AN ASSESSMENT OF THE EFFECTS OF LANDUSE PRACTICES

ON

AGBA DAM IN ILORIN

USING A REMOTE SENSING TECHNIQUE

BY

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BEING A THESIS SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS IN TECHNOLOGY (REMOTE SENSING) SCHOOL OF SCIENCE AND SCIENCE EDUCATION

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DECLARATION

I ADEDIRAN BANKE KUBRA of the Department of Geography, School of Science and Science Education, Federal University of Technology, Minna do solemnly declare that the research work presented for the award of Masters of Technology (***Remote Sensing***) has been carried out by me, under the supervision of Dr. Halilu Ahmed Shaba of the Department of Geography, School of Science and Science Education, Federal University of Technology, Minna, Niger State.

_____ _____

ADEDIRAN BANKE KUBRA DATE

CERTIFICATION

This is to certify that Adediran Banke Kubra did conduct a research on the Impact of Landuse practice on Agba Dam in Ilorin. And is approved for its contribution to knowledge and literary presentation. In partial fulfillment of the award of M. Tech degree in Remote Sensing, School of Science and Science Education, Federal University of Technology, Minna.

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DEDICATION

This thesis is dedicated to my mum,
my Jewel of inestimate value.

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ABSTRACT

The way we use the land has direct impacts on the nearby water bodies. Land use practice around Agba Dam varies from agricultural practices to residential purposes. Agricultural areas have the potential to pollute the water in many ways. Runoff on farms carries sediment, nutrients salts, pesticides and fertilizer, thus the water in the reservoir is contaminated with these pollutants. When livestock graze along the edges of the reservoir, they increase sedimentation in the dam, and when the vegetation is overgrazed, it result in erosion.

Land use areas of residential purposes yield the greatest amount of pollutant to the Agba dam via domestic sewage. Domestic sewage from the residential buildings around the dam includes all wastewater from baths, sinks, basin and other sources.

Four stations were located around Agba dam and physico-chemical parameters were observed and analyzed in the laboratory. The low dissolved oxygen in the 4 stations indicates that the dam is under pollution stress. The dam is also being encroached upon by man's activities around the dam. This

has caused a reduction in the size of the dam from what was observed in the aerial photograph of 1982 and what is on ground now (2003).

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND TO THE STUDY

Land use can be defined as the use of land by people, usually with emphasis upon the functional role of land. Agba Dam, an earth fill dam for the storage of water for water supply, irrigation and flood mitigation purposes, has been constructed since the colonial days, in the early 1960s.

In order to protect the quality of water supply in Agba dam, there is need for a comprehensive planning of community activities to coordinate the amount and placement of private and public facilities around the dam. Uncoordinated development can lead to inefficient and undesirable land uses around the dam. For example; unplanned residential development around the dam has adverse effect in terms of the drainage system and pollution of the water in the dam.

Works on the effect of human activities on natural environment are considerable in the literature. However, pollution, sedimentation and erosions will be the main focus of this research work.

Soil degradation occurs when the soil develops characteristic adverse to maintenance of stability of land use system, either in terms of decrease of quality or quantity of the outputs of the system or by increase of the amount of inputs require by the system (UN FAO/UNEP, 1974) as a direct consequence of the various human activities on drainage basins.

Water pollution may be defined as the introduction of substances into water bodies either directly or indirectly resulting in such serious effects as harm to living aquatic resources and hazards to human health. The various method of land cultivation may have adverse effects on the quality of water in the reservoir especially the application of fertilizer to farmland around the dam.

Domestic sewage from residential buildings around the dam includes all wastewater from baths, sinks, basin and other sources. It also includes refuse generated in the course of doing one's domestic chore or the other in the home. The decomposition of sewage results in the oxygen depletion of the water and stimulates eutrophication and its attendant problem of mortality, migration and gene mutation in aquatic life (Sikoki and Kolo 1992)

The general rapid rate of population growth in Ilorin has brought pressure to bear an social facilities such as water supply, transportation etc. Different land use practices can be vividly observed around the dam ranging from residential building to recreational garden, small scale farming and cement block industries.

Man interference with Natural denudation is highly dependent on the use he puts the land and this various land uses practice have impact on the dam. The unguarded rapid urbanization manifested in the changes observed around the dam. The impact of human being i.e. man on the environment cannot be over emphasized. Man, through this developmental process e.g. modernization, technological know how, and resources exploration within his environment has brought about some effect such as pollution. Water pollution is the result of the release of too much unwanted materials by human activities in the water body especially via the various land use practice such as livestock grazing, farming, fishing, sewage and drainage system:

Water pollution could either be of two forms: by point source or by non point source. We are more interested in the non point source of

pollution because it is related to land use practices i.e. it occur from run-off water containing pesticides and fertilizer used on farmland. Thus it does not have a specific location and can find its way in the dam. This is very difficult to control. Most agricultural pollution is non-point since it typically originates from many fields.

The quality of water in such a dam is often reflective on the degree of pollution being generated within the drainage basin.

Though man's devastating impact in sculpturing the earth is not reversible, he could do much to protect what is left of the environment "because man's continued existence depends in great part on understanding rivers, their morphology and dynamics (Smith 1971).

Thus this study would assess the various land use practices e.g. livestock grazing, farming, residential purpose etc. and the impact of this landuse practices on the dam, such as pollution, erosion/sedimentation e.g. so as to help develop strategies to manage the quality and quantity of water supply in Agba dam.

Remote sensing is becoming increasingly important for assessing the impact of landuse practices because large areas can be imaged quickly and respectively.

Remote sensing method eliminates the problem of surface inaccessibility that often hamper ground survey. However, some limitation of remote sensing technique include; some type of landuses may not be distinguished on images and most images lack horizontal perspectives that is valuable for identification of many categories of landuse.

1.1 STATEMENT OF THE RESEARCH PROBLEM.

The need for continuous inventory and management of available natural resources is widely recognized as an essential part of planning and development process. Urbanization refers to the changes in the proportion of the population of a nation living in an urban place.

This has resulted in the changes of the land uses practice around the dam. Various human activities are going on around the Agba dam, one of the oldest dams in Nigeria. The area is now a new government-

reserved area, courtesy of the fully developed beautifying building around the dam area. However there has been no assessment of the magnitude of impact of these land use practices around the dam. It is therefore the focus of this research, to find answers to the following questions.

a. What are the land use practices, in the study area?
b. What are the impacts of these land use practices on Agba dam?
c. How effective can remotely sensed data (aerial photographs) be used in assessing the landuse changes in the area?

1.2. AIM AND OBJECTIVES

This study aims at ascertaining the impact of landuse practices around Agba dam on the reservoir, using remotely sensed data. This is to be done with a view to fulfill the following set of objectives.

a. Delineate the various types of landuses around Agba dam.
b. Determine the spatial extent of landuses changes between 1982 and 2003.

c. Assess the physico-chemical parameters of Agba dam and their pollution effects

d. To determine the impact of various landuses practices on the dam.

e. Proffer possible steps for future research.

It is hoped that with the above accomplished, the research would have explored the potential of remote sensing in studying landuse practices impact on Agba dam.

1.3. SIGNIFICANCE OF THE STUDY

Landuses reflects the character of the interaction between people and environment and the influence of distance and resources base upon basic human economics activities.

The purpose of this research is to ascertain the impact of land use practices on Agba dam in Ilorin. With the aid of aerial photographs dated 1982, the study will observe the type of landuses the area is subjected to and how it affects the quality and quantity of the water in the reservoir, by testing the quality of the water.

Heavy metals such as copper, lead, mercury and selenium get into water from automobile exhaust, mines and even natural soil. Chemical impurities, particularly those imported by heavy metals, such is lead, mercury, and copper, arsenic, iron etc. are usually not removed from water. If for any reason, therefore, the levels of concentration of this chemical element in the water appreciably increase over and above the acceptable limit, the life of the consumers will be threatened. This threat could come as a result of the direct consumption of the supposedly treated water or as a result of the consumption of aquatic animals, such as fish that live in the water.

Finally the research would also aid the government of Kwara State in conserving one of our major reservoir from being silted so that would not provoke a major cut in drinking water supplies to Ilorin.

1.4. SCOPE OF LIMITATION

This research covers only Agba Dam and it environs. The conclusion derived from this study is based entirely on the information gotten from the study of this area. Variations are thus expected to occur if

the study is carried out in a different location. It is also possible that similar results may be obtained when it is replicated in a different geographical location.

Due to financial and time constraints coupled with lack of data, the researcher restricted this research work to Agba Dam and the data collected is limited only to those from aerial photography of 1982, Ilorin street guide of 1987 and Ilorin landuses map of 1990. The researcher was therefore constrained to use only the available data to evaluate the problem.

1.5. DESCRIPTION OF THE STUDY AREA

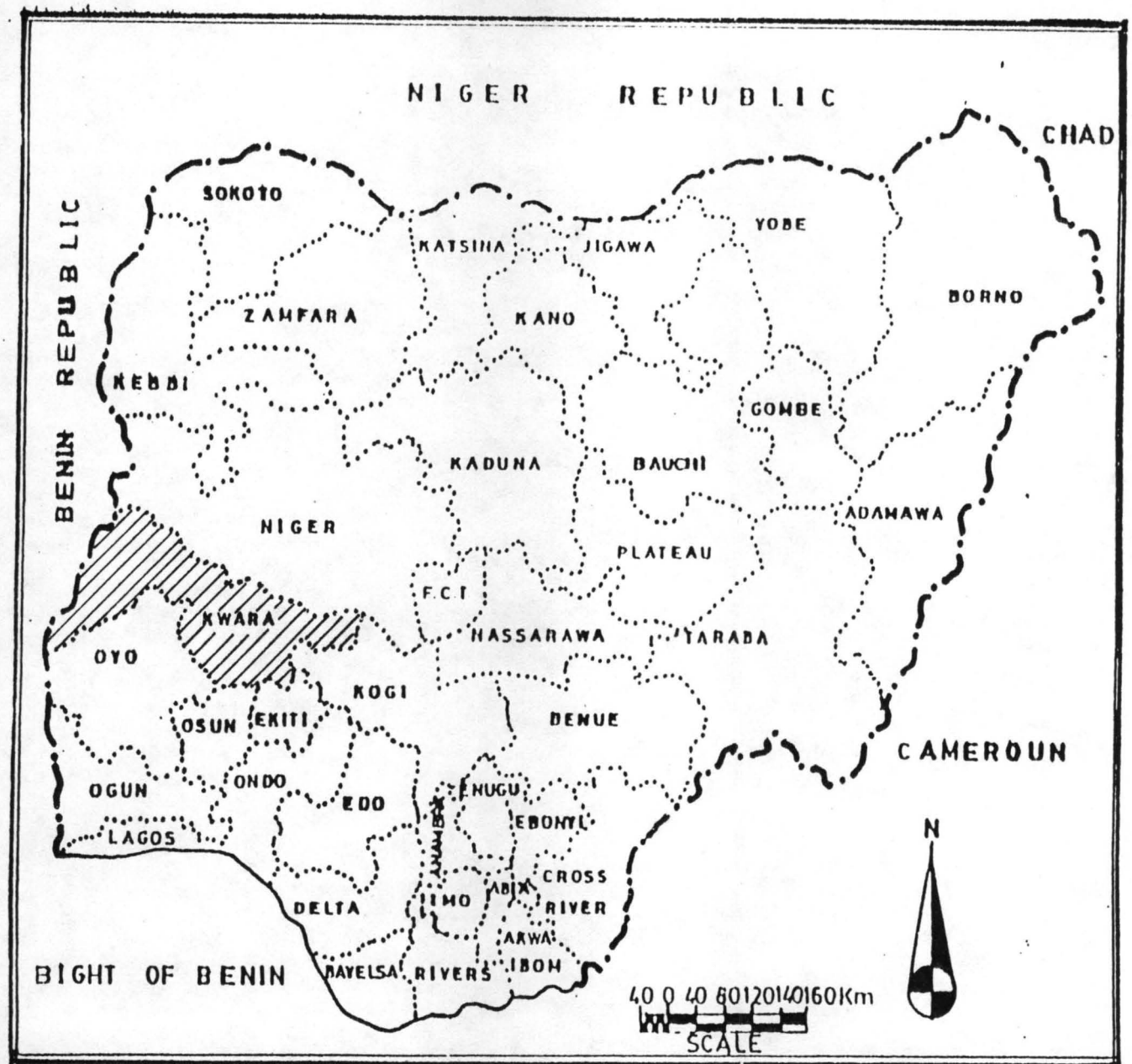
1.5.1. LOCATIONS AND EXTENT

Kwara State is located on latitude $8^{o}\ 30^{i}\ 26^{ii}$ North and longitude $4^{o}\ 35^{i}\ 0^{ii}$ East of the prime meridian. Niger, Kogi, Osun and Oyo states bound it. It also has an international border with the republic of Benin. Kwara State was created on 27th May 1967 along with eleven other states in the Federation.

1.5.2 CLIMATE

The State enjoys the tropical wet and dry seasons. The wet season begins towards the end of March and the end towards the end of October. Dry season begins in November and last till February. December and January are usually cold, dry months due to the influence of harmattan winds coming across the Sahara Desert.

There is a short spell of drought between August and September. The mean annual rainfall is about 1,318mm, which is mainly concentrated between April and October. The mean monthly temperature is very high ranging from 77°F to 86°F and in March reaching about 85.8°F.



LEGEND

National Boundaries . . . . . —•—•—

State Boundaries . . . . . •••••••

Study Area . . . . . ▭

Fig. MAP OF NIGERIA SHOWING KWARA STATE

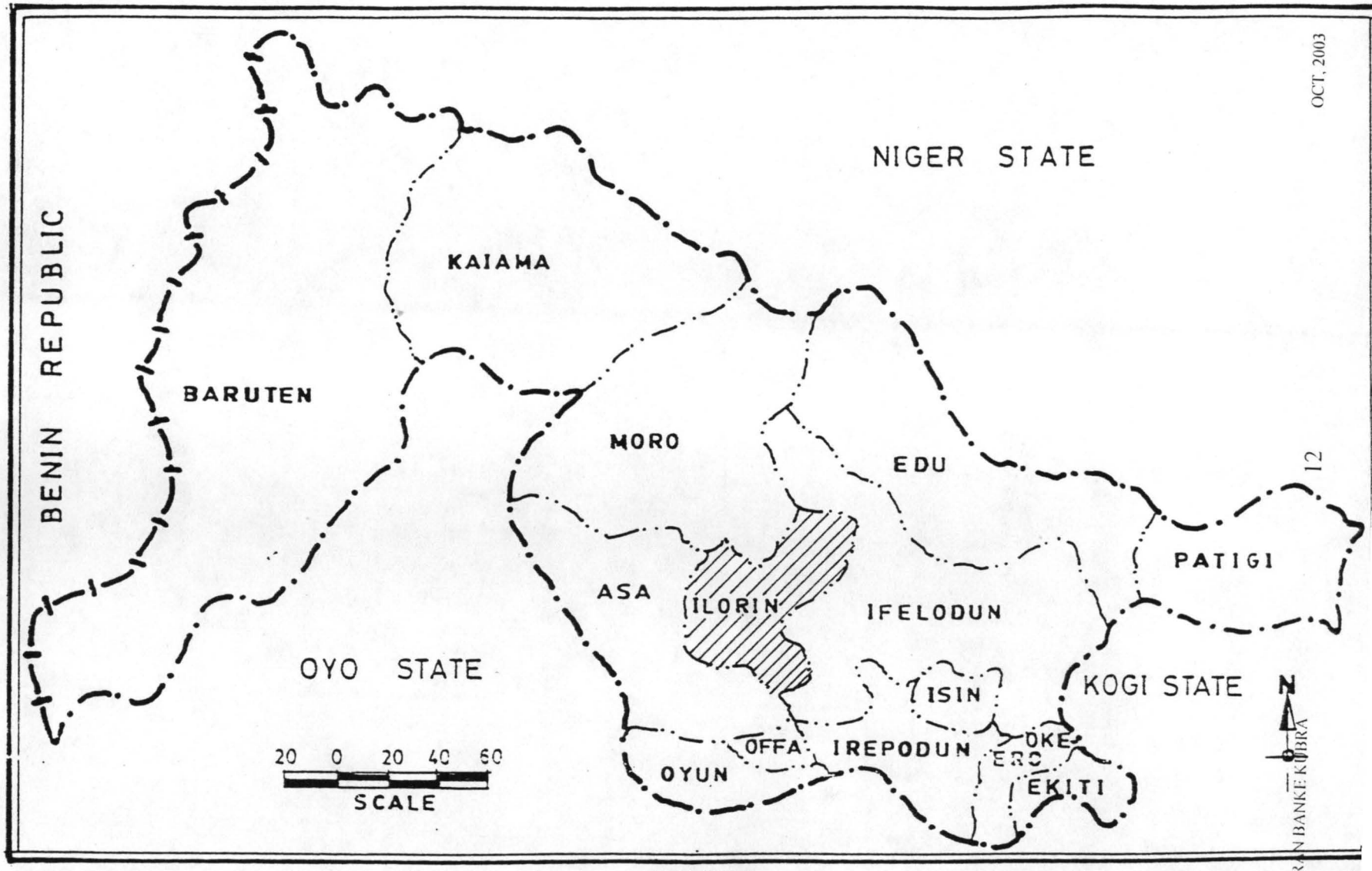


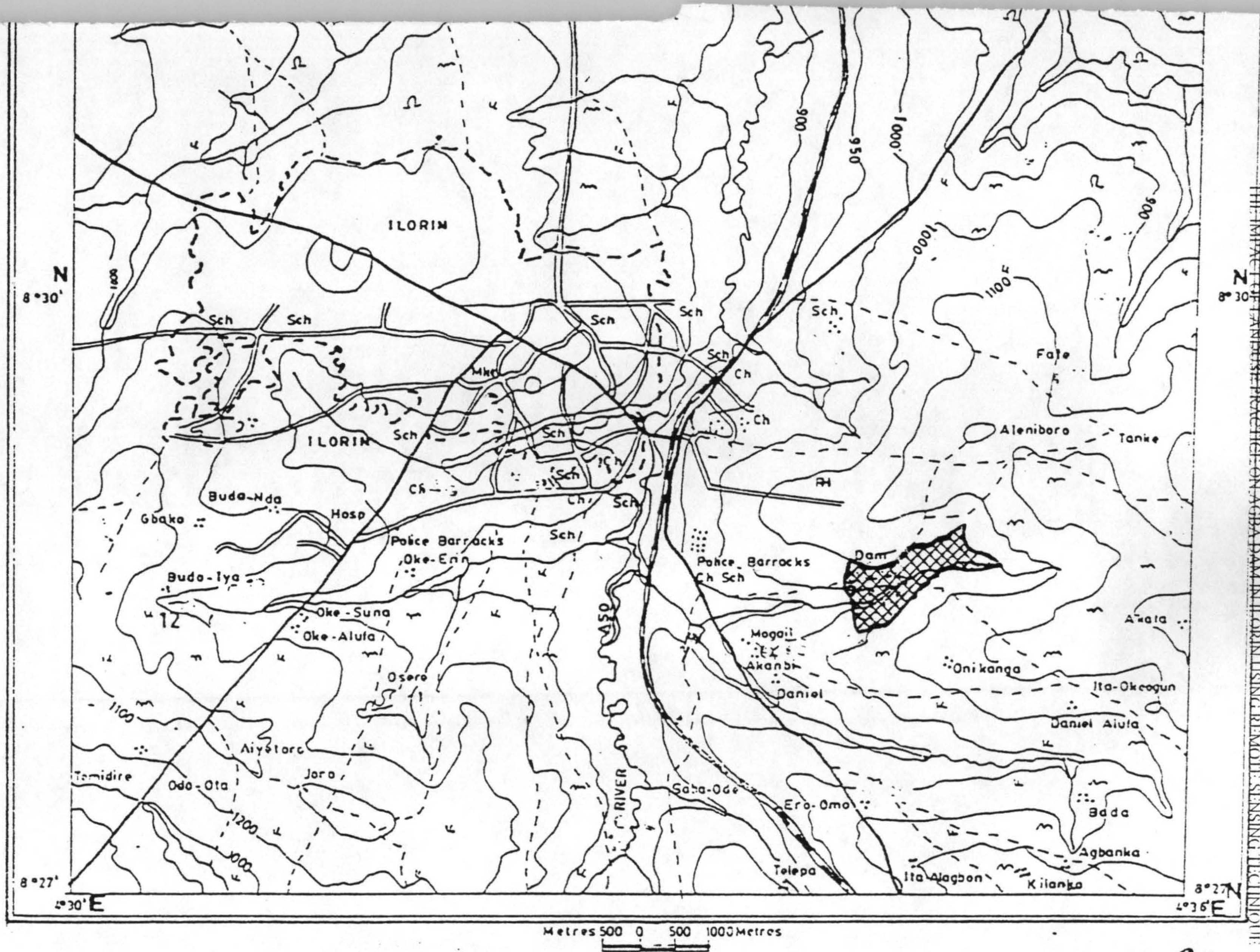
Fig. KWARA STATE MAP SHOWING ILORIN

1.5.3. TOPOGRAPHY AND DRAINGE

The landform varies from ranges of undulating hills with valley to plain land. River Asa is the only major perennial water course. Agba stream is a small stream that drains from the northeastern part towards the northwest direction of the area. Two streams are sourced within the study area and they flows into the reservoir.

1.5.4. VEGETATION

Ilorin falls within the Southern Guinea Savanna and grassland zone. As characteristics of the Guinea Savanna zone, we have tall grasses and a few scattered trees in this area. Some of the notable trees include the locust beans, Baobab, Akee-Apple and sheabutter trees.



— — Boundary of the City —— Major Highways Railway ═ Major Roads —·— Foot Paths Sch = Schools Ch = Churches Dam

Fig. Topographical map of Ilorin showing the study Area (Dam)

1.5.5. POPULATION

The first estimate of population of Ilorin was made in 1911 and this put the population at 36,343. By 1921 another estimate of the population was 36,688. This rose to 45,616 in 1931. The relatively well-concluded census of 1963 put the population at 208,546.

The 1991 census exercise put the population Ilorin at about 600,000. The population is made up of numerous ethnic groupings. Among these are the Yoruba's, Hausa, Fulani's, Nupe's and Barba's speaking people.

1.5.6. AGBA DAM

Agba Dam is located across Agba stream. It is located in Ilorin metropolis, just behind the government house. It was constructed in the early 60s during the colonial era. Agba Dam is the oldest dam in Ilorin. It is owned and operated by Kwara State Water Corporation. The dam impounds water from little Agba stream; through the reservoir capacity is still unknown.

The dam was designed and constructed to supply water to Ilorin metropolis. With a daily supply of fifty thousand gallons of water per day. It is one of the sources of water supply to Ilorin municipal and it's environed. Its upstream can be viewed from pipeline road, while its downstream can also be viewed from Agba Estate road. Presently the landuse practices around the dam is different from what it was in the aerial photograph taken in 1982. It is now fully developed with more residential buildings and other activities such as farming. And this is the main purpose of the study i.e. to monitor and observed the impact of this various land use practices on the quality of the water in the dam.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Dam is a barrier built of concrete or earth materials (embankment) across a river or stream, to hold back water and raise its level to form a reservoir. More than 160 dams of various reservoirs capacities have been constructed in various part of Nigeria. The principal objectives for building these dams are for water supply, irrigation and hydropower generation. Secondary benefit includes recreation, fisheries, flood control and wildlife conservation.

There is nothing in the literature on the study area which examines the same objectives as set out in chapter one i.e. 1.2.

Urbanization refers to the changes in the proportion of the population of a nation living in an urban place. Thus in urban areas, there is total broadening and beautifying city landscape. While putting developmental indicator in place, allowance for the environmental stress is hardly considered. Thus infrastructure provision in the human community most often translates into a number of environment related

problem. During rain storms, pollutants from dirty streets including pets waste, herbicides, vehicle waste and house hold chemicals are washed into local streams. Urban areas with river bank development increase erosion because of the loss of vegetation due to man and animals activities.

2.2. LAND USE IDENTIFICATION AND POLLUTION STUDIES USING REMOTE SENSING

The way we use the land has direct impact on the nearby water bodies. Man has the ability to put a parcel of land into a number of uses. Indeed, a given parcel of land is often confronted with a number of competing uses. The general consequence is that land use mixes tend to occur, depending on different preferences e.g. for agriculture, residential, commercial, industrial purposes and road construction etc. As this process of subjecting a parcel of land into various uses commences, soil and vegetal resources becomes degraded. The soil resources become exposed. The exposure hardens up the soil and it sometimes looses some of its nutrient status. The net effect of this development is a downward trend in agricultural production. Thus for a farmer to improve the

fertility of the soil, he will have to apply fertilizer to it. This fertilizer contain chemical such as phosphates and nitrates, which are the main causes of water pollution during water run-off into dam or water bodies.

Sabins (1981), according to Halilu (1993) describes land use as the description of how a parcel of land is used, such as for agriculture (cultivation of land and animal grazing), residential or industry. He further explained that accurate and current information on land use is essential for planning activities and remote sensing methods are becoming increasingly important for mapping landuses for the following reasons, among others;

- Large areas can be imaged quickly and repetitively
- It eliminates the problem of inaccessible surface that often hamper ground surveys.
- Image interpretation is faster and cheaper than conducting ground survey.

Floyd (1981), according to Halilu (1993), described remote sensing as the science of acquiring, processing and interpreting images and

related data obtained from aircraft and satellites which record the interaction between matter and electromagnetic energy.

Water pollution is the discharge of unwanted biological, chemical and physical materials into water bodies from man's enviroment.

The pollutants are usually chemicals, physical and biological substances that affect the natural condition of water. With increasing population and urbanization in Nigeria and consequent increase in the need for water supply, there is the need to protect the existing water bodies from contamination which are peculiar to the urban centers. For example, Kehinde (1998), reported that ground water in metropolitan Lagos is under uncontrolled exploitation and indiscriminate discharge of all type of waste at illegal dump site. This incidence is responsible for the widespread water contamination in cities such as Lagos, Kano, Port-Harcourt, Ibadan among others.

According to Sikoki et al (1992) of all pollution problems being experience in Nigeria, water pollution occupies the pride of place. Both man and the aquatic ecosystem are directly and indirectly affected and

man needs to be adapted to combat pollution and to conserve aquatic ecosystem.

According to Ofejekwu (1990), water pollution is of three principal types.

- The physical, these include silt and other abrasive agent.
- The chemical, including toxic material from industries and agricultural products like insecticides and weed killers.
- Organic, including domestic sewage, industrial waste like fertilizers.

Remote sensed data are better and quicker than the conventional method in detecting and mapping of features. Correlation can also be made between two points measurement on the ground while some properties of the remotely sensed data such as density level between two spectral bonds could be measured.

Really remote sensing has come of age in its ability to monitor the environment and the study of the earth's surface features interaction with aquatic environment and the resultant changes such as construction of reservoirs, building of canals for drainage or irrigation purpose etc.

Poul et al (1988), according to Halilu (1999), used enhanced classification approach form Landsat MSS data set (1975 –1984) in assessing natural and man induced changes in landuse/landcover in the semi arid environment of North Western Nigeria after the construction of Bakolori Dam. It was evident that the result of an overlay enhancement of band 5 images (As described in Banner and Lynham 1981) provided the most accurate identification or spectral changes.

Extensive investigation of digital analysis in soil mapping has been done in the industrial countries of Europe and North America.

2.3. AGRICULTURAL WASTE AND POLLUTION STUDIES USING REMOTE SENSING

Agricultural areas have potentials to pollute water in many ways. Run-off from farms carries sediments and nutrients, salts, pesticides and fertilizer.both round water and surface water can be contaminated with this pollutant.

Pollution of Agba dam are likely to come from agricultural wastes, domestic sewage, heavy metals sedimentation and infectious organism.

Agricultural wastes are chemicals used by farmers for various purposes. This chemical includes Herbicides, used to kill unwanted plants, the pesticides are used to kill unwanted lower animals whereas the fertilizer is used as manure to enrich the soil and ensure rich harvest. This contain chemical which find their way into the water body and would adversely affect the water quality.

Metals contain in fertilizers and pesticides are also contaminants. Phosphorus and nitrogen, which comes from fertilizer can cause algal bloom which reduces oxygen in the water. Organophosphorus, a type of pesticide used in agricultural garden also contribute in a great measure in polluting the nearby water reservoir.

Lloyd (1992) pointed out that the first important fact to remember is that all chemicals are harmful if this are present in high concentration, even those chemical that are essential to life at lower concentration.

Thomas et al (1987), reported that it is rarely possible to make a positive identification of the type and concentration of pollutant by air photo interpretation alone. However, it is possible to use air photo

interpretation to identify the point at which a discharge reaches a body of water and to determine the general dispersion characteristic of plums.

Fertilizer is a major pollutant. Das et al (1977) reported that about 80% to 60% of the nitrogen applied in farms during autumn and winter leach into lakes ands stream. This results in an increase in nitrogen and phosphorous content of rivers enhancing eutrophication. Eutrophication occurs as a result of depleting oxygen level due to the decomposition of micro-organism.

The most serious effect of pollution is the depletion of dissolved (free) oxygen. All higher forms of aquatic life exist only in the presence of oxygen. Under anaerobic conductions, aquatic organisms are retarded.

LIVESTOCK

The way livestock is managed have impact on water reservoir when livestock are permitted to graze along the edge of a stream, they increase sedimentation in the river. The stream bank are weakned when vegetation is overgrazed, resulting in erosion. When the vegetative cover is lost, this run off can be a source of contamination for the nearby stream.

2.4 DOMESTIC WASTE AND POLLUTION STUDIES USING REMOTE SENSING.

The Oxford Dictionary (revised version of 4th edition) described sewage as waste matter from human bodies, factories, town e.t.c that flows away in sewers. While domestic is described as a home or household.

By far the greatest volume of waste discharge to the marine environment is sewage. Sewage effluents contain industrial waste, rainwater and water from domestic baths, fats, faecial matter and anything washed down drains or flushed down the toilet.

Sewage pollution is caused when high concentration of untreated industrial and domestic waste enters water bodies. Decaying organic matter and nutrients in sewage enhance plant growth. Excessive plant growth and oxygen depletion can leads to alteration in ecosystem structure and these are both features of eutrophication (excessive growth of algae due to increased nutrient inputs.)

Panchromatic black and white as well as colour infrared aerial photographs has been employed in identifying and monitoring

environmental pollution in Netherlands (Bishop, 1976) as reported by (Halilu 1993).

2.5. EROSION/SEDIMENTATION AND POLLUTION STUDIES USING REMOTE SENSING.

Erosion has been linked with such factors as human activities, precipitation, run-off, vegetation cover, biological process in the soil and inherent inability of soil to resist erosion (Tee 1988).

Sedimentation: Is a process of erosion, enticement, transportation, deposition and compaction is a general problem faced by dams and reservoirs. Sedimentation depletes land resources and it also reduces the quality of water resources. Though sedimentation is a natural process as asserted by Vanoni (1975) as reported by Halilu (1999). It can also be said to be an anthropogenic consequences, because man is the major factor in triggering and aggravating sedimentation problem.

A study reported by Halilu (1993) have pointed to the effect of erosion and sediment across river chemicals such as the reduction in river volume in river Nile and the subsequent deposition of sediment down

stream of Aswan Nasser Lakes. Generally it is assumed that all the world resevoir may receive 3200 x 10^6t of sediment a year.

Accompanying the land use mixes are the incident of soil erosion which have severally threatened/destroyed very many part of Nigeria.

Nest (1991) reported sedimentation and eutrophication problems in the following dams : Ede, Owo, Iwo, Efun-Alaiye, Ilesha, and Ado-Ekiti, Opa and Asejire dams.

Sedimentation also plays an important part in aquatic ecosystem. Suspended sediment is a major problem in streams, lakes and estuaries T

Garland (1982) as reported by Halilu (1993) used panchromatic block and white and infrared photograph to map erosion in some agriculture land in South African and noted high spectral sensitivity with panchromatic photographs for cultivated and uncultivated areas.

Water pollutant result from various human activities. (As Ofojekwu (1990)) stated, human activity and a variety of modify the composition and state of a natural water body to the extent that such water body losses its ability to serve designated purpose.

Rivers and dams receive all forms of pollution, particularly where conceives efforts are not made at managing and controlling such pollutions. The quality of water in such dams is often reflective of the degree of pollution being generated within the drainage basin.

CHAPTER THREE

METHODOLOGY

3.0. INTRODUCTION

This chapter deals with the data that will be used to delineate the type of landuse around the dam. For the purpose of this study landuse is expressed as the activities taking place on the earth surface. These activities include farming, construction of building and irrigation together with their attendant problems which directly or indirectly affect the quality of the water in the dam.

Landuse practices around Agba dam environ need to be monitored and assessed. This can be done through observation and measurement made at strategic points or collections of samples from discrete locations. These samples are subjected to physical and chemical test to measure the levels of pollution in the dam. It also involved systematic application of the knowledge of the various landuse practices around the dam; so as to realize the need to avoid destructive misuse of the water reservoir, an

accurate way of obtaining information on landuse practice changes is through Remote Sensing.

3.1 MATERIAL COLLECTED

All relevant available data, maps, reports were obtained and examined in order to acquaint the researcher with the data quality and the study area. The aerial photograph covering the dam was collected. topographical map covering the dam was also collected. The Ilorin street guide map was acquired and used in locating and marking the specific area of interest.

Four water samples were collected from four sampling stations. The first station is located at the upstream, the second station is at the downstream while the third station is located very close to the downstream where residential building are found. The last location is where the water flows out of the dam toward Tanke Road. These four samples were sent to the laboratory for a quality test on Agba dam water.

3.2 MAPPING OF SURFICIAL FEATURES

The topographic map acquired was used in locating and marking the specific areas of interest and some changes were observed from the topographic map. Some features were traced out from the aerial photographs; using tracing paper that was fastened to the aerial photograph. Built up areas, farmlands, land under fallow, bufferzone, the reservoir and roads were traced out, to compare the aerial photograph taking in 1982 with the changes observed around the dam.

3.3. AERIAL PHOTOGRAPH INTERPRETATION

Photo interpretation is a deductive reasoning process, which include taking into account the general pattern of features identification by a systematic approach, evaluation of phenomena in a scene and classification or categorization of features.

The size and location of the study area is determined on the scanned aerial photograph. The landuses delineated were based on the potential impact on the quality of water in the dam.

When a transparency was placed over the aerial Photo, the boundary of the features were traced out manually. The land cover interpretation map was prepared, to reflect the built up areas close to the dam, the cultivated farmland very close to the water, land under fallow, bufferzone and also roads constructed around the dam.

The five aerial photographs super-imposed on one another by produced the features of interest mentioned aboved.

3.4 SURVEY AND SAMPLING

Reconnaissance survey of the area was carried out with the assistance of some attendants in determining the sample points.

A pilot survey was undertaken round the dam. This is to identify the upstream and downstream of the dam, it was observed that the water enter the dam via two-source .The two sources to the dam is from Agba stream and the second source can be seen in Fig 4.4.

The source of pollution was the main criteria for the selection of the four sampling stations and physcio-chemical samples were collected and preserved. The interpretation of aerial photograph is only to give a

backing to the field trip since some object are better observed on aerial photographs.

3.5 PARAMETER EXAMINED AND METHODS ADOPTED

3.5.1 BIOLOGICAL OXYGEN DEMAND (BOD) AND CHEMICAL OXYEGEN DEMAND (COD)

The four water samples was taken in bottles to the laboratory for the determination of the dissolved oxygen levels. These were determined using the methods of Ahpa (1985).

3.5.2. P.h. AND CONDUCTIVITY

The Ph and conductivity of each sample were determined using Beckman's electric Ph meter model H5 and table conductivity meter model WPA respectively.

3.5.3. HEAVY METAL

Each sample was analysed for concentration of lead (Pb) Iron (Fe), Zinc (Zn), Copper (Cu) and calcium (Ca) using Pye Unicam Atomic Absorption Spectrophotometer (AAS) mode S.P. 100.

This study therefore carried out an analysis of some chemical content in Agba dam water using the standard procedure.

3.6 REMOTE SENSING DATA

Due to non-availability of imagery for the study area. The main data source for the research was aerial photograph. Five Aerial Photographs covering the study area were collected from the Survey Department Ministry of land and Housing, Ilorin. The Aerial photographs were scanned and concatenated into mosaic. This shows the types of land uses around the dam. Three of the aerial photographs overlapped one another.

Aerial photograph has for a long time been used for mapping land uses due to its simplicity in interpretation and its ability to make small detail visible. These and other advantages of aerial photos make it an ideal one for such a study as this.

3.7 INSTRUMENTATION

Remote sensing applications are instrument-dependent. The nature and accuracy of the interpreted data is to a large extent dependent on the type of instrument used. Aerial photograph covering the dam and other areas are studied, using sets of mirror stereoscope. Field studies were also be carried out, as the researcher went round the Dam to verify some information's on the aerial photograph.

3.8 FIELD CHECKING

The study area was revisited after the interpretation of the finding. This helped the researcher to identify the feature that is not seen clearly during the visuals interpretation.

This was necessary for further verification in order to make up for or at least reduce the errors due to human senses limitation. This was adequately carried out.

3.9 CONCLUSION

Having discussed the methodology that was employed, in the study, These methods was meticulously followed logically to bring out the results obtained from the procedure adopted in the study.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0. INTRODUCTION

This chapter presents the result of the investigation on the impact of the various land use practices around Agba dam, the analysis of the aerial photograph of study area as well as the discussion on the implications of the findings around the reservoir. The various land use practices were identified and delineated from the aerial photographs using tracing paper.

4.1 VISUAL INTERPRETATION OF AERIAL PHOTOGRAPH

The aerial photograph taken in 1982 was classified into six main landuses types as shown in Table 4.1. This classification forms the basis for assessing the effect of landuses practice. The dam is located in a well-developed environment i.e. with more buildings very close to the dam. As shown in Fig 4.1

TABLE4.1

CONBINED LAND USE CLASSIFICATION AND PERCENTAGE CHANGE TABLE OF 1982 AND 2003

LAND USE	AREA M^2 1982	AREA M^2 2003	% change	
Built up areas	115.20	172.80	24	
Farm Land	67.20	24.00	18	
Fallow land	9.60	4.80	2	
Buffer zone	4.80	2.40	1	
Reservoir	43.20	36.00	3	
Total	240.00	240.00		

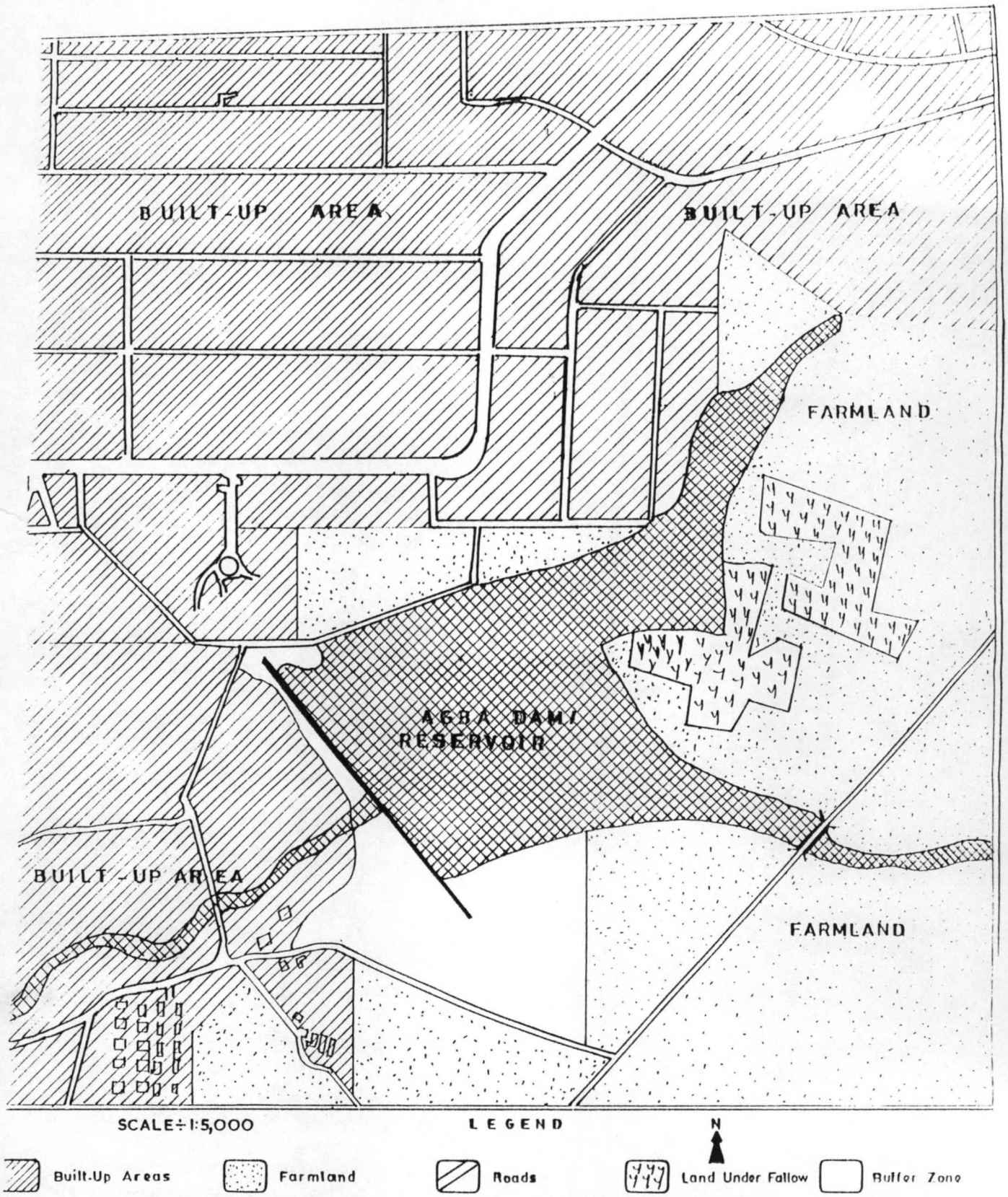


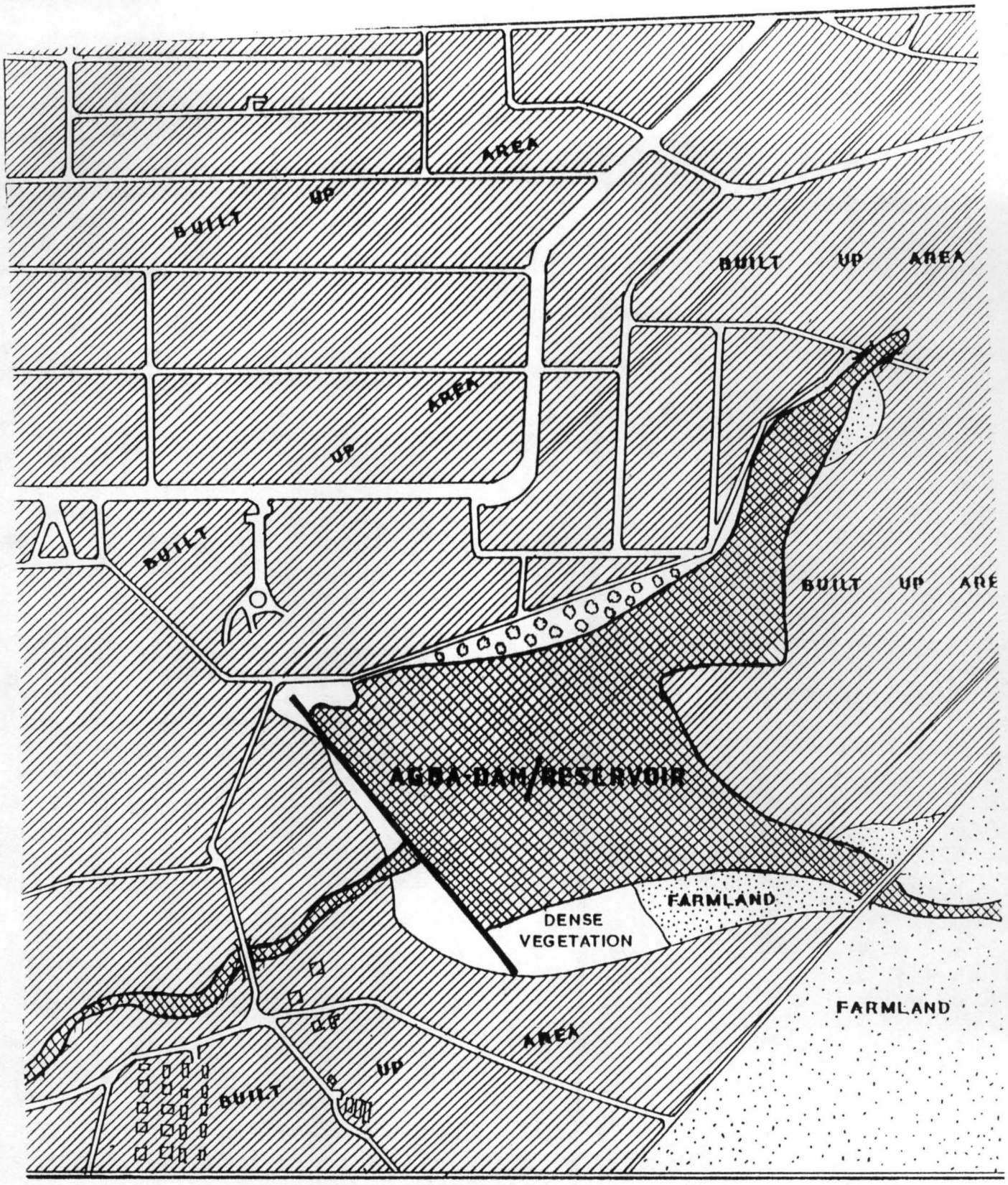
Fig. 4:1 LANDUSE MAP OF AREAS AROUND AGBA DAM AT ILORIN (SATTELITE DERIVED)

4.1.1 LANDUSE CLASSIFICATION

The six features delineated and classified were based on the potential sources of pollution, sedimentation and erosion around Agba dam, in 1982.

An updated landuses map was carved out. This reclassified the various landuse practices visible on ground as compared to the 1982 aerial photograph. The map was drawn to a scale 1: 5,000.

The Landuses in the area is still dominated by farmlands, built up areas, farmland fallow land buffer zone reservoir and roads as can be seen in table 4.1 and Fig 4.2.



4:2 LANDUSE MAP OF AREAS AROUND AGBA DAM, ILORIN. 2003 SCALE÷1:5

4.1.1.1 BUILT UP AREA

Built up structures around Agba dam is visible from the aerial photograph, the western side of the dam is fully developed with buildings, covering about 48% of the total area in 1982, now rank first in the classification table with 72% as shown in table 1 and 2. This can also be viewed in plate 1, 2 and 3 below. The increasing population and urbanization around Agba dam, lead to an increase in domestic sewage. Waste matters from households, channeled into sewer contribute to the rate of pollution of water in the dam.

Household detergent that contains phosphates flows into water bodies and also lead to eutrophication of the water. This domestic sewage from buildings around the dam includes all wastewater from bath sinks, basins and similar appliances in the home.

Tarred road are seen detouring round the dam and also leading to the dam and out. Since erosion between tarred and untarred road are not the same so the tarred roads are prone to surface wash and this all have serious impact on the dam.

Plate 1:- Residential Building Close to the Dam

Plate 2:- Tarred Road round the Dam

Plate 3:- Domestic Waste Disposal very close to the Dam

4.1.1.2 FARMLAND

Farmland appeared as shrubs but areas less vegetated were identified as farmland the total area covered in 1982 was 28% of the total area, presently it account for 10% as shown in Table 4.2 and 4.3. This shows a decline in land cultivation with % change of 18% in both years as shown in Table 4.1. This has been tampered with in man's quest for food through farming. The whole dam environment has be ecologically tampered with by human interference, as can be viewed in plate 4 and 5. The land has been subjected to farming until recently when farmers are short of fertile land and the few farmers that can afford fertilizer still farm around the dam.

The clearing of land also increase the rate of run-off of the surface water and thus it speeds up soil erosion with subsequent silting and nutrient increases in the water draining such areas. Most general type of cultivation lead to a loss of soil and nutrient and the deficiency of the latter in the soil is commonly rectified by the regular addition of artificial fertilizer. These too tend to be washed off in considerable quantities and

may have a major effect on the nutrient status and ecology of water system into which they are drained.

Rapid eutrophication caused by increased nutrient input from fertilizer and sewage effluent is becoming one of the major problems of fresh water today. The use of herbicides in agriculture can pollute the water, when the herbicides are washed onto waterways.

TABLE 4.2 LANDUSE CLASSIFICATION TABLE OF 1982

LAND USE	AREA $M^2$1982	%
Built up areas	115.20	48
Farm Land	67.20	28
Fallow land	9.60	4
Buffer zone	4.80	2
Reservoir	43.20	18
Total	240.00	100

TABLE 4.3 LANDUSE CLASSIFICATION TABLE OF 2003

LAND USE	AREA M^2 2003	%
Built up areas	172.80	72
Farm Land	24.00	10
Fallow land	4.80	2
Buffer zone	2.40	1
Reservoir	36.00	15
Total	240.00	100

Plate 4:- Picture Showing Irrigation Farming

Plate 5:- Banana Cultivation and Sedimentation

4.1.1.3 FALLOW LAND

It conforms with high altitude and steep slope that has not been under much activities. This area looked less disturbed ecologically because of predominant tree, tall grasses and shrubs. It is thick and inaccessible with little sign of cultivation. In 1982 the total area covered was 4% as shown in Table 4.2 as compared to 2003, which is 20% as shown in Table 4.3. Fallow land can also be viewed from plate 6. This are land left fallow and regenerating slowly in the fragile soil, follow is vegetation now. Since the upstream is dammed, the downstream remains luxuriant, which conform with the findings of Olofin (1980) that downstream of rivers dammed are annexed by vegetation, as reported by Halilu (1999).

Plate 6:- A Picture Showing Sedimentation

Plate 7:- Another Source of Water into the Dam

4.1.1.4 BUFFER ZONE

The land category covered about 1% of the total area covered in 1982, and 1% in 2003 as shown in table 4.2 and 4.3 the percentage change between this two periods is 1%. The other landuse types are compacted open laterite this is a plain from where the earth was removed for the construction of the dam. It's located in the eastern part of the reservoir after the dam crest. Though, this area is compacted and prone to surface wash.

4.1.1.5 DAM RESERVIOR

This is centrally located in the map. It represents the deposit bowl where most of the sediment is eventually deposited. The topography of the area tends to dictate the rectangular shape of the dam. Water enters the dam via two sources i.e. Agba stream and the unnamed stream as can be seen in plate 7. Water flows out of this dam through one slough. The total area covered in 1982 was 15% and in 2003 it is 18% as shown in Table 4.2 and 4.3 thus the combine percentage change is 3%. The

capacity of Agba dam remains unknown as it is the oldest dam in the state and it was constructed as far back before Nigeria got her independent.

The dam ranked third in the area covered by landuse types with 3 % change between 1982 and 2003 as shown in table 4.1. The size and location of the dam is determined on the aeriel photograph based on 1:50,000. Thus the total area covered by the dam was 15% in 1982 compared to 18% in 2003as shown in Table 4.2 and Table 4.3, this the combine percentage change is 3% as shown in Table 4.1, it was observed that man activities around the dam a lead encroachment on the sizes of the dam.

4.2 PHYSCIO-CHEMICAL OBSERVATIONS

RESULT TABLE
TABLE 4.4

	PARAMETER	STATION 1	STATION 2	STATION 3	STATION 4
1.	Biological Oxygen Demand	5.45	1.58	3.4	4.41
2.	Chemical Oxygen demand (COD)	5.98	1.43	3.88	4.92
3.	Conductivity	83.5	85.3	56.4	94.0
4.	Dissolved Oxygen ($mg0_2$ /l)	2.40	5.40	3.80	3.50
5.	P H	7.2	6.0	6.0	7.4
6.	Temperature (^oC)	2.40	5.40	3.80	3.50
7.	Total Alkanity (Mg $CaCO_3$)	23	6.0	8.0	8.0
8.	Turbidity	34FTU	53FTU	92FTU	102FTU

Laboratory result October 2003

Table 4.4 shows that the physical chemical characteristic of Agba dam varied with each station.

4.2.1. BIOLOGICAL OXYGEN DEMAND (BOD) MgO_2 $^1/_5$ CHEMICAL OXYGEN DEMAND (COD)

The four water samples contain in four bottles were taken to the laboratory for the determination of their dissolved oxygen levels. The mean BOD of Agba dam ranged from 1.58mg/l to 5.45mg/l and the COD ranged from 1.43mg/l to 5.98mg/l. This is low thus indicating of low oxygen demand.

The BOD gives a measure of the amount of oxygen required by microorganism to decompose an organic matter in a water sample under a specific condition. It is very useful in evaluating the pollution strength of a waste. Station 1 is located in built up areas and this account for it high BOD result.

4.2.2 CONDUCTIVITY

The conductivity of each sample was determined using the table conductivity meter model. The highest mean value was observed in station 4 (farmland and built up area) followed by station 2 (area of

sedimentation and this can be related to the impact of various landuse practices on the Dam.

4.2.3 DISOLVED OXYGEN (DO) (MgO_2/l)

This is on of the most important parameters in the investigation of the aquatic environment. Dissolved oxygen provides valuable information about the biological reaction going on in the water. The solubility of oxygen in water varies with the temperature.

Areas of high sedimentation is the Station 2 and it has the highest mean value of 5.40mg/l followed by area of built up areas i.e. station 4, 3.50mg/l, station 1 has the lowest mean value of 2.40mg/l.

4.2.4 P.h. (HYDROGEN IONS)

This is a quantitative expression for the acidity or alkanily of water, it measure 1 – 14 scales; the range of 1- 6 is acidic, 7 is Neutral while 8-14 is alkaline. The Ph of the each sample was determined using Beckman's electric Ph meter model H5.

Agba dam reservoir water ranges between 6.0 and 7.0. this is alkaline. The maximum standard by FEPA is 6.5 – 92 and the highest is

between 7.0 – 8.5. The highest Ph observed at station 1 (i.e. built up areas) and 4 (i.e. farmland + built up area) may be as a result of intensive algae growth associated with organic pollution.

FEPA (Federal Environment Protection Agency) launched in 1989, to assume a statutory responsibility to protect the environment.

4.2.5 TEMPERATURE

Temperature is linked with the amount of dissolved oxygen (DO) content. The higher the temperature the less the dissolve oxygen.

The temperature of the four stations is comparatively Relative, station 1 has the least temperature of 24.4^{oc}being built up areas, followed by station 2 with 24.5^{oc} i.e. area of high sedimentation and station 3 and 4 has a flat value of 24.6^{oc} each as a result of the area being a fallow land. FEPA standard of temperature is put at 20^{oc} – 33^{oc}, so the temperature observed at the four stations is normal.

4.2.6 TOTAL ALKANITY

This refers to the capacity of water to accept protons. It is usually impacted by the presence of salt of weakly ionized bases. The alkalinity

of Agba dam ranged between 6.0mg/l to 23mg/l. This value is also comparatively low, especially for the station 2, (i.e. area of high sedimentation) station 3 (i.e. fallow land) and station 4(i.e. farmland + built up areas).

4.2.7 TURBIDITY

This refers to the decreased ability of the water to transmit light caused by suspended particulate matter, ranging in size from colloidal to coarse dispersion. Indeed, turbidity restricts light penetration and thus limits photosynthesis. Sedimentation of soil particle result to high turbidity.

From the turbidity result of the four stations it was observed that station 4 has the highest turbidity, this is due to high sedimentation in the area, thus, station 2 which is predominantly residential area is not the only area of high sedimentation

4.2.8 HEAVY METALS

TABLE 4.5 **HEAVY METAL CONCENTRATION (Mg/g-1) IN SAMPLED STATION OF AGBA DAM**

METAL ELEMENTS	STATION 1	STATION 2	STATION 3	STATION 4
Iron	0.03 mg/l	0.05mg/l	0.19mg/l	0.18mg/l
Copper	0.01mg/l	0.19mg/l	0.70mg/l	0.57mg/l
Lead	40µg/l	16.0µg/l	23µ/l	13µ/l
Manganese	0.001mg/l	0.038mg/l	0.078mg/l	0.014mg/l
Hardness	0.89mg/l	1.16mg/l	0.94mg/l	1.14mg/l

The level of heavy metal ranges, for Iron (Fe) = 0.03 – 0.19 mg/l, Copper = 0.01mg/l – 0.70mg/l, Lead = 13µg/l - 40µg/l Manganese = 0.001mg/l – 0.078mg/l.

The levels of heavy metals are not very high; this could be as a result of low industrial activity around the dam.

Conventional water treatment plant can clean up the physical as well as the biological impurities in the water before being supplied to consumers. Chemical impurities, particularly those imported by heavy metal such as Lead (Pb) Copper (Cu), Iron (Fe) etc. are usually not removed from water, if for any reason, there after, the level of concentration of these chemical element in the dam appreciably increase over and above the acceptable limit, the life of the consumer will be

threatened. This threat could come as a result of the direct consumption of the supposedly treated water. Continuous intakes of these chemical elements through any of these sources gradually concentrate these elements in the human body and ultimately lead to death or paralysis.

A continuous monitoring of the level of concentration of chemical element, particularly those of heavy metal in the dam is therefore desirable, so as to reduce the health risk of the potential consumers.

CHAPTER FIVE

5.0 CONCLUSION

5.1 SUMMARY OF MAJOR FINDINGS

This chapter summarizes the finding of the study. Conclusions were drawn from the result presented in chapter four. Recommendation on the mitigation measures relevant to the presentation and protection of our existing dam and the provision of good quality of water will be emphasized.

From all the landuses practice impact on the dam, it can be deduced that waste dominate the major source of water pollution in the study area because residential areas or built up areas and farmland have the highest percentage of dissolved oxygen. Also the solubility of O_2 varies with the temperature of the stations. The turbidity results also prove that station 4 has the highest turbidity, this is as a result of high sedimentation in the area due to the landuse type is Residential purposes.

Landuses areas of residential purposes yield the highest amount of pollutant and this is followed by agricultural purposes, this is due to the fact that all activities taking place in the residential areas will be washed

down into the dam as a result of the topography of the area, more so most buildings around the dam do not have planned drainage channels. The dam environ, as it can be observed from the drawn map, is still under intensive farming in the upstream of the dam, and these activities brings changes to the reservoir, even though most of these changes has arisen as a result of the quest of man to improve his socio-economic and technological status.

The dissolved Oxygen (D.O) is one of the most important parameter in the investigation of pollution especially Organic matter washed into the water bodies as a result of urban development and it was observed that Agba dam receives wastes as a result of the impact of the built up areas around the dam.

Furthermore, metallic minerals such as Lead and Zinc are becoming increasingly found in water bodies, this is as a result of human activities (such as domestic sewage and use of fertilizers) along watershed and the use of water for refuse disposal.

5.2. CONCLUSION

Several conclusions could be arrived from the result of the use of remote sensing in delineating the land use types around a dam. It has prove to be a viable tool in ascertain the impact of land use practices on Agba dam in Ilorin. It could be concluded that the dam is bound to face future threat as unplanned residential buildings continue to spring up and if the trend of cultivation with fertilizer and grazing continues. Thus, it is obvious that the dam will not be able to function well.

5.3. RECOMMENDATION.

Man is a product of the environment as the latter is also an important component in the life of the former, thus protecting the environment of man from destruction is in evitable.

It is worth recommending that, with the increasing population of Ilorin metropolis and the resultant growth in the need for water supply, there is need to adhere to the master plan of the state before allocating land for construction of building.

There is the need to embrace an environmental education. This programme should focus on the mode of man's environment interaction. Public awareness on the impact of landuse practices around a dam, controlled cultivation and construction of standard drainage system should be embarked on through television and radio programs.

This, in the hope of highlighting in good time the consequence of whatever form of interaction man engaged with his environment.

I also recommended that, with the rapid development of cities and increase in the rate of urbanization, master plan should be reviewed to forestall the problem of urbanization and other planning techniques exploited to solve problem emanating from misuse of land.

And lastly it is worth recommending for further studies that the problem of the dam capacity should be looked into, i.e. future researcher should be encourage to conduct research on how to find the capacity of the dam, so as to help further conserving of Agba Dam.

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WATER QUALITY LABORATORY
NIGER STATE WATER BOARD, MINNA
REPORT OF CHEMICAL EXAMINATION OF WATER

Name and address of sender: KUBURAT WATER

Sender's reference number: NIL

Laboratory reference number: CHEM.004/14

Nature of sample: NIL.

Date and time of collection:

Date and time of arrival at laboratory:

Where collected:

Date and time of commencement of examination:

Appearance: See Below.

Colour

Odour

Temperature: °C

pH

Electrical conductivity at °C

mg/l

S/No	PARAMETERS	1	2	3	4
1	T. D. S. Mg/L	41.7	42.6	28.1	47.0
2	p.H	6.0	6.0	6.0	6.0
3	Conductivity µs/cm	83.5	85.3	56.4	94.0
4	Acidity mg/L	0	0	0	0
5	Alkalinity mg/L	23	6.0	8.0	8.0
6	Iron mg/L	0.03	0.05	0.19	0.18
7	Manganese mg/L	0.001	0.038	0.018	0.014
8	Copper mg/L	0.01	0.19	0.70	0.57
9	Lead mg/L	40	16.0	23.0	13.0
10	Phosphate mg/L	0.61	0.64	0.92	0.92
11	Sulphate mg/L	0	9	9	13
12	Hardness mg/L	0.89	1.16	0.94	1.14
13	B. O. D mg/L	5.45	1.58	3.42	4.41
14	C. O. D mg/L	5.98	1.43	3.85	4.92
15	D. O mg/L	2.40	5.41	3.80	3.50
16	Temperature	24.4	24.5	24.6	24.6
17	Turbidity FTu	34	53	92	102
18	Suspended Solids mg/L	0	13.0	44.0	63.0

Date of report

Remarks

Signed

13/10/03