINDINGS

The study has shown vividly that, though satellite imagery "SPOT Xs 2" to be precised false colour prints could be used for the assessment of resource potentials of Ero –catchment basin, it has a number of limitations that may impinge on interpretation techniques. The combination of manual interpretation with ground truthing for the on the 'SPOT' assessment of some resources gave a better result than when relying solely on SPOT x 2 imagery.

By and large, the following resource were identified and assessed accordingly:-

Agricultural resources, ranging from arable crops such as Maize (popcorn), Cassava, Rice, Yam and Sugar cane. Under this category, popcorn top the list after assigning weights and using the 4 quadrant method after Adefolalu (1994) to assess the total area coverage in relationship to other arable crops grown in the region. To this end, a large scale maize farming have been proposed to meet the demands of buyers that normally comes as far as Lagos, Kano, Ibadan etc the Nigeria industrialist specializing on production of beverages can invest in this venture.

It has been discovered that the catchment area has potential for the production of hybrid oil palm as evident in the plantation managed by Ilejemeje High School and other wild oil palm found all over the catchment basin. The soil of the area indicated under soil Association is found to be suitable for the growing of rice, yam, maize, sugar cane and oil palm as well as cassava. Base on the volume/quantities of cassava harvested yearly from the catchment area, a starch industry is seems to be feasible.

The inventory of resource survey conducted showed that the potential of the following are equally high such as Holiday resort for recreational purposes for tourists, to engage in site scene, boating, serving and photography; rock polishing, clay for ceramics industry and burnt bricks factory; flood plain for sugar cane production on a large scale and timber production from the wooded land area around the various river channels.

Under the water resource potentials, domestic and industrial water supply was rated very high due to the enormous volume of water supply daily to the inhabitants of 62 towns and villages in Ekiti and Ondo states.

Based on the surface area coverage and the availability of land for future expansion and topography of the catchment areas along with Oye catchment basin, it was found out that the present Ero dam can be redesigned for hydro-power generation. In view of this, it has been suggested that inter basin transfer of Oye Basin along with Ero catchment basin is possible with minimum cost compared with the long-term return from electricity generation.

Finally, one-hectare rainfed fish farm per farmer has been proposed to boost the fish farming potentials of the catchment area since fish strive well in shallow water than deep water. Large fish tend to prefer to live in pools and smaller fish in shallower water. Depth may become a limiting factor for fish migration when the water is too shallow for passage. This informed the author to proposed fish farm (rainfed) to increase the protein level of peoples diet and enhance the standard of living of the people within the catchment area and perhaps, most importantly bring about sustainable development

5.3 CONCLUSION

Ero Catchment Basin promises a lot of potentials for the government and people of Ekiti State or anybody who is interested in Long-term projects. The dam site can accommodate Hotels of international standard for tourists and investors. Unfortunately, the poor finance of Ekiti State government has not allowed the siting of an hotel around the dam, not only that, the government is yet to buy a standby generator for water treatment at the dam water treatment plant to cushing the effect of power outages .

Again, the roads leading to the dam from all sides are poor, untarred and slippery during rainy season as well as dusty during the dry season almost to the point of abandonment at the time. See plate 5.1 . these are developmental inputs, as well as accelerator which must be put in place before the resource potentials of Ero catchment basin can be harnessed and bring about the much desired sustainable development in Ekiti Land.

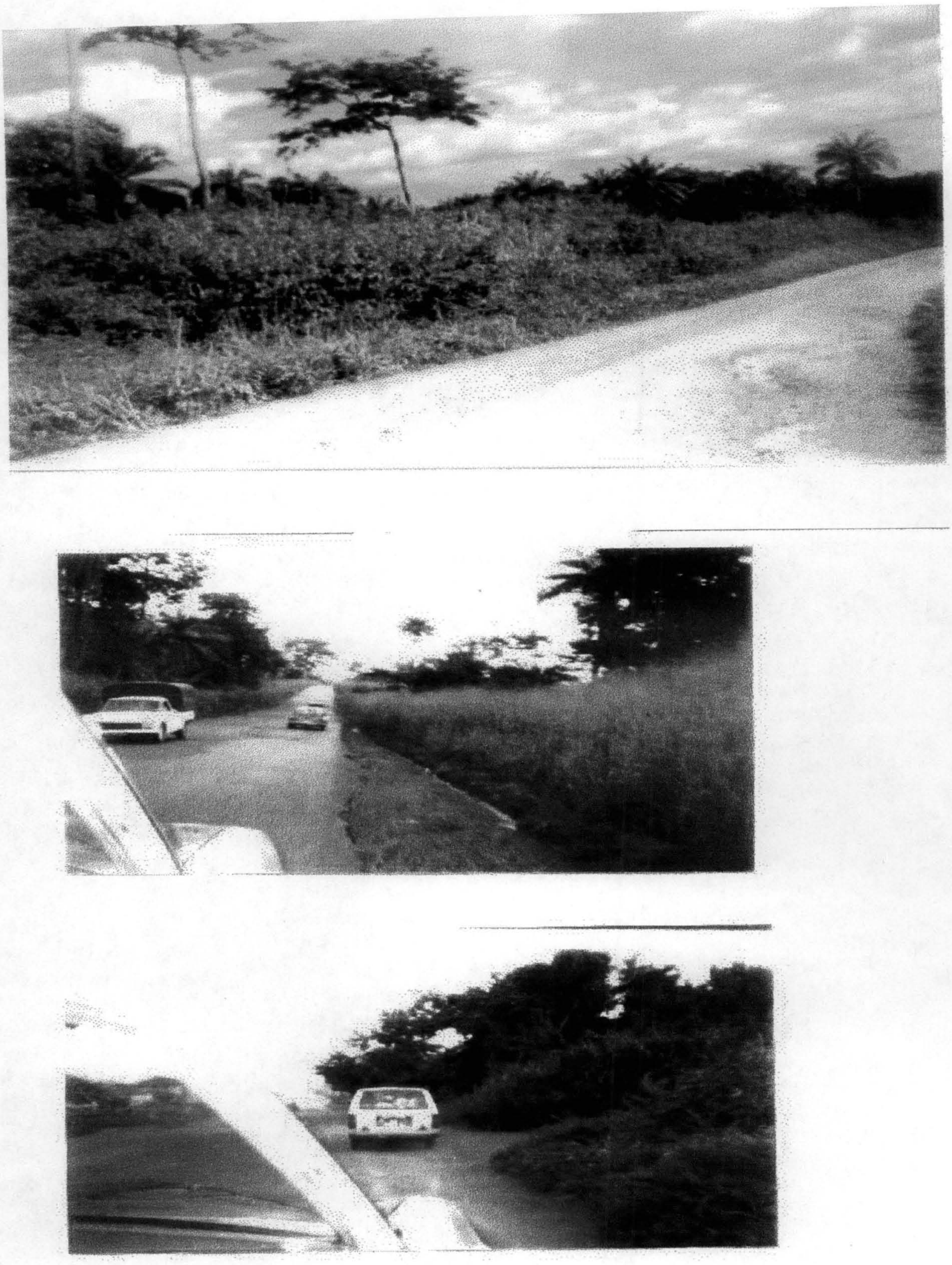


PLATE 5.1: SHOWING TYPICAL UNTARRED ROADS THAT CHARACTERIZED THE STUDY AREA
SOURCE: FIELD SURVEY (2002)

5.4 RECOMMENDATIONS

Further research could employ other remote sensing data sets such as SAR, ERS, Landsat and JERS 1 to asses the resource potentials of the catchment basin for an indept probe of the geological features and hydrological phenomenon of the region. The government should commission feasibility studies of Oye catchment basin for a possible transfer of the basin to Ero basin so as to harness the hydro-potentials of the two catchment basins at the Ero-dam for hydro power generation.

Ero-dam should be further protected upstream against soil erosion in order to reduce drastically Sediment loads into the dam by the introduction of buffer zone of about 50m planted with trees for shelter belt. See figure 5.1 recommended shelter belt. Within this zone, farming activities should be restricted a synoptic station should be established at Ero-dam for data gathering and generation for detail studies of the region. This will put an end to the present problem of lack of data as a result of the burnt stores of Ekiti State Water Corporation located at Ero Dam Site.

The government should invest in the production of the following viable crops in the basin: Maize, pineapple, cassava, Sugar cane, Oil palm and supply more vessels for the potential fishermen as well given out soft loans for fish farming. The government should intensify effort in tarring all the roads within the catchment basin and its environ since, transportation is a function of landuse and more importantly, this will haste the development of the resource potentials of the catchment basins by would be investors. Equally, a standby good generator should be provided for the treatment of water at Ero dam to increase the efficiency of water supply in both Ekiti and Ondo States respectively. This will compliment the effort of NEPA and put and end to the problem of power outages.

Above all, the government should look at the plight of the people living upstream of the dam so as to attend to their problems. The government may even consider relocating them with adequate compensations. The village worst hit with flooding are: Iye, Ijesha-Iye, Eda and Iludun.

For investment purposes, the Ekiti State government should construct an holiday resort centre within the vicinity of the dam site for recreational purposes since the catchment basin has a great potentials for tourism.

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APPENDIX.

ASSESSMENT OF RESOURCE POTENTIALS OF ERO-CATCHMENT BASIN USING SATELLITE IMAGERY

QUESTIONNAIRE

Please answer the following questions correctly. Your answers will be treated as confidential as possible.

1. Time and date of interview..

2. Town of respondent..

3. Sex of respondent (I) Male ( ) (ii) female (......)

4. Age of Respondent

   Less than 20 years

   20 – 24 years

   25 – 29 years

   30 – 34 years

   35 – 39 years

   40 – 44 years

   45 – 49 years

   50 years and above

5. Educational status :

(i) Illiterate ( )

(ii) Less than Primary Six ( )

(iii) Primary six Education ( )

(iv) Secondary Education ( )

(v) Tertiary Education ( )

6. Occupation of Respondent

(i) Farming

(ii) Civil Servant

(iii) Fishing

(iv) Others (Specify)

7. If farming what type of farming activities do you engaged in?

(i). Arable Farming

(ii). Cash Crop Farming

(iii). Animal Husbandry

(iv). Aquatic farming or fishing.

8. If arable farming what type of crop (s) do you plant

(i). Popcorn

(ii). Rice

(iii). Cassava

(iv). Yam

(v). Sugarcane

9. Please arrange these crops in order of yield and priority.

10. Why do you have interest in growing these crops?

(a). Good Yield

(b). Good soil available for its cultivation.

(c). Ready market for the output

(d). Cost of production

11. Please tick the one that will perform best out into consideration the soil in your area:

(i). Cassava

(ii). Yam

(iii). Sugarcane

(iv). Rice

(v). Popcorn

(v) Oil Palm

12. Apart from arable crops, what other resources are found in this area? Tickthe most common one.

(i). Timber

(ii). Clay

(iii). Fish

(iv). Water

(v). Gravel

(vi). Animal (Cow)

13. Which of these resources, will you like to invest in their development.

(i). Popcorn ( )

(ii). Fish ( )

(iii). Sugarcane ( )

(iv). Yam ( )

(v). Clay ( )

(vi). Water ( )

(vii). Animal (Cow)

14. what are the major problems facing the production of any of the arable crops and development of resource.

(i). Lack of good road

(ii). Lack of Land

(iii). Lack of fund

(iv). Lack of Labour

(v). Problems of pests, rodent and diseases

15. Will you prefer cooperative farming system to one man or one household system

(i) Yes......................... (ii) No.....................................

16. Do you have problem of water here?

(i) Yes.......................... (ii) No...................................

17. If yes, why?

(i). Problem of power outage. ( )

(ii) . Lack of pipe borne water . ( )

(iii). Inadequate water supply ( )

18. Which of these fish families is the most commonly cropped from this reservoir.

(i). Tilapia 3

(ii). Claridae 1

(iii). Clechilidae 2

(iv). Saratheradon 4

(v). Mochokidae 5

19. Are you in support of fish ponds to increase source of fish production apart from the lake? (i) Yes........................ (ii) No..............................

20. If yes, will you prefer rainfed to damming of stream (i)Yes………. (ii) No………

21. If yes, why do you prefer rainfed pond?

(i) Easy Cropping

(ii) Good Management

(iii) Problem of Flooding/ erosion.