AN APPLICATION OF REMOTE SENSING TO THE ASSESSMENT OF LANDUSE CHANGES IN BIDA, NIGER STATE.

By:

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BEING A THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE AWARD OF MASTERS DEGREE N REMOTE SENSING APPLICATION, GEOGRAPHY DEPARTMENT, SCHOOL OF SCIENCE AND SCIENCE EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA – NIGERIA.

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CERTIFICATION

I certify that this study was carried out by Jiya Kolo of Geography Department, Federal University of Technology, Minna under the supervision of Dr. (Mrs) Odafen of the Geography Department, school of Science and Science Education.

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DECLARATION

I Jiya Kolo, hereby declare that, apart from references to other peoples work which have been duly acknowledged this work is the result of my own research and that, it has neither in whole nor in part been presented for any degree else where.

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DEDICATION

This project work is dedicated to my creator, ALMIGHTY ALLAH, for making me one among his creatures, giving me this great opportunity in life and strength to undertake this work and prophet Mohammed, may peace of Allah be upon him. Also, to my immediate family; wife, Hajara Jummai Kolo, children – Nafisatu Kolo and Abdulshakur Kolo.

ACKNOWLEDGEMENT

The accomplishment of a project of this nature requires more than the effort of one person be affected. As such, I would be failing in my duty of appreciation. If I do not give my regards to those who have in one way or the other helped me in accomplishing the work..

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Last but not the least, my sincere gratitude goes to my family – father and mother and my wife and children. This success is for us and not for me alone. Most importantly, I thank the Almighty Allah for seeing me though the studies.

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1.3 AIM AND OBJECTIVES

The aim of this project is to assess the changes in landuse in Bida southeast in Niger State from 1976 – 1995.

With this aim, the objectives are:

(a) To highlight the various changes that have taken place in the area.

(b) Qualify the area extent of all the landuses identified.

1.4 JUSTIFICATION

In view of the fact that Bida is the capital of Nupe land and the presence of a Federal institution in the study area-Federal Polytechnics, the area influx of people into it from other places. And this has resulted to an increase rate of developmental activities taking place. There has been a drastic reduction in natural vegetation cover as a result of different landuse activities such as road construction, housing and other features of urbanization.

Looking at the present trend, there is the need to study the available land using remote sensing techniques. This will enhance a more meaningful and proper development strategy for the study area. This project will also provide some assistance in future landuse pattern in the study area.

1.5 SCOPE AND LIMITATION OF THE STUDY

Bida been the capital of Nupe land is very large. It is very difficult to cover the local government area as a whole as well as its surrounding. As a result, the project work is only limited to Bida South east.

The satellite image data from lands at MSS and spot xs are the main source of information for study white the information obtained from field check, provide alternative source of information for analysis and updating the features observed in 1995 map.

One of the limitation encountered in using the imageries is there is no current landuse imageries to show recent changes occurring in the area. Despite these stated limitations, the best use was made of the available materials for the accomplishment of the aim and objectives of the study.

1.6 DESCRIPTION OF THE STUDY AREA.

Bida is situated in the middle belt of Nigeria. It is the capital of Nupe land and it is one of the twenty five local government area of Niger State. Bida is situated on a truck a road 80km away from Minna the capital of Niger State.

LOCATION

The area lies between Latitude 8 ^{o} N and 12 ^{o} N and Longitude 4 ^{o} E and 8 ^{o} E.

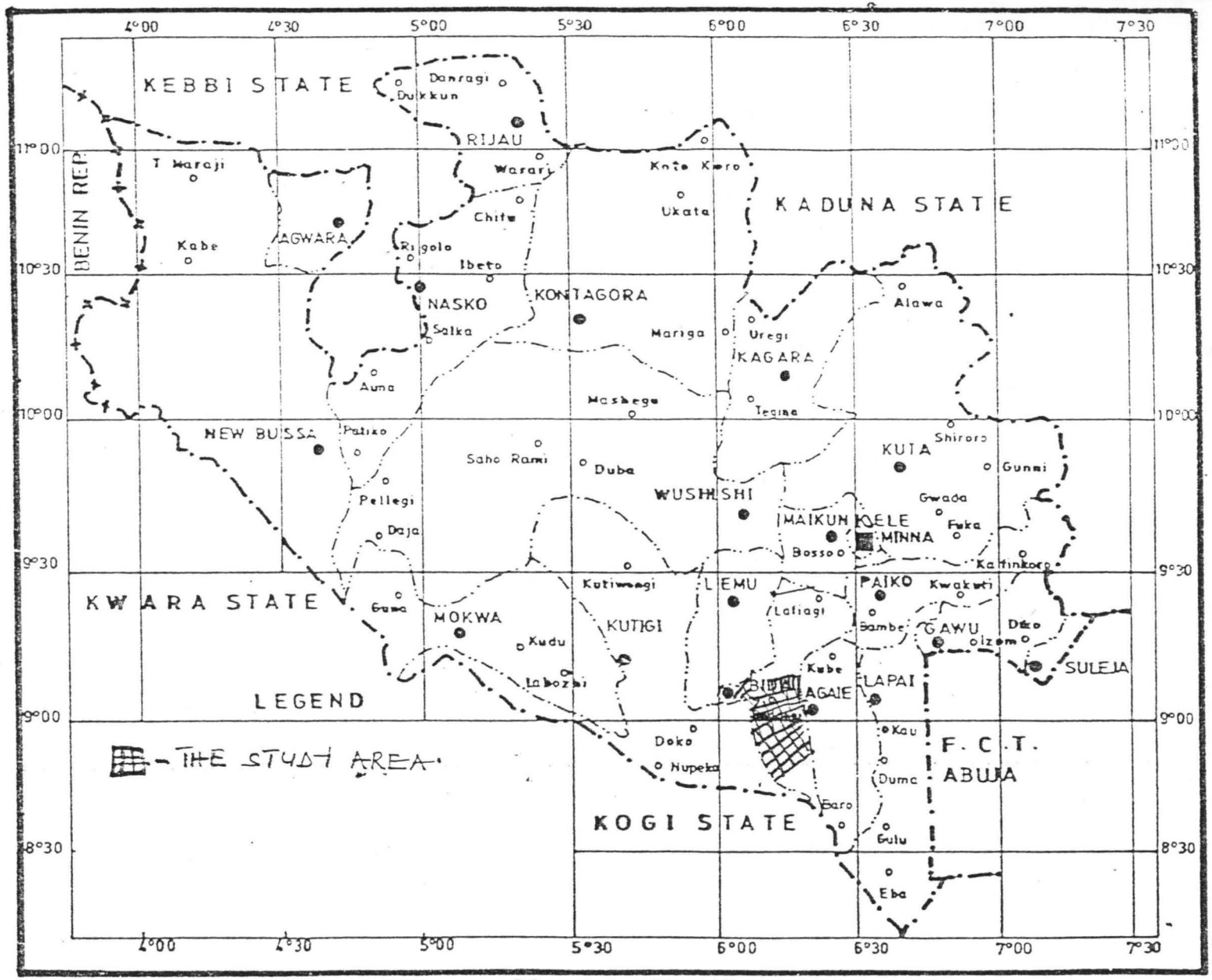
RAINFALL AND TEMPRETURE

Monthly rain fall varies in Bida from about 2 inches to 12 inches, while annual rain fall reaches up to 58 inches. About 90% of the rain falls in the six months between April to September and the rain usually comes in thunder intensity particularly at the beginning and towards the end of the raining season.

Temperatures are relatively high with an annual mean of 27 ^{o} C and maximum of 31^{o} C

VEGETATIONAL AND SOIL

Bida lies in the Guinea savanna belt. And vegetation is majorly consists of grasses and in some other areas have scattered shrubs and trees. It lies in the interior area of laterite soils.



SCALE:-1: 2,000,000

FIG. 1.1. MAP OF NIGER STATE SHOWING THE STUDY AREA.

Remote Sensing technology has already been identified as one of the most promising and up to date methods ideal for such study and assessing landuse change, not only because of the quality of the result obtained but because the techniques is faster and produces more reliable data to work on. Also, information collected by Remote Sensing technology offers repetition, objectivity, accuracy and restoration in the form that permits combination with other data, or climate map. This technique becomes more faster, convenient, less expensive and less time consuming in data acquisition compared to other conventional techniques.

REMOTE SENSING:- The term Remote Sensing has been understood in various ways by different authors since the name was first coined in 1960.

Then, the word was simply referred to as the observation and measurement of object without direct contact with it. It is also viewed as the art and science of acquiring, describing, analyzing, assessing, inventorying and monitoring features on the earth surface without actually having physical contact with such features using various sensors.

Data can be remotely collected and analyzed to obtain information about objects, area or phenomena being investigated. The techniques includes satellite imagery analysis, aerial photography interpretation or any other remote sensing techniques.

for their utilization as well as monitor both natural and human induced changes in their environments.

The potential or remote sensing for the provision of environmental and resource information for planning and management has been adequately demonstrated in developed countries as well as in several developing countries such as India, Brazil, Indonesia, south Africa et. In these nations Remote Sensing and its related technologies have been used to contribute tremendously to the level of knowledge and information about their environment, resources and underlying ecological processes. In a broad term, these countries have utilized these technologies in several areas, which includes the following: Land and water resources inventory and management, mineral exploration and exploitation, crop condition assessment and production fore cast, forest and soils evaluation and management, natural and human induced disaster assessment and prevention, ocean and marine resources management planning and management of infrastructural facilities, urban and rural landuse planning, environmental monitoring and impact assessment as well as production of various types of maps for planning and decision making.

The widespread adoption and application of this technology have been influenced by the need to acquire knowledge about the state of the earths atmosphere, forest, water resources etc.

LANDUSE MANAGEMENT:- The management of landuse activities in any given geographical region rest on how to arrive at the proper use of the land without the land being degraded. Landuse is indeed a primary indicator of the extent and degree to which man has made an impression on the earth's surface. It reflects political, social and economic aspects of human, culture and provide and index of intensity of human lifestyle. It therefore, has to be properly maintained and managed.

Knowledge is light, so the meaningful management of landuse activities in an area first and foremost has to do with general awareness of the intended goal, so that the inhabitants of the said area, will be conscious of their land utilization endeavours. The primary use of the land in an area, if left in the dark of the repercussion of their actions than the side effects will continue unabated.

The use of Remote Sensing techniques in recent times is considered as one of the viable means of landuse management. The advanced technique is used in detecting and assessing the impact of landuse activities of an area from which policy action be taken. This technique as earlier mentioned, saves time, cost and energy in implementing the intended management policies on landuse.

Infact, landuse policies are developing rapidly across the globe especially in relation to agriculture and forestry. The effective management of the landscape requires not simply an understanding of local, social, environmental and economic processes but also that of natural ecological stock and how it is changing with passage of time.

CHAPTER TWO

LITERATURE REVIEW

Landuse is a primary indicator of the extent and degree to which man has made an impression on the earth's landscape. It reflects political, social and economic aspect of human life styles.

Since particular landuse generally have artificial expressions on the landscape. Landuse is susceptible to study by remote sensing technique. Several studies have been conducted on landuse changes and the impact of different activities that takes place which result to these changes using remote sensing data of different types. Landuse mapping is important in the recording up to date information regarding the use of land. A knowledge of landuse is also important for planning and management activities concerns with the surface of the earth.

Adefolalu (1987) studied both the west African and Nigerian landuse situation using a combination of SLAR and landsat data with ground truth observations. The study recognized five major five major vegetal cover-wood lands, grass lands, shrub land, farmland and forest, the study shows that two states in the Sahel savannah, Borno and Sokoto States as of 1986 experienced harsh effect of desertification of arable land which had reduced to 19.29% and 41.89% respectively while grassland/shrubs were reduced to 59.97% and 38.36 respectively. Human activities made situations in Kano and Kaduna States equally pathetic.

Both states, according to Adefolalu (1986) have between 68% and 82% of the land under intensive agriculture. The forecast from the study was that at the early part of 1991 – 2000, arable land in the two states would be turned in to shrub land vegetation and the Sahel proper.

Patrick (1993) makes use of three set of aerial photographs taken in 1964, 1978 and 1987 to identify features of gully erosion in the guinea savanna area of Taraba State to map out erosion blackspots in general. The sets of data generated include, landuse types and change categories and total stream lengths for these years. The results obtained were used to analyse the relationships between erosion and landuse through the impositioning of data materials. The total length of gullies was classified into serious, not serous moderately serious, very serious and severe. An erosion blackspots map was produced indicating these different intensities. The study revealed that danger areas can be detected from the air using photographs, but to be able to predict future areas of erosion would require sing a set of photographs taken regularly at a suitable scales and seasons.

Adeniyi (1981) used aerial photographs to illustrate through simple visual interpretation method, the landuse pattern in a rapidly urbanizing area of Lagos. In an attempt to assess the magnitude and the nature of the spatial growth rate of Lagos, a field survey was carried out by the United Nations Centre for Human settlements (HABITAT) and the Master Plan Project Unit (MPPU) of Lagos State

Government. It was noted that Agege (NW OF LAGOS) was one of the urban fringe where rapid changes occurred (Adeniyi, 1978).

Ikhuoria (983) worked on the vegetation and land use changes in a rain forest ecosystem of North-East, Edo State using sequential aerial photograph in black and white. The result indicates a considerable reduction of forest lands and wooded shrub grassland between 1967 and 1977. The study also shows an increase in land used for farming and agricultural plantations and also notable changes were recorded in settlement area. The study further reveals the state of dyamic eqilibrium of rainforest ecosystem in Nigeria and photograph techniques potential tools for monitoring and mapping changes.

Ojeleye (1996) used a combination of aerial photographs spot image and ground truthing data to evaluate landuse and landcover changes in the hilly area of Idanre Ondo State. The result indicated that within that 26 years, there had been a tremendous increase in agricultural farmlands, built up area equally increases in hectarage but it was relatively small when compared with agricultural lands, both rock out crops and vegetal cover exhibit a decrease in the real extend of hectarage and the existing water body did not change throughout the period of study.

Adeboye / landcover situated of the lower Usman-Dam. The results show that most of the study areas are undeveloped due to its steep rugged and unsuitable slope. The reservour fringes were found to be quite erodable as such there is a high

possibility of sedimentation. Therefore it is recommended that preventive measures should be promptly taken and further mapping should be carryout probably in the next 2 – 3 years from now.

Abubakar (1998) undertake the study of landuse and transformation of Talata Mafara and its Environs, Zamfara State using remote sensing techniques. The study was undertaken to evaluate the suitability of using satellite remote sensing imagery (LAND SATMSS) to assess the landuse and its transformation in the study area.

Landsat imagery of 1987 and 1989 were used as the major source of information while aerial photographs and topographical maps of the study area were used as the secondary sources of information. Analysis of the imagery and the aerial photographs revealed that a lot of transformation has taken place within the period are anthropogenic in nature. The land was transformed from shrub land to an irrigated agricultural area.

In the United States, the U.S.D.A. (United State Department of Agriculture) carried out a large scale inventories using Aerospace Remote Sensing (Ag TISTARS) to determine the usefulness, cost and extent to which aerospace remote sensing data can be integrated into the existing U.S.D.A. information system to improve the objectivity, reliability, timeliness and adequacy of information required to carry out the monitoring of agricultural crops from planting to harvesting period (crop production). The primary sources of their data used was landsat MSS data sources and crop (wheat) yield was estimated with accuracy of considerable better than 90% at 90% significant level, and

information was worth about 200 million dollars to the united state agricultural industry. These estimate on wheat production was obtained region by region for 6 – 8 weeks before harvest (Barret 1982).

Martin-Kaye and Donough (1983) used uk as a test sites to carryout a study of landuse. The L-band SAR imagery used in the landuse studies was acquired by SEASAT in august and September 1978. A total of nine study areas were examined in order to determine the extent to which detailed landuse information can be mapped from SEASAT imagery. These studies were completed using both optically and digitally correlated SAR imagery. The digitally correlated was processed by the Royal Aircraft establishment, farnborough, who made available both precision photographic products and computer compatible tape (C.C.T) data.

A considerable part of these analyses was undertaken using SAR imagery covering Northern East Anglia, uk, because the area was considered to a model test site for establishing a SAR – based landuse classification. To complete the study, the classification was tested in a wide variety of area with significantly different landuse pattern. Where possible the landuse interpretation from SAR were checked in the filed.

When the study was conceived in early 1978, it was proposed that several test sites, each characteristic of a particular landuse system would be established for a continuous monitoring throughout the duration of the SEASAT mission.

DEFINITION OF TERMS

LAND: This is defined in various ways, in some cases in line with individual's predictions, orientation, occupation and ideology. In a legal point of view, land is defined as any portion of the earth's surface over which ownership rights might be exercised in relation to object attached to the surface by nature, to buildings and other improvements attached by man as well as those objects of value that lies either above or below the surface.

However, to some, land often means soil, but may refer to it as a region or country. Culturally speaking, land has been define as "a measurable entity divisible into parcel by means of mathematical and technical processes of surveying and cartography". To Economist, land is natural and man-made resources over which possession of the earth's surface gives control. In the applied sciences which Remote sensing in a field of study. Land is considered as a measurable entity divisible into parcels by mathematical means. It is defined in the Longman Dictionary of Geography as the solid surface of the earth where it is not covered by water.

The various concepts of land shows that land is an important basis resource for man, Man cannot do without land. All man's activities take place on land and this lead to the various land uses.

LAND USE: Landuse in broadterm refers to the various activities associated with the land. This could be agricultural, industrial, residential and commercial. Perhaps the most commonly used maps by planners is the landuse maps. Landuse is related to human activity associated with a specific piece of land. For example, a tract of land on the fringe of an urban area maybe use for single family housing. Depending on the level of mapping detail, purpose of the map and the characteristic of land use type, its landuse could be described as urban use, residential use or single family residential use.

The concept of landuse is referred to various human endeavors on land. Therefore landuse is a primary indicator of extent and degree to which man has made an impression on the earth's landscape. A good knowledge of landuse of any given geographical region has to do with the human activities on land such as industrial activities and a lot of many other activities.

Landuse pattern in the context of allocating areas of land to specific activities very from one part of Nigeria to another in relation to variation in population. Variation in population densities in the country constitute an important factor in determining the proportion of land devoted to a given activity, for example, farm use types such as fallow, industries, commercial urban builtup area.

Since particular land use generally have unnatural expressions in the landscape and vary from one part to another, landuse is especially susceptible to study by remote sensing techniques using tools of landuse analysis such as fixed

work, serial photograph and other satellite imagery as well as topographical map. This kind of land use involves a complexity of interacting variable such as population the land tenure system, the level of technology and stage of region development.

A good knowledge of landuse of a geographical region has to do with the human activities on land, the facilities placed on land e.g drainage channels the effect of such activities on the environment and lastly, the actual people making use analysis such as fieldwork, topographical maps, aerial photographs and other remote sensing imageries.

LANDUSE CHANGE:- Landuse change detection is closely related to the study of vegetation, crops, and soil of the biosphere. Landuse is man's activities on land in relation to the land.

Land in itself is an area on the earth surface that is characterized by a distinctive assemblage of attributes and inter linking processes surface features, including a number of natural characteristics, namely geology, soil, topography, hydrograph and biology as well as the extent that they directly influence the characteristics of land under consideration.

This definition however, stresses the dynamic character of land which is a major reason for land investigation and assessment in order to determine the spatial and temporal influences.

The earth surface is a complex setting in which physical ad biological factors of the earth's crust and in constant interaction with man's influence; there are always changes taking place as a result of its dynamic nature.

Daily, seasonal and annual information are needed for updating landuse maps and management of natural resources. This is because man's livelihood is highly dependent on resources. The need for landuse change assessment and its effects on the people, constitute planning, inventory and management of land, mapping, environmental monitoring and protection of which when taken together involves one of the primary issues in economic development. This is because inventory of land resources calls for current situation mapping, control and management of these mapping.

The study of landuse assessment and its effect can be carried out in a more simplified way i.e matching two landuse maps and compared for two different dates and to only delineate any changes. In this way, landuse changes and assessment map can be obtained. However, a more probable and faster means of acquiring such information on landuse change and assessment for the production of landuse and assessment map is through the use of a vital technical tool called "Remote Sensing".

Barret and Cutis (1982) sees remote sensing as the observation of a target by a device some distance away. It had also been defined as the art and science of obtaining dependable information about the earth surface from satellite either air borne or space borne (Adebukun, 1986). However, there are practically no visible contact with the feature been sensed.

It has been stressed by Lives and Kiefer (1976) that remote sensing is the science and art of obtaining information about area, object or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area or phenomenon under study.

Another author, short (1982) also gave a good and lengthy definition of remote sensing as the acquisition of data and derivative information about objects or materials located at a distance from the targets to make measurement (multispectral) of interactions between the targets and electromagnetic radiation.

Remote Sensing can also be thought of a reading process using sensors, data is remotely collected for various analysis such that information can be obtained about the objects, areas or phenomena being studied.

The primary objective of remote sensing is to extract environment and natural resources data that are related to the earth.

Remote Sensing has created opportunities for nations to undertake proper inventories and evaluations of their resources endowment, make appropriate plans

In Brittany coast also, the study of landuse which covered part of the North Brittany coast was carried out to evaluate the extent to which SEASAT imagery is appropriate in the analyses of landuse. Some part of the North Brittany coast was imaged by SEASAT from different look direction (orbits 785 and 791). As this area has a significantly differently landuse pattern from that of eas Anglia, it was considered appropriate to extent the evaluation of SEASAT by analyzing some of this imagery. The study shows that high proportion of the arable land is devoted to fodder crops. Wheat barley and oats are also grown. The topographic maps shows that small blacks woodland, used as wind breaks are evenly scattered over the whole region.

Haefer etat (1985) use aerial photographs and 1978 landsat mss imageries to monitor land surface changes in Sri-lanka. A fundamental thematic map bench mark map was established and it formed the basis of assessment of landuse features. Marks were constructed of each delineated landuse category and overlaid on the enlarged landsat imageries. Average annual rate of deforestation amounted to 1.75% which shows that of the should the trent continue without any correct measure, desertification can occur in many years to come.

Larsson (1994) carried out a study on the landuse, water and vegetation of munnessa area in Ethiopia using spot imageries. The result was found to be very interesting which came out with the following findings.

Identified and mapped out the significantly hydrographical features including the major river divide. Infrastructures such as villages roads and fences were also demarcated.

The major landuse / landcover were identified and demarcated from forest bush land, farming and frazing land.

A study was carried out in Boston and it served as one of the prototype for the cities census project. The purpose of the study was to prepare a landuse / landcover maps and a computerized data base for the entire metropolitan region from 1:120,000 scale aerial photographs. The landuse/landcover map was complied directly from the photographs (on transparent overlays) with a minimum required field checking. The landuse classification system consisted of 24 categories. A minimum cell size of about 10 acres for mapping was established in order to make it comparable with the anticipated resolution of ERTS-1. The authors concluded from their study that, it was practical to prepare an urban landuse / landcover map from high altitude aerial photographs and that such a map would have utility for state and regional planners.

Apart from the use of aerial photographs, radar remote sensing has also found application urban landuse / landcover study. Although research is still at its preliminary state. Three (3) types of urban related projects have been identified for which the radar can be used. And they include the following.

1. The collection of data, when aircraft flight is been postponed due to poor weather. This is possible, because the radar has a higher penetrating power.
2. Analysis of gross landuse/landcover patterns for large cities etc. as the radar has a greater synoptic view coverage.
3. Surveys of large regions to determine location and area extent of sall urban centers, since the radar has a higher spatial resolution than the camera.

For landuse/lancover studies, k-band radar has demonstrated a capacity to provide data on linear transport features as well as on gross pattern of industrial residential and other landuses. Thought attempts to identify commercial landuses have not been successful.

The information provided by thermal infrared on landuse / landcover is very gross. For example, while a city's central Business District (CBD) is usually quite distinguishable on thermal infrared imagery, it cannot always be clearly differentiated from surrounding multi-store apartment buildings. Major outlaying shopping complexes are distinguishable, but area of mixed or multi-purposes as in the case of commercial / industrial / residential landuse are not. Although individual house are usually visible, there is in essence little landuse/landcover data provided by thermal infrared that cannot be obtained more easily from conventional aerial photograph.

Though the ability of the thermal infrared to provide us with urban data has not been fully demonstrated. But in a study dealing with the evaluation of the relative utility of the radar, that is, thermal infrared and conventional photography for distinguishing builtup area from non-built-up areas, t was concluded that only under special operating condition relating to weather, cost and the like, would one select radar or thermal infra-red in preference to conventional aerial photography.

Lo and Shipman (1990) carried out a study on Geographical information system (G.S.) approach to landuse change dynamic detection. It was applied to assess the impact of new town development in Tuen Mum, New territories (Hong Kong) on the environment through intergrating past and current aerial photographs which were taken in 1976 and 1987 at a scale of 1:25,000 and 1:40,000 respectively. Image overlaying and binary masking technique were used. A low cost micro computer based G.S-IDRISI was used in landuse change detection. The result shows that the binary masking method reveals the dynamics of landuse change. It also revealed that the government of Hong Kong had some success in controlling the spread of eroded badland with reforestation as the inventory of urban landuse increased.

Treitz (1994) employ satellite and Gis (geographic information system) technologies for landuse and landcover mapping at the rural-urban fringe of Markham, located at the North eastern fringe of metropolitan Toronto, Canada. The study involved the combination and analysis of the xs (multispectral mode) and p (panchromatic mode) data from the HRV (high resolution visible) sensor on board the

spot satellite global positioning systems (GPS) data, landuse zoning maps and Ontario basic mapping data.

Omojola and Soneye (1983) demonstrated the application of remote sensing techniques in the mapping and landuse and landcover features in middle Sokoto River area, north western Nigeria. This study demonstrates the use of various remotely sensed data, historical aerial photographs and SPOT-KS/P in mapping the landuse for 1962, 1977 and 1986 in Sokoto close settled semi and area of Nigeria. Thirteen (13) different landuse and landcover categories were identified.

Adeniyi (1980) carried out a change study of Lagos Nigeria, using sequential aerial photographs. The study area comprises of urban builtup areas, urban vacant land and non-urban land. He divided nine (9) major categories he used were residential, commercial, industrial, institutional, tranportational and utilities, recreational and open spaces, vacant land, non-urban land and water. He used aerial photographs for the year 1962 and 1974 with scales of 1:40,000 and 1:20,000 respectively and limited his interpretation to the central portion of each photography only.

From the literatures reviewed, it is evident that carrying out studies, inventories and other remotely sensed data is not new. But a number of problems that bother on accurate classification of vegetation types, forest species and canopy models are prevalent (Myers and Benson, 1981; mead and Gammon, 1981; Way etal, 1990; Richards, 1990; Mohe, 1991). In 1978, the Federal Department of forestry undertook a comprehensive vegetation / landuse identification mapping in Nigeria with Radar remote sensing technique.

Inspite of the accuracy and value of using colour infra-red, radar, micro wave systems and landsat and spot imageries in vegetation and landuse studies in developed countries, their use in Nigeria is constrained by the prohibitive cost of acquiring the image as well as processing and interpretation skills (khuoria, 1993). Therefore, the use of aerial photographs where available appear to be more favourable.

The studies highlighted in this chapter are just few of different studies carried out by various researchers, whose primary interest was to obtain remote sensing techniques. And the informations derived have served as valuable in put in solving different environmental problems. I have the strong belief that, this research work will demonstrate the effectiveness and usefulness of remote sensing technique in data acquisition and also serve as a valuable channel of information for monitoring and studying landuse.

CHAPTER THREE

DATA AND METHODOLOGY

This chapter discusses the types and sources of data used for this project work. It also discusses the methodology used for analyzing the data.

3.1 SOURCE OF DATA:

The primary source of data is the 1976 and 1995 interpreted satellite imagery derived from SPOT xs and landsat MSS. Other sources of information are the topographical map, layout plan and Forestry Department Vegetation Map which served as sources of base map details, as well as general reference materials. Further details are provided in the table of data (Table 1) below.

DATE	1976	1995
DATA TYPE	SATELLITE IMAGERY	SATELLITE IMAGERY
SCALE	1:250 000/1 CM T0 2.5 KM	1 CM TO 2.5 KM
AREA	BIDA SOURTH EAST	BIDA SOUTH EAST
FIELD CHECK	NOV. 2001 & FEB. 2002	NOV. 2001 & FEB. 2002
SOURCE	FORMECU ABUJA	FORMECU ABUJA

3.2 METHODOLOGY

In analyzing the data obtained for this research work, the mean total (x) of the vegetation and other land use changes extent were computed to facilitate the application of interpretation statistics.

During the interpretation process of features on the imageries were identified with the use of the map legend and the entire area of study on the map divided in to squares of one centimeter each. Features were then identified, marked and assigned numbers. Transparent sheet was put on each of the two imageries and features were then traced out continuously one after the other. The traced out features on the transparent sheet now brought out the landuse system of the study area.

This is done separately for the two imageries 1976 and 1995 and they are reduced to the same scale and super imposed on each other to map out the changes between the two maps. This reduction of the landuse map to the same scale made it possible and easier for change detection analysis.

The total area delineated covers about 190 km^s and the demarcated land areas were calculated, using a 1 cm by 1 cm square grid transparent overlay method. The formular employed to compute the area of each categorized landuse is represented by:

$A = n.d^2$

Where: (A) Implied Area

(n) Implies number of square grids, and

(d) Distance between the square multiplied by the scale.

3.3 LANDUSE CLASSIFICATION SCHEME USED

The adopted classification scheme was designed to cover builtup area, vegetation and agricultural land uses. As a result, the Federal Department of Forestry (coordinated by FORMECU) vegetation and landuse classification scheme was employed with minor changes to reflect local situation in the area and objectives of the study.

CHAPTER FOUR

4.0 DATA ANALYSIS AND INTERPRETATION

This is mainly based on analyzing the two main data set used for the landuse changes over the period of 20 years between 1976 and 1995.

4.1 LANDUSE INTERPRETATION OF 1976 SATELLITE IMAGERY

4.1 Below was calculated from the statistical generation of fig 4.1

TABLE 4.1 LANDUSE SITUATION 1976

S/NO	LANDUSE TYPE	LANDUSE IN KM2	PERCENTAGE LANDUSE
1.	BUILTUP AREA	6.25	3.2
2.	AGRICULTURE	167.5	88.1
3.	MARSH/SWAMP	5	2.6
4.	FOREST	8.75	4.6

From table 4.1 above, it is observed that built-up area covered about 6.25km^2 of the total study area which is about 190km^2 representing 3.2%. This consists of both part of main settlement and suburbs. Agricultural land covered about 88.1% been the largest representing about 167.5 km^2 of the total area of study. Marsh/swamp represents about 5km^2 which is about 2.6 %. Forestland covered about 8.75 of the area of study representing about 46%.

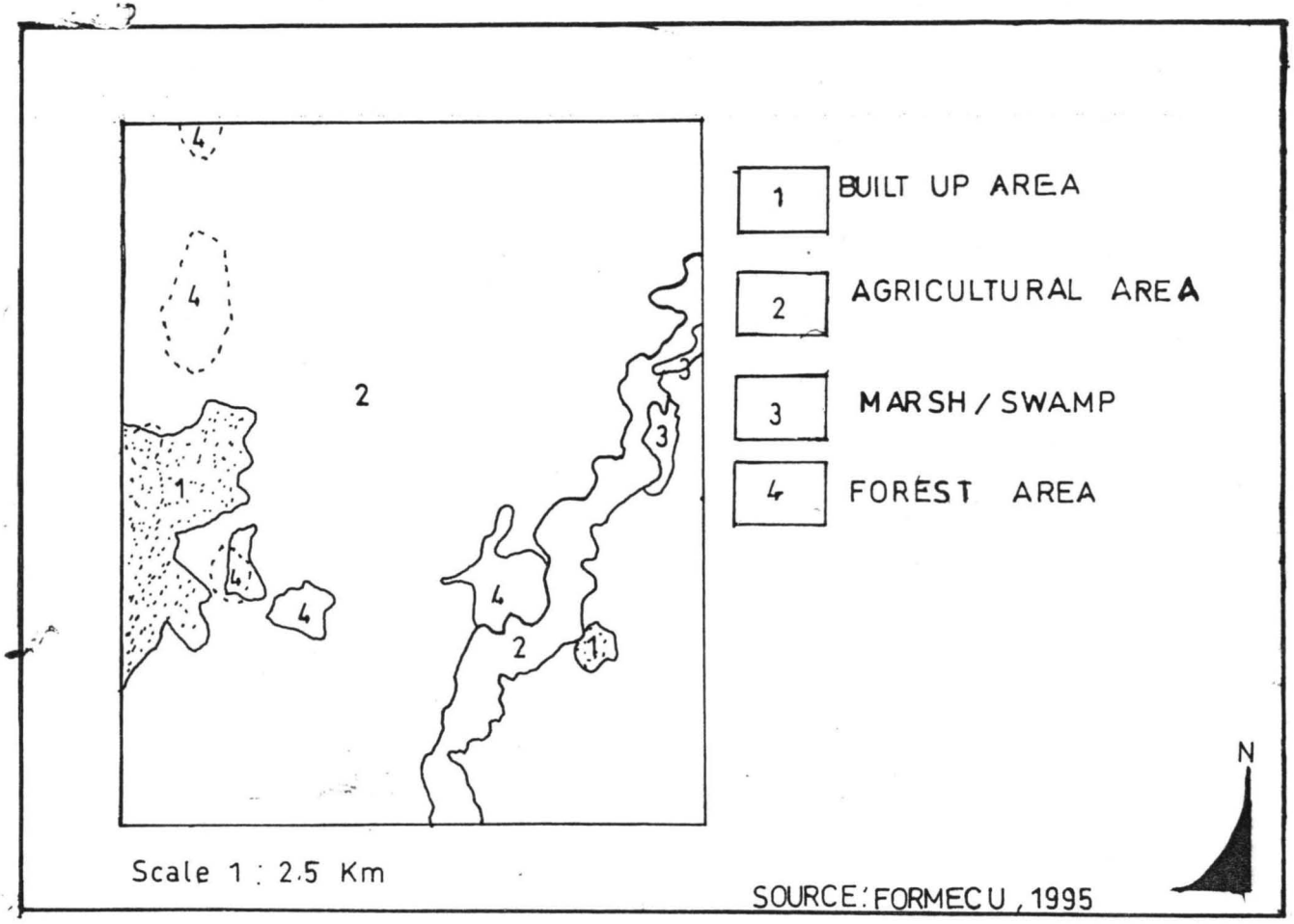


Fig. 4.1 MAP OF THE STUDY AREA SHOWING LAND USE 1976

4.2 INTERPRETATION OF 1995 SATELLITE IMAGERY

This table shows the landuse situation of the study area I 1995 which is derived from fig. 4.2 analysis.

TABLE 4.2 LANDUSE SITUATION 1995

S/NO	LANDUSE TYPE	LANDUSE IN KM^2	PERCENTAGE LANDUSE
1.	BUILT-UP AREA	7.5 KM	3.9
2.	AGRICULTURE	157.5	82.8
3.	MARSCH/SWAMP	3.75	1.9
4.	FOREST	18.75	9.8

In table 4.2 above, it shows that up area occupied 7.5 km^2 of the total area covered representing 3.9%, Agriculture occupied 82.8 representing 157.5 km^2 of the total area covered. This shows that larger percentage of the area covered is mainly agricultural land. Here tree crops, irrigated and small holder rainfed agriculture inclusive. Forest on the other hand occupied about 18.75 km^2 representing about 9.8% of the total study area.

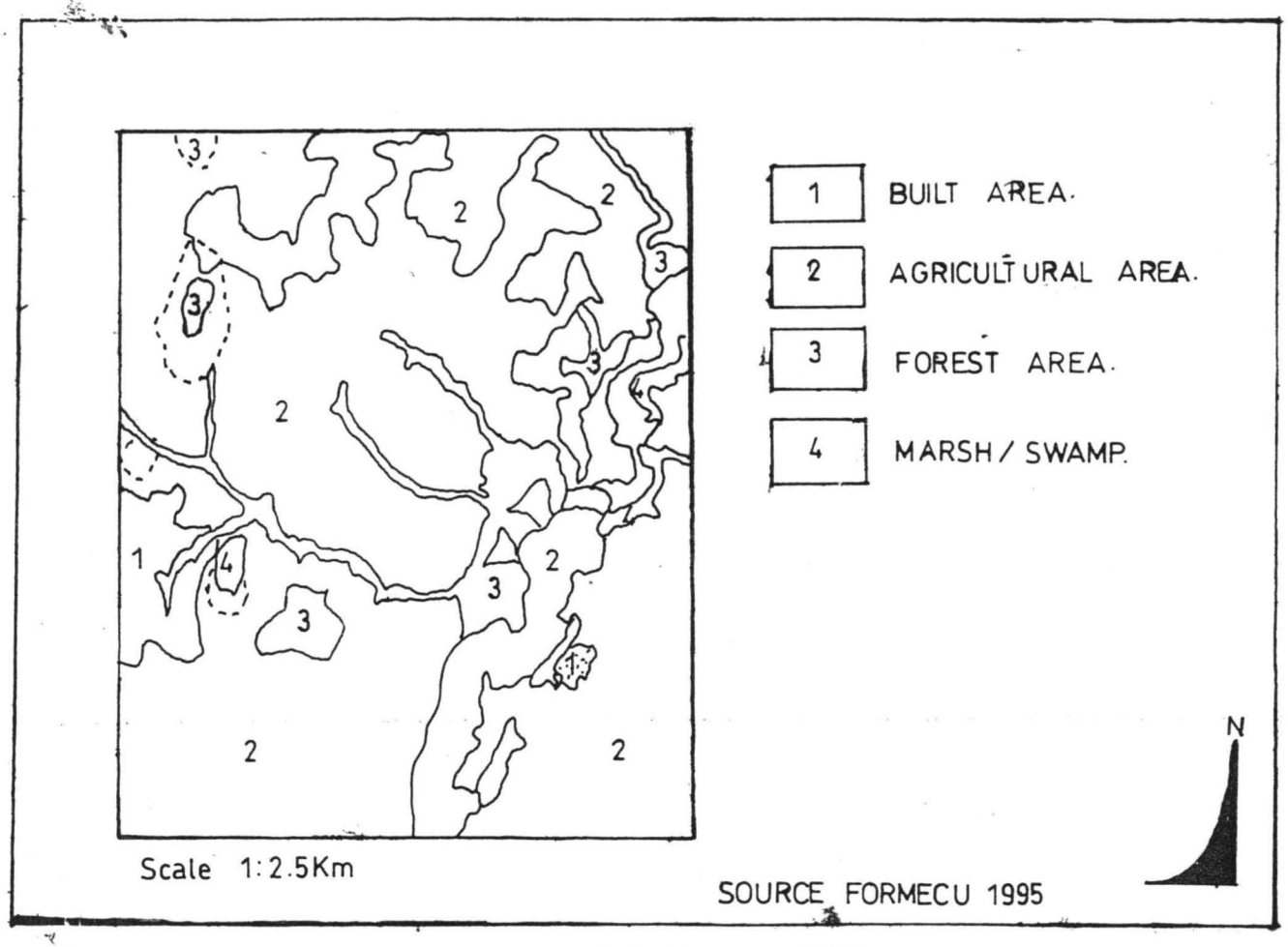


FIG 4.2 MAP OF THE STUDY AREA SHOWING LAND USE 1995

4.3 LANDUSE CHANGES BETWEEN 1976 – 1995.

Of the total of about 190 km^2 of land under the study area, the analysis revealed that about 22.5 km^2 of the land area has been changed either positively or negatively.

It is therefore shown that there is 11.9% changes within the period of study.

TABLE 4.3 LANDUSE CHANGES BETWEEN 1976 – 1995

S/NO	LANDUSE	SITUATION IN 1976	SITUATION IN 1995	CHANGE IN KM^2	CHANGE %	PATTERN OF CHANGE
1.	BUILTUP AREA	6.25	7.5	1.25	5.6	INCREASE
2.	AGRICULTURE	167.5	157.5	10	44	DECREASE
3.	MARSH/SWAMP	5	3.75	1.25	5.5	DECREASE
4.	FOREST	8.75	18.75	10	44	INCREASE

The forest area increase from 8.75 km^2 during the period understudy because of artificial forest that were raised in some areas by Forestry Department of the state in conjunction with the Federal Forestry Department. This change accounted for a reduction in the agricultural land which decreases from about 167.5 to 157.5 km^2. Built up area increased from 6.25 to 75 during the period under study. Marsh/swamp decreases from 5 km^2 to 3.75 km^2.

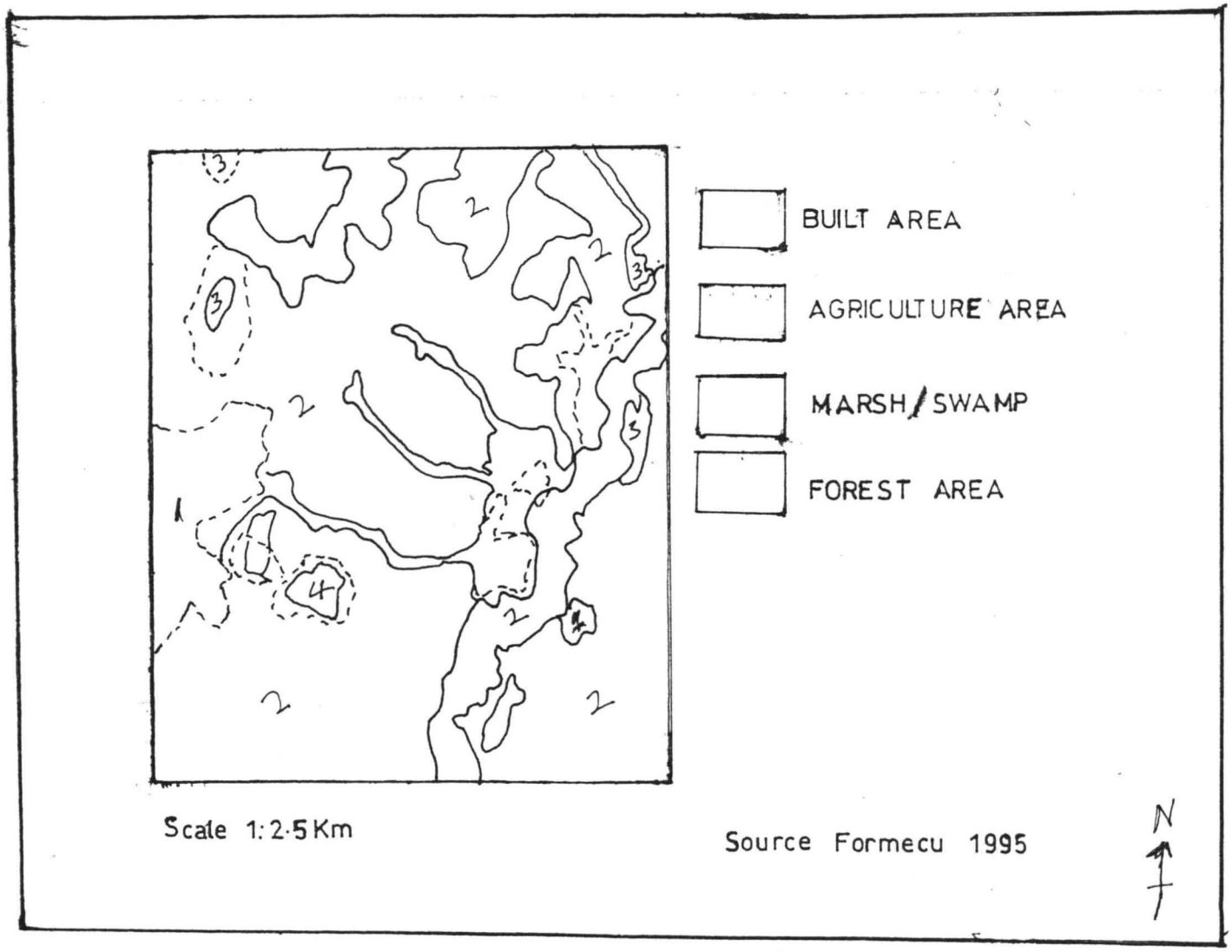


Fig 4·3 MAP OF THE STUDY AREA SHOWING LANDUSE 1976-95

4.4 DISCUSSIONS

It should be noted that, the interpretation process of the landuse types was subject to certain errors that have arisen from the delineation of boundaries and the technique used in calculating coverage area of landuse.

But on the whole, the landuse map produced provides sufficient information on the general landuse pattern and change between 1976 – 1995 as well as the conversion of one landuse to other uses.

Builtup area increased from about 6.25 to 7.5 during the period of under study. This is carried out at the expense of vegetation clearing.

The area covered by forest increased from 8.75 to 18.75 km^2 during the period under study. This is as a result of the artificial forest raised in some areas by Forestry Department of the state in conjunction with the Federal Forestry Department. This change accounted for a reduction in the agricultural land which decreases from 167.5 to 157 km^2.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

This study has revealed that the land area where this project was carried out is not static and it has demonstrated the capability of Remote Sensing as a valuable means of monitoring continuous landuse changes. Specifically and significantly is increase in the area occupied by forest which increased from 8.7 km^2 to 18.75 km^2 in 1995.

It was noted that built-up area increased from about 6.25 km^2 to 7.5 km^2 between 1976 to 1995.

Agricultural area occupied 167.5 in 1976 which represents 88.1% of the total land of the study. This however, decreased to 157.5 in 1995 representing about 82.8% of the study area.

Area covered by forest increased from 8.75 km^2 in 1976 to 18.75 km^2 in 1995. This increase is bound to have positive effect on the environment.

5.2 CONCLUSION

It is hoped that, this study will not just serve as a reference material for other related studies, but will provide planners and decision makers with information that will enable proper planning, and management of our

environment. Finally, the study has shown that remotely sensed imageries are useful in landuse management, identification of forests, other landuse and related environmental studies.

5.2 RECOMMENDATIONS

It is very important to have reliable source of data for monitoring landuse and the way it is changing overtime to provide a current data and map for reference, planning and development.

The government of Nigeria should try and award contract to relevant group of people to assess the landuse of the area for current planning and development of the area.

Remote sensing provide this or serves as source for data availability of this nature. The use of remote sensing is therefore recommended because it provides a repetitive coverage which is good for monitoring changes. One important remote sensing data is spot panchromatic and multispectral image, which can provide higher resolution imagery for monitoring changes particularly in settlements which may difficult to delineate using other platforms like aerial photographs.

Nigeria should properly adopt. Develop and utilize remote sensing and its related technologies for the inventory, evaluation and monitoring of its natural resources and changes taking place in order to enhance the capability to plan for accelerated socio-economic growth and to make sound decisions with respect to natural resources utilization and environmental protection.

The establishment of a remote center in Jos is good but the center should be accorded a more serious attention and more centers should be establish in the country. There is also the need for the country to have a ground receiving station where data can be processed immediately especially on issues relating to our environment.

The National Centre of Remote Sensing should be restructured. The restructuring should note the following – Recruitment of qualified personnel's, a proper organizational structure should be put in place to facilitate efficient performance of the center for the benefit of the country.

Assistance from international agencies should be sought in the area of technological advancement.

Various ministries and agencies charged with the responsibility of providing information and data about the environment should strengthen to provide up to date data about the various landuse and changes.

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