CHANGE DETECTION THROUGH TIME SERIES THERMATIC IMAGERY (1987-2001) IN THE FEDERAL CAPITAL TERRITORY, NIGERIA

BY

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MINNA

JUNE 2009

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A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF TECHNOLOGY (M.TECH) IN REMOTE SENSING APPLICATION IN THE DEPARTMENT OF GEOGRAPHY SCHOOL OF SCIENCE AND SCIENCE EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA.

JUNE 2009

DECLARATION

I Awwal,Hayatuddeen Atiku hereby declared that this thesis was wholly and solely written by me under the supervision of Dr. P.S.Akinyeye.No part of this work had either been wholly or partially presented before for any Degree else where

AWWAL,HAYATUDEEN ATIKU
M.TECH/SSSE/2003/1015

7/5/09
.....
Signature & Date

CERTIFICATION

This thesis titled "Change Detection Through Time Series Thematic Mapper Satellite Imagery (1987-2001) in the Federal CapitalTerritory, Nigeria by Awwal, Hayatudeen Atiku (M.Tech/SSSE/2003/1015) meets the regulation governing the award of the degree of Master of Technology (M.Tech) of the Federal University of Technology Minna and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This research work is dedicated to the memory of my late Father Alhaji Atiku Awwal who did not live to see the fruit of his efforts.

ABSTRACT

Federal Capital City is located in the central part of Nigeria; the study area covers a total land of 27281.9 ha. The problem facing the new federal capital city is destruction of vegetation as a result of rapid urban growth. This research work was aimed at accessing the current status of vegetation and built up area (road net work, baresoil and building construction). Satellite images of land sat 4TM 1987 and land sat 7 ETM of 2001 and ground truth were combined to access the changes that occurred (1987 and 2001). Result shows decrease of vegetation within Fourteen (14) years. The implication of the observed pattern is gradual replacement vegetation by building road network and bare soil, if not control it will result to gradual degradation of the entire environment given way to different environmental hazard.

ACKNOWLEDGMENT

My Sincere gratitude goes to Almighty Allah for enabling me to start and complete this work successfully. I owe my parents every gratitude, honour and esteem particularly my Late Father Alh. Atiku Awwal for his encouragement and support since when I was young. Similarly I am also indebted to my supervisor and mentor, Dr. P. S. Akinyeye for his limitless guidance and inspiration from the beginning to the point of conclusion of this work, his contribution toward, the success of this work worth mentioning in recognition may he be rewarded accordingly.

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To my family particularly my beloved wife Hajiya Maimunatu and our children whom we share the tremor of the trying period, my brother Shamsudeen Atiku Awwal and host of others friends I say thank you.

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ABSTRACT

Forest Vegetation provides not only wood, food, medical product, it also serve as a habitat for plant and animal species. Human activities have exacted uncontrolled degradation and deforestation of these resources to other uses such as agriculture, buildings, roads etc. This study is aimed at examining the present state of vegetation change in Federal Capital City to compare the present state with previous state of changes, to estimate the rate of change and to offer useful advice for environmental management. Satellite images of land sat 4TM 1987 and land sat 7 ETM of 2001 and ground truth were combined to access the changes that occurred between 1987 and 2001. Result shows decrease of vegetation within Fourteen (14) years. The implication of the observed pattern is gradual replacement vegetation by building road network and bare soil; if not control it will result to gradual degradation of the entire environment given way to different environmental hazard.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Forest vegetation provides not only wood, food, medical product, it also serve as a habitat for plant and animal species. Human activities have exacted uncontrolled degradation, deforestation and conservation of these resources to other uses such as agriculture. The pattern at which this resource is consumed is alarming.

Forest resources are renewable and can be managed. Remotely Sensed data can greatly assist in providing information concerning it's condition, extent and growth characteristics, monitoring it's conditions forest fire diseases and damage assessment of deforestation etc. increasing population pressure, speedy urbanization constitute frightening threat to environment. As man always searches for physical comfort, the environment is being misused causing a lot of discomfort.

It is vital to protect forest particularly tropical forests, because they contain the majority of the planets land-based species. Natures products support such diverse industries as agriculture, cosmetic, pharmaceutical, pulp and paper horticulture, construction and waste treatment, in addition, forest regulate the global atmosphere cycle that makes biological life possible on earth.

Before the emergence of remote sensing, studies on environmental changes are either done through ground survey and interpretation of aerial photograph. And the changes were detected by manual comparison of a single data analysis. While if remote sensing is apply you have the choice of using satellite images of different time series to make your comparison using computer system and appropriate software.

Deforestation is the Amazon in the late 50s with the construction the Belem-Brasilia High way Moran (1993).

The technology advances in remote sensing during the last 30 years have been extremely helpful in studying regional processes in the Amazon Basin with the new Landsat 7 satellite and US fine resolution sensor. More calculation can be drawn from each image. The urban development that is existing now reveal that the destruction of natural vegetation cover are being permanently replaced by bare soil surface, usually covered by concrete, asphalt or steel.

Construction activities in the Federal Capital city led to removal of natural vegetation cover. However, the F.C.T agricultural sector succeeded in maintaining 260 hectares of forest plantation in Luge, Kuje, Gwagwalada, Kubwa, Jabi, Bwari, Abaji e.t.c Federal Capital Territory Agricultural Development Activities (1994-1997).

Table1 :Show some species of forest plant in the Federal Capital Territory.

S/NO	BOTANICAL NAME	HAUSA NAME
1.	Beylinia Granalia	Dokar Rafi
2.	Piptaadeniastrom Africana	Doronwa Kurmi
3.	Avbrevillaea Kerstingii	Doronwan Mahalisa
4.	Antians Africana	Farin Loko
5.	Mitragyna Stipulosa	Ganyen Goro
6.	Triplochiton Soloroxylon	Hannua Biyar
7.	Afzilia Africana	Kawo
8.	Sterculia Oblonga	Kukukin Rafi
9.	Chlorophora Excelsa	Loko
10.	Khaya Senegalensia	Madaci
11.	Khaya Grandifoliola	Male
12.	Tectona Grandis	TIK
13.	Nauclea Diderridii	Tafashiyen Kurmi
14.	Terminalia Superba	Baushen Kurmi
15.	Blighia Apida	Alele
16.	Ptoricaarpus All SPP	Madobiya
17.	Canarium Schwinforthii	Atili
18.	Dalbergi Spp	Dalbejiya
19.	Albizia Zygia	Tsintsiyar Kurmi
20.	Dannilia Ogia	Majen Kurmi
21.	Danulia Ogia	Maje
22.	Gmalina Arborea	Malaina
23.	Allan Black All Spp	Mangoron Kurmi
24.	Anogeissus Leiocarpos	Marke
25.	Ceiba Pentandra	Rimi
26.	Vitex Doniana	Dinya

27.	Borassus Aethoiopum	Giginya
28.	Erythrophleum Guinese	Gwaska
29.	Cola Cordifolia	Bokoko
30.	Adousonia Digitata	Kuka Adansonia
31.	Butrospermun Paradixon	Kadanya
32.	Tamarindus Indicus	Tsamiya
33.	Irvingia Gabonensis	Akokari
34.	Diospuros Mespuliforines	Kanya
35.	Syzgium Guinelse	Malmo
36.	Ricinodedron Hend	Wawan Kurmi
37.	Detarium Senegalensis	Tauran Kurmi
38.	Eleeis Guineenisis	Kwakwa
39.	Manilkara Obvate	Kaden Rafi
40.	Azadiracta Incia	Nim

Source: Agriculture and Rural Development Secretariat FCT Abuja

1.2 PROBLEM STATEMENT

The study of mans environment is the central theme of geography; land use is the most important way by which man is related to the environment. The current land use have led to the destruction of vegetation particularly tropical forest because they contain the plant based species that are use in our pharmaceutical, construction and agricultural industries to mention few.

Forest vegetation also regulate both local and global atmospheric cycle that makes biological life possible on the earth surface, any change in the cycle has its environmental consequences.

Presently the Federal Capital City is facing the challenge of serious destruction of its vegetal cover principally as a result of construction which replaced the vegetated area with bare ground, concrete, asphalt or steel

The study will determine the extent of vegetation degradation and to assess the condition zone.

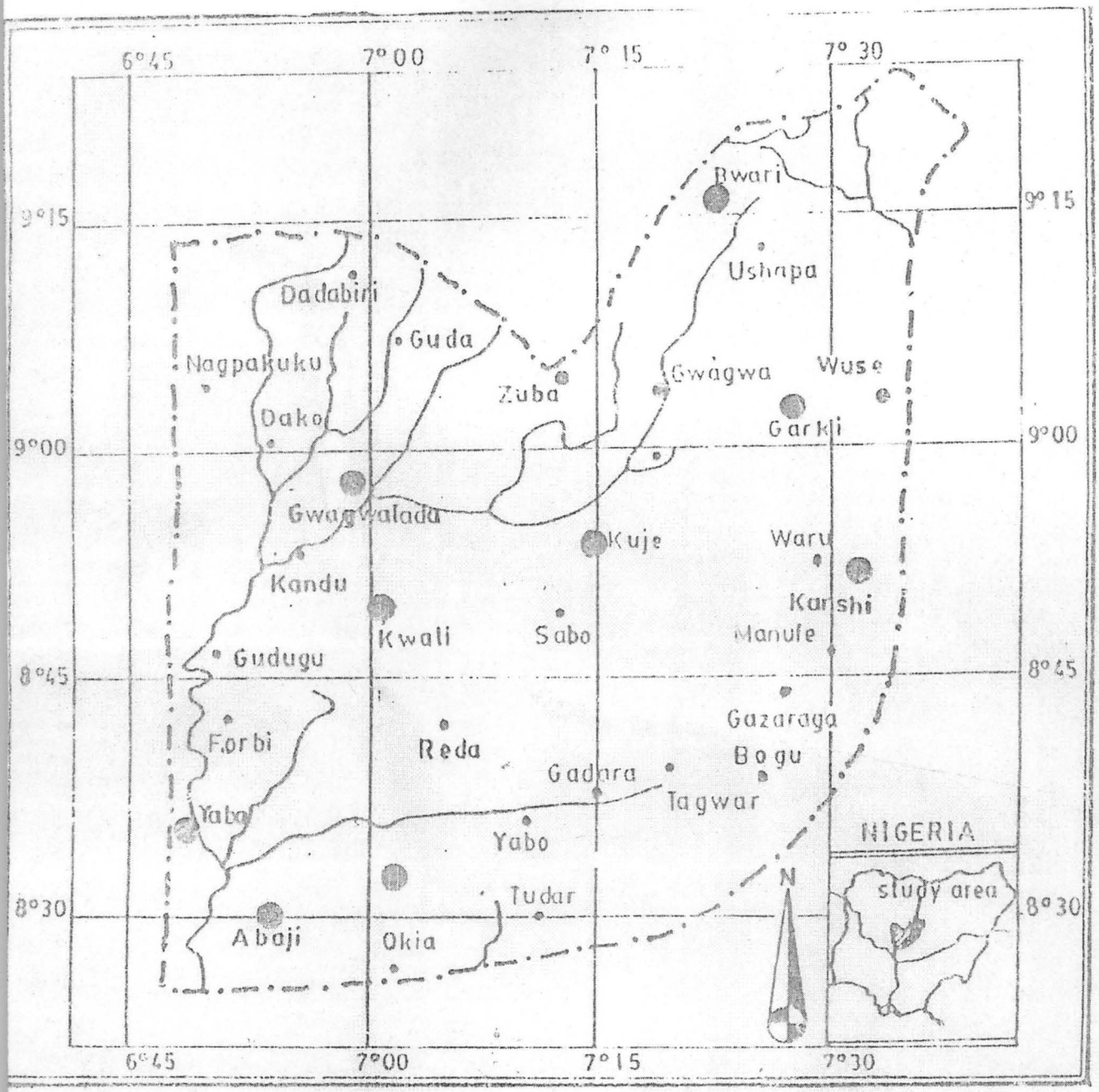
1.3 GEOGRAPHY OF THE STUDY AREA:

1.3.1 LOCATION:- The Federal Capital Territory is located at the central part of Nigeria it was carved out of the present Kaduna, Kogi, Nassarawa and Niger State with a total land area of 8000sqkm. Federal Capital is endowed with a rich vast arable land and its centrality in the country can support the growth of many species of plants that you can see across the country.

According to Federal Capital Territory Master Plan, it was designed to accommodate 3.1million in a land area of 8000sqkm when fully develop with necessary infrastructures.

The physical development of Federal Capital Territory was structure into 4 phases. The first phase was planned to accommodate 230,000 people, the second phase will accommodate 585,000 people. The third phase will accommodate 640,000 people, and the final stage of development which is phase four will accommodate 1.7million people respectively.

Fig. 1 **MAP OF THE STUDY AREA**



ource: Geography Department
ederal University of Technology, Minna.

SCALE:- 1: 250,000

LEGEND

Boundaries of the Federal Capital Territory
Met. Station — Bwari
Major Towns — Garki
Minor Towns and Villages — Kandu
Rivers

1.3.2 CLIMATE

The climate of FCT is determined by the alternation dominance in the region of either the dry continental air mass from the north or the moist marine air mass from the south. The zone or boundary delimiting the area of dominants of either air mass called the surface4 discontinuity migrates north or south in response to seasonal variation of the intensity solar radiation. The FCT is located in such a position that it undergo roughly equal period of dominance by each air mass. The north-south migration of the limit of dominance of each air mass creates the season which are wet and dry periods during each year DOX-NIG-A138 (1983).

1.3.3 TEMPERATURES

The daily minimum and maximum temperature in FCT are strongly influenced by elevation and extent of cloud cover, temperature at lower elevations, mostly associated with rivers and valleys, are noticeable higher than those encountered at higher elevation of the plains and hills, wet and dry season is also an influencing factor. The highest temperatures and greatest diurnal ranges occur during the months of the dry season (Nov-April) during which maximum temperature range between 27.5^{o}c-37.0^{o}c. The diurnal range can be as much as during dry season. Extreme maximums normally occur during the month of March with the highest temperature occurring at lower elevation.

1.3.4 RAINFALL

Rainfall in the Federal Capital territory begins from April and end on October. The period of the raining season sometimes varies within localities as a result of FCT location on the wind Ward side of JOS plateau which creates condition that are highly favorable to frequent rainfall. Influence of north-south migration of surface discontinuity give way to two maximum rainfalls frequently noticeable. One maximum occurs when the northward migration of the moist maritime air, the second maximum occurs during the southward migration of the air mass. This double maximum is therefore more common in the southern portion of the territory than the north DOX-NIG A138 (1983).

The quality of rain in terms of both annual amount and seasonal spread, inter annual variability is then ascertained by comparing the values for the year under study. The study shows that base on the available data and going by the principle of Monsoon Quality Index (M Q I) two important point are observed the first is that FCT has more rainfall than most areas on the same zone even a more southern latitude, secondly the northern part receives more rainfall than the southern part Umar (2002).

1.3.5 RELATIVE HUMIDITY

This is a general expression relating to the content of Water vapour in the atmosphere. The source of humidity is the earth surface therefore humidity is concentrated in the lower part of the atmosphere. Seasonal variation of humidity

follows a simple pattern, control by air mass characteristics and temperature, diurnal variation are more complex.

At dry season period humidity falls in the afternoon. This low relative humidity, coupled with high afternoon temperature account for desiccating effect of dry season, while during the raining season the relative humidity rise in the afternoon which gives heat trap effect.

1.3.6 SOIL

The soil in the federal capital developed from the crystalline rock of the basement complex. The common characteristics of most soil within the FCT include stoniness, a generally acidic reaction, sandy texture and shallow depth with the exception the soil derived from diorite and hornblende schist's of the Gwagwa plains, soil are less stony, deeper and finer texture e.g. Clay loams and sandy clay loams. Drainage of the soil in FCT is generally free except where it may be restricted by topography e.g. valley bottoms.

1.3.7 VEGETATION

The FCT vegetation consist of five (5) plants communities out of these two (2) are forest rain (forest and riparian forest) and three savannah (savannah woodland, park savannah and shrub savannah). The location, development and current status of these plant communities reflect the different soil type and water availability condition. Rain forest is the type of vegetation that occurs throughout the FCT within an area coverage of about 592sq. Km. The rain forest is develop usually in four vertical layers, three of tree and one shrubs, a grass cover is

absent due to the close tree canopy maximum tree height reach 40m. Under higher moisture condition the rain forest transform into the second type of forest which is Riparian vegetation, this cover about 1000sqkm.

1.4 AIM AND OBJECTIVES

The aim of the study is to collate and analyze information on existing vegetation and build up areas In Federal capital city phase I. To achieve this, the following specific objectives were conceived.

1. To examine the present state of vegetational change.
2. To compare the present stage with previous stage of changes.
3. To estimate the percentage/rate of change in vegetation
4. To offer useful advice for environmental management.

1.5 SCOPE AND LIMITATIONS

The scope of the study basically covers the phase 1 of the federal capital city. The study is limited to change detection on vegetal cover. The time frame of interest is between Dec. 1987 and Dec. 2001. It is considered that 14 years period is long enough to transcend all assumption related to the changes in the policy of the environment since the effective relocation of organs of government into the new federal capital territory took place in 1991.

1.6 JUSTIFICATION

The essence of under taking such study about change detection on vegetation cover is to obtain information for future planning toward attaining a sustainable environment settlement.

The improvement and maintenance of vegetation is important because of its role in regulating atmospheric cycle that makes biological life possible on earth.

The choice of remote sensing techniques is for its unique ability to provide different attribute data of an area. It is also the only practical method of obtaining data from inaccessible region.

CHAPTER TWO

LITERATURE REVIEW

2.1 ASSESSMENT OF FOREST LAND CONDITION AND VALUE USING REMOTE SENSING DATA.

Assessment of forest land is aimed at knowing the current condition of vegetation of a specified study area. The use of satellite technology has proved to be one of the current technology uses in conducting such studies.

Satellite data was used to provide information on change in vegetation condition over time. Estimate of different trends through time can be calculated from a series of images and displayed to highlight areas with different dynamic response.

An analysis was conducted and suggests that simple indices of summer images are almost suitable in West Australia agricultural area. The summer brightness of (Land sat ETM) band 7and 5 (or band 7 above) is effective in a range of vegetation type in the Keller area and the Kent catchments Jewelry and Suzanne (1994).

Field surveys of plant, and animals were combined with satellite remote Sensing of broad vegetation types to map bio-diversity and thereby help plan conservation in the Sango Bay area, some 30 by 100KM bordering Lake Victoria in Uganda. A statistical classifier applied to satellite images identified 14 land-cover classes including water, swamp, dry grasslands, degraded woody vegetation, semi-natural forest classes and intensive land use. Validation using

240 sample sites recorded 86% correspondence between field and map data Fuller (1998).

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different time. The basic premise in using remote sensing data for change detection is that changes in the object of interest will result into changes in radiance value or local texture that are capable from changes sensed by the factors such as difference in atmospheric conditions illumination and viewing angle soil moisture, e.t.c. Peter (2000).

Classification of vegetation in Etosha National Park was carried out as a part of a project to measure vegetation status in near real time use NOAA-AVHRR image. The classified scheme used in Etosha was adapted from Yanganbe classification. The aim is to separate vegetation classes according to the height, density and main species of woody vegetation Taylor et al (1996). A collaborative assessment of forest and range condition was initiated to gather information on common vegetative and soil conditions of forests and rangelands in wallows country.

2.2 LINK BETWEEN VEGETATION COVER AND CLIMATE CHANGE

The first link lies in the role forest play in regulating the earth's temperature and weather pattern by storing large amount/quantities of carbon and water. The amount of forests is considerably larger carbon stored in managed temperate zone; a secondary forest will need some 150-250 years of undisturbed growth in order to accumulate carbon stocks comparable to those in Primary forest. In the

tropical climate, managed secondary forests are believed to need more than 150 years to accumulate carbon stocks comparable to those found in Primary forest Jutta (2001).

The flow of CO_2 between forest and agricultural soils and the atmosphere is a two way street. For example, when trees grow they absorb CO_2 from the atmosphere but when they die and decay or are burned down they release CO_2 into the atmosphere. On a larger scale, the amount of CO_2 either absorbed or released by forest and agricultural soil can be influenced by human management and by events in nature, such as forest fires, drought or a particularly favorable growing season Government of Canada (2001).

When tropical forests are clear cut, burned or destroyed, much of the carbon stored in leaves, woods and soil is estimated into the atmosphere as carbon dioxide. Given the breath of deforestation, emissions from tropical rainforests are shockingly high Bonn (2001).

2.3 LAND COVER AND NATURAL RESOURCES MANAGEMENT

Land cover is use to describe the background of naturally vegetated, non-vegetated and human affected landscapes within a region Simon et al (1996) in part, these landscapes are themselves the product of large-scale variation in the distribution of soils, temperature, precipitation and edaphic factor. Natural and anthropogenic forces act continuously to modify and change land cover and it is this shifting mosaic that must be mapped for natural resources management.

Human pressure has led to the uncontrolled degradation, deforestation and conversion of these resources to other use such as Agriculture and settlement, unsustainable consumption pattern have manifested.

Land use of the Agro River Basin in Philippines was derived from SPOT satellite image, different land use classification Herath and Dutta (1996). In Nang Ring district Buriran province, North East Thailand and 18 numbers satellite image time serves extending from 1973 to 1997 has been assembled and processed for land cover characterization through a derived hierarchical land use. Land cover classification scheme pattern metrics haven been used to explore compositional and spatial changes in landscape organization over time, space and ground control data has been collected through differently. Converted GPS measures as well as still photography and video-graph. An aerial photography time series dating back to the 1950s has also been acquired with a number of them now scans digitized and geo-referenced to other spatial and thematic data larger within the GIS Walsh et al (2000).

In the United States, urban land consumption is occurring at about twice the rate of population growth. The rapid development of land that was previously forest, farmland, prairies or wetland has created a serious sprawls problem. Natural areas are paved, open space is lost and cities faces increasing cost of installing infrastructures, such as roads sewers as development sprawls even outward. The Seattle metropolitan area has faced considerable development pressure as the population has increased in recent decades. From 1990-2000, the population

increased by over half a million people (20%). Corresponding to conversion of forested land and farmland to housing development Jocelyn (2004).

Huntsville also known as the Rocket city is one of the forest growing cities in the state Alabama. This city was founded by Pioneer John Hunt in the year of 1805, by 1819 Huntsville had grown tremendously and was the largest town in the Alabama territory. For over a decade (1990-2001) now this city has experienced a dramatic landscape change due to the increasing population, new development of commercial zones, and different agricultural land uses. During this decade, the suburban areas as well as the urban areas have both school systems and living preference. The agricultural land use changes annually depending on the crops that is being planted Horn (2004).

2.4 DEFORESTATION

Deforestation varies from location to location, but certain patterns tend to be consistent across all forests. Logging companies in search of valuable rain forests hardwoods or, less often, oil companies in search of petroleum are often the first to enter a remote area of rain forests. Some logged forest if left alone can regenerate in a few decades. But typically, logged companies often provide access for lawless farmer to enter a new area, as well as a means to transport agricultural crops to market. For every 1 kilometer of new road built through a forested area, 4 to 24 sq km (1.s to 9. 3sqml) are deforested and colonized Halilu (2004).

Deforestation results not only in the loss of tress, but may also cause the entree remaining vegetation to partially break down. Moist areas are drained and organic matters e.g. humans bound in the soil decomposed more easily. All these processes release Co_2 and CH_4 and can result to climate charge climate of the 21st century edition (2001).

The environmental implications of deforestation and forest degradation are determined jointly by the type and magnitude of the human intervention as well as the ecological context of the land and forest area under change. Forest resources assessment (1990)

Urban development has expanded rapidly in the Tampa bay area of west-central Florida over the past century. A major effect associated with this population trend is transformation of the landscape from natural cover types to increasingly impervious urban land. George and Mike (2005).

2.5 APPLICATION OF REMOTE SENSING TO CONSERVATION OF FORESTS ECOSYSTEM

At regular to global scales the only feasible way to monitor the world forest is through remote sensing. The use of coarse. Grain remote sensing techniques for measuring deforestation and fragmentation at regular and global scales in combination with new developments such a neural network classification promises to improve the accuracy of forest extent measurement.

The improvement in remote sensing techniques, sensor Technology and the growing emphasis on conservation are bringing forest ecologist and remote sensing scientist together for the first time

The use of coarse spatial resolution system particularly AVHRR has been available tool; for measuring the forest extent. New techniques such as neural network classification, promise to improve the accuracy of global forest maps produced from AVHRR data. However difficulties in identifying specific types of forests, even with the help of techniques such as seasonality analysis, limited the operational use of AVHRR to forest non forest classification.

CHAPTER THREE

MATERIALS AND METHODS

3.0 INTRODUCTION

The interpretation and result analysis computed in this research work were purely based on two satellite images Landsat 4TM of 21st December 1987 and Landsat 7 ETM of 27 December 2001 and ground truth conducted by the researches .The total area coverage of the study area was 27281. 9Ha with the following geographical coordinates.

Minimum – x – 322807.4

Maximum – x – 338190.9

Minimum – y – 992123.9

Maximum – y 1009851.9

Thematic mapper satellite image and digital photograph were the major source of data use in this study. Currently, remote sensing is one of the reliable tools of conducting environmental study, due to its unique characteristics to sensing and recording reflected or emitted electromagnetic energy from different feature of the earth surface and augmented by ground truth and oral interview.

3.1 TYPES OF DATA USED

1. GEO- Referenced Landsat 4 Thematic Mapper (Tm] image of 21st December 1987 and Landsat 7 Enhanced Thematic Mapper [ETM] image of 27th December 2001
2. G PS coordinate of the study area
3. Digital photographs of the study area
4. Map of the study area

Table 2: Satellite Images used

SENSOR	VEHICLE	DATEOF ACQUISATION	SCENE COORDINATES	PROCESSING
Thematic Mapper	Land sat 4	21/12/87	Minimum-X-322807.4 Maximum-X-338190.9 Minimum-Y-992123.9 Maximum-Y-1009851	Auto Rectified
Enhance Thematic Mapper	Land-sat 7	27/12/2001	Minimum-X-322807.4 Maximum-X-338190.9 Minimum-Y-992123.9 Maximum-Y-1009851	Auto Rectified

3.2 MATERIAL

1. Computer system was used in the image processing; the soft ware of choice was Idrisi 32 for image processing while Microsoft word was used in writing the entire scripts.

2. Digital Camera was used to Capture photo graph of some feature of the study area.

3. Global position system (GPS) was used in recording the coordinates of the study area and serve as a guide to identify some spatial feature from the image.

3.3 COLOUR COMPOSITE

The composite's were produced and onscreen digitization were conducted to determine the extent of land use and vegetation cover by creating point polygon and line, layer of specific features were formed such as vegetation and built up area..

3.4 CLASSIFICATION

Supervised classification was conducted to know different classes of feature within the study area. The reason of using supervised classification is due to the familiarity of the spatial information of the study area.

3.7 CROSS TABULATION

Cross tabulation comprises of two operations. The first, is cross tabulation, of image where categories in one image is compare with that of second image and a table is form with number of cells in each combination.

In this study the first image used was Landsat 4 TM of 21/12/1987 while the second image was Landsat 7ETM of 27/12/2001. This is to ascertain the changes that took place between the time series of the two images.

The result is represented as a table Landsat 4TM 1987 is represented as column while Landsat 7 ETM 2001 as a row.

The other basic operation is cross classifications which are multiple overlaid showing combinations of logic and operation. The results produce a new image.

In the research a cross tabulation of Landsat 4 TM and land sat 7 ETM was computed to ascertain the rate of change in vegetal cover in Phase 1 of the federal capital city.

CHAPTER FOUR

4.0 RESULTS

4.1 RESULT ANALYSIS

4.2 COLOUR COMPOSITE: True colour composite of any image attempted to give an idea of the spatial features on the specific area of concern.

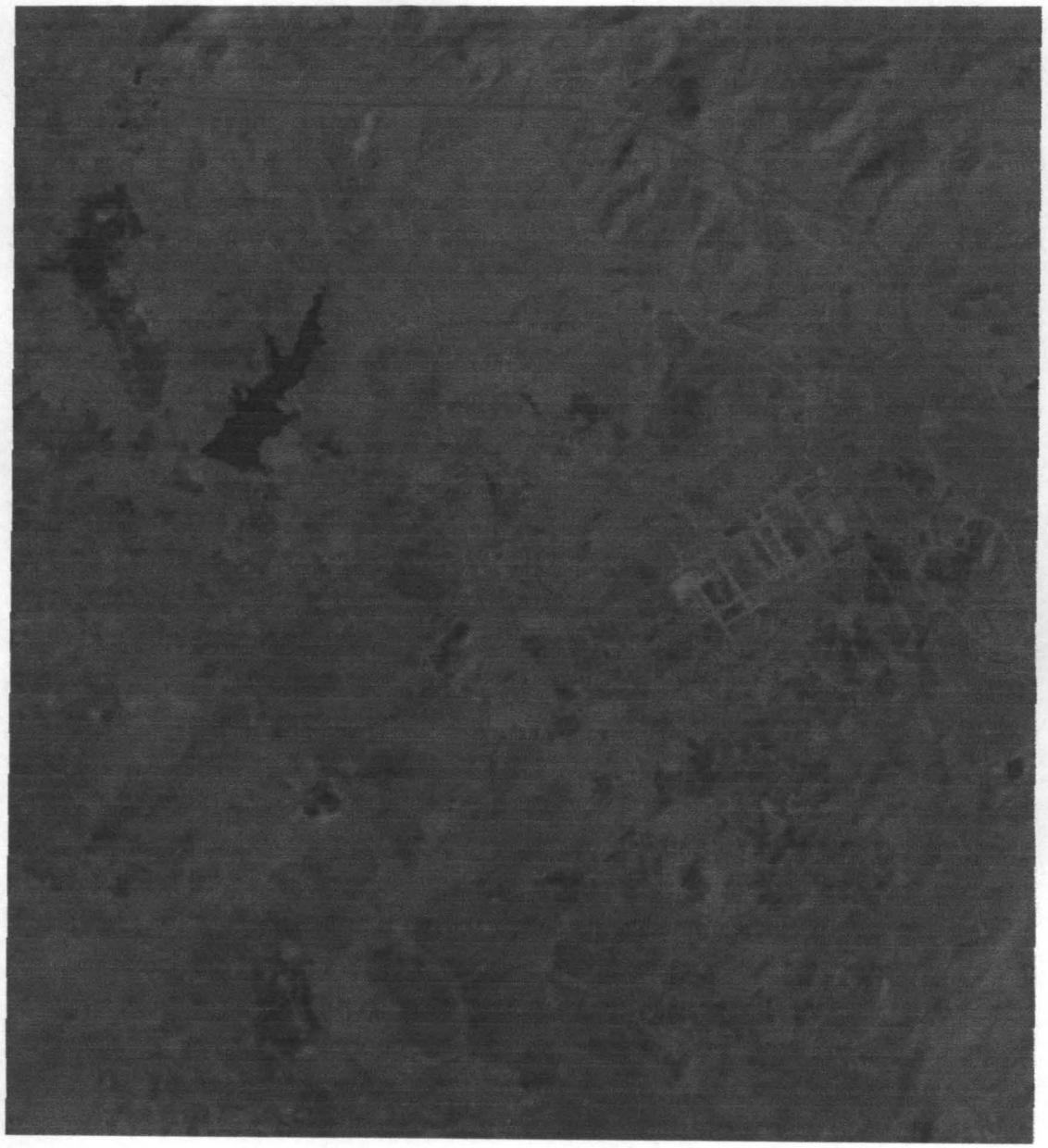


Fig 2: True colour composite of December 1987 from landsat 4 TM

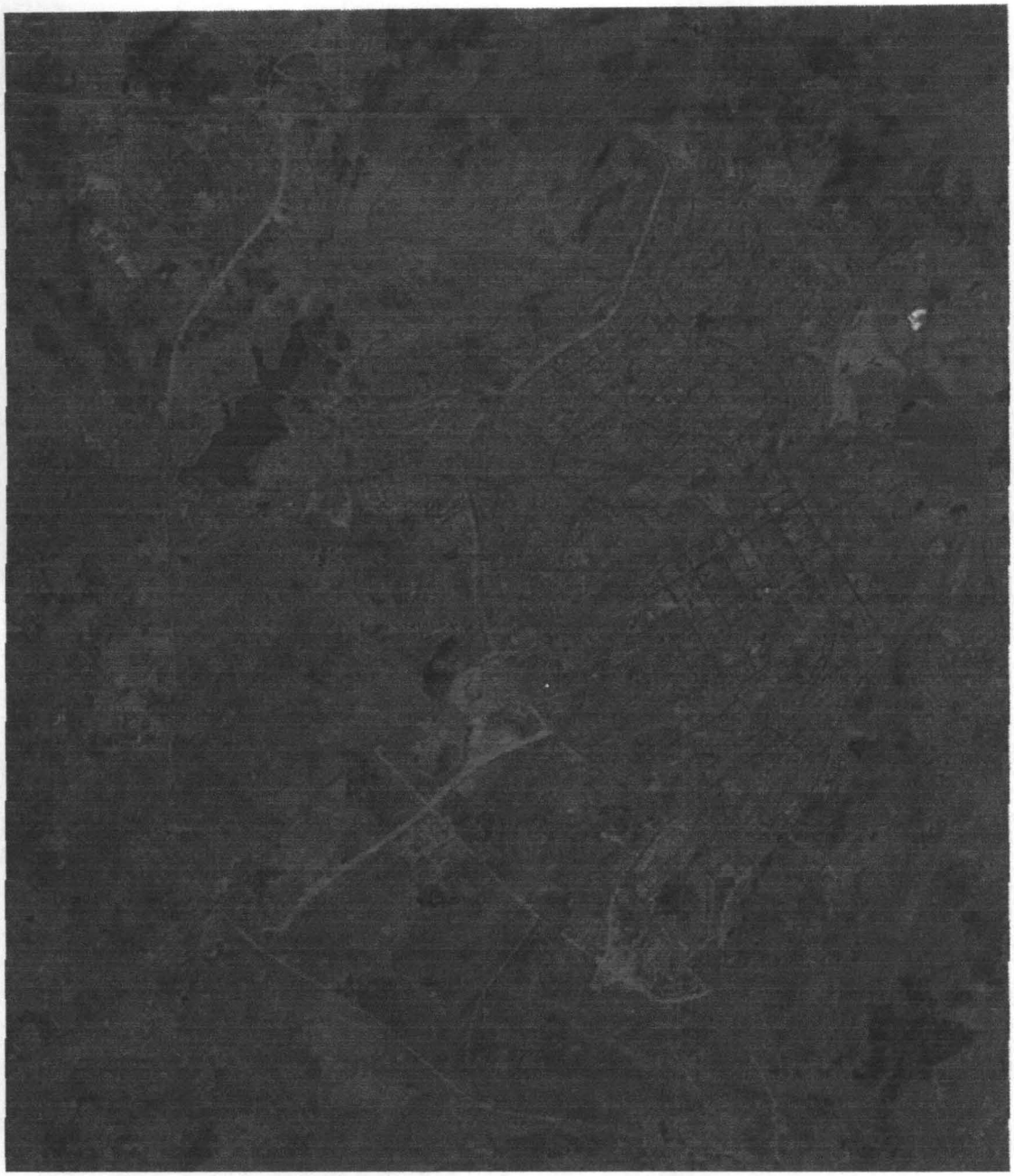


Fig 3: True colour composite of December 2001 from Landsat 7 ETM

4.3.0 Land use land cover classification.

4.3.1 Land use land cover classification per Hectare 1987

Table 3: Shows land use land cover in 1987 per Hectares

Land use land cover	Area coverage	Percentage
Vegetation	18807.4 HA	68.9%
Built up areas	8474.5 HA	31.1%
Total	27281.9 HA	100%

Table 3 shows the sizes of the two classes of landuse per hectare in December 1987.

4.3.2 Land use Land cover classification land sat 4 TM 1987.

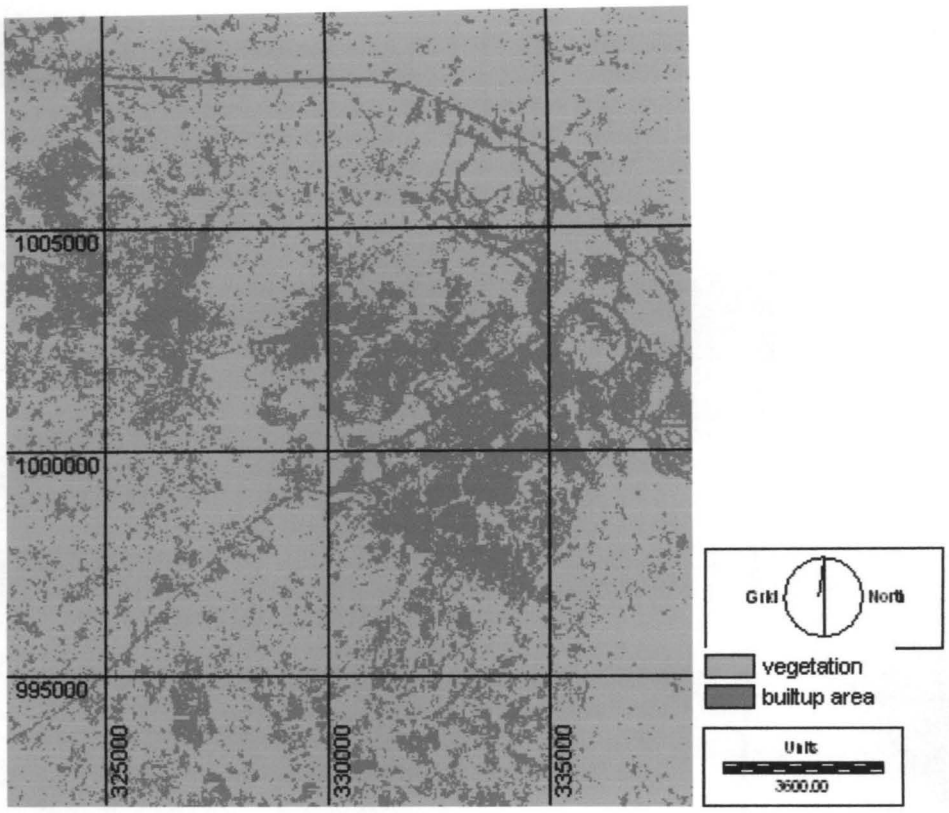


Fig 4 : land use land cover in 1987

Figure 4 shows Landuse Landcover of Thematic mapper Imagery of December 1987.

4.3.3 Landuse landcover per Hectares 2001.

Table 4: Shows land use land cover in 2001 per Hectares

Land use land cover	Area coverage	Percentage
Vegetation	18611.9 HA	68.2%
Built up areas	8670.0 HA	31.8%
Total	27281.9 HA	100%

Table 4 shows the sizes of the two classes of Landuse per hectare in December 2001.

4.3.4 Landuse Landcover classification Landsat 7 ETM 2001

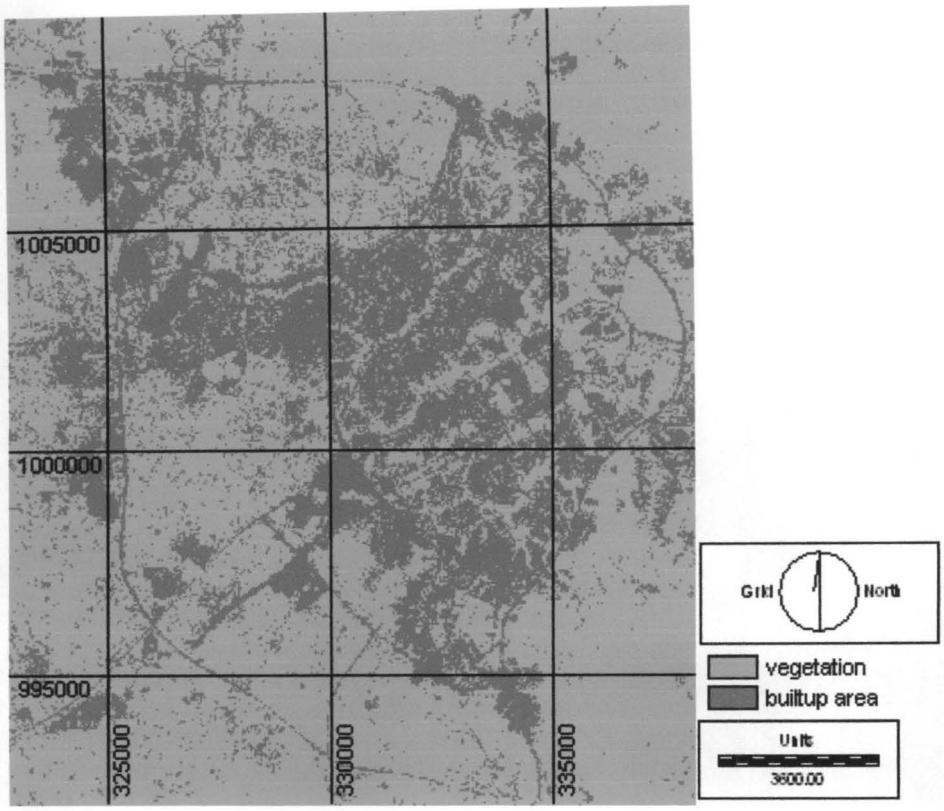


Fig 5 : land use land cover in 2001

Figure 5 shows Landuse Landcover Classification of Land sat 7 Enhance Thematic Mapper Imagery of December 2001.

4.3.5 Landuse Landcover Changes of Landsat 4TM and Landsat 7 ETM(1987-2001)

Table 5: Shows land use land cover change analysis between 1987-2001.

Land use land cover	Land use statuş 1987	Unchanged land use land cover	Land use land cover status 2001	Change + -
Vegetation	18807.4HA	12115.4HA	18611.9HA	-195.5HA
Built up areas	8487.5HA	3826.1HA	8670.0HA	+195.5HA

Table 5 shows changes in diffirent landuse landcover per hectare between December 1987-2001.

4.3.6 Landuse Landcover changed analysis of Landsat 4 TM and Landsat 7 ETM (1987-2001)

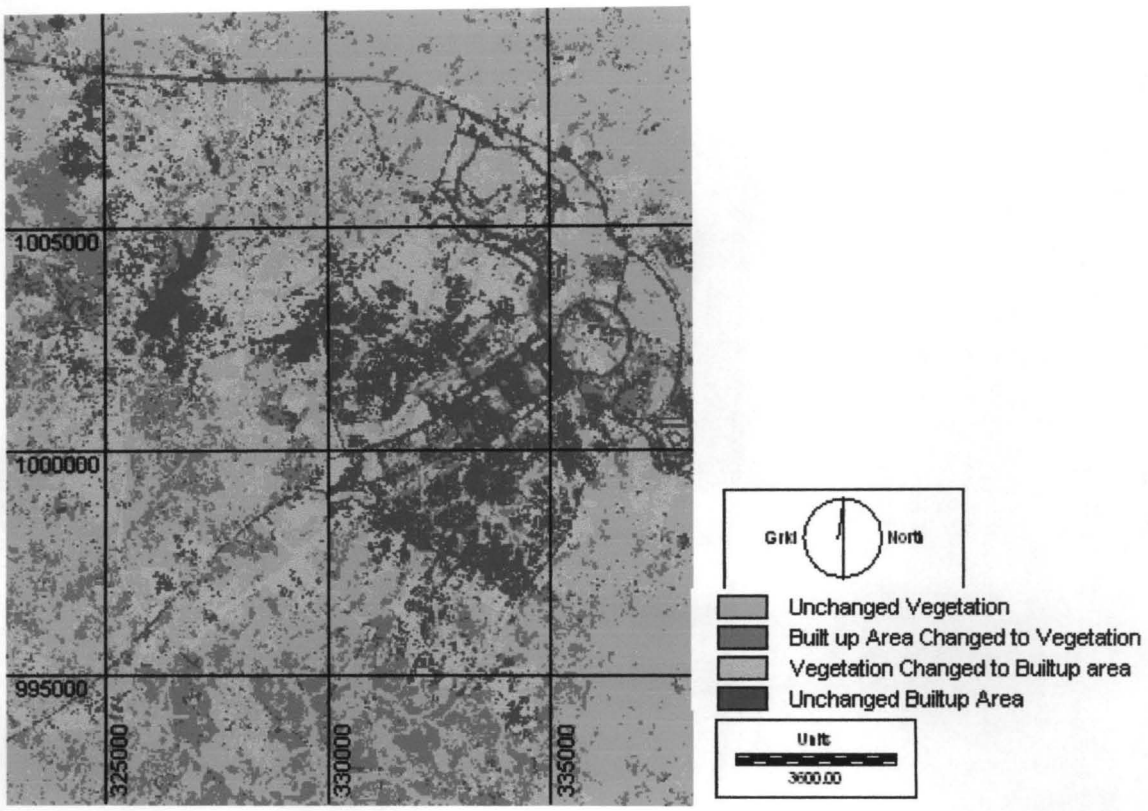


Fig 6 : land use land cover change analysis between 1987-2001

Figure 6 shows how landuses have change from one form to another between December 1987-2001.

4.4 VEGETATION

Vegetation in this study include all classes of green plant within the study area either natural grown vegetation or planted by man as can be seen in some of the plate in this research result.

Plate I: Forest plantations planted and being maintained by the Federal Capital Territory Agricultural Department along Kubwa express road in Abuja.

Plate II: The available natural vegetation within the study area but suffering human intervention in there development as a result of road construction and installation of power line.

Plate III: Some vegetation that was destroyed as a result of the need for Agricultural land and as well as source of energy (fuel wood)

4.5 BUILT UP AREAS

The built up areas include the road network, bare soil and buildings that replaces the former vegetation in the area.

Plate IV: One of the areas that road network and bare soil replace the former natural vegetation in the study area.

Plate V: The residential building within the study area that replaces vegetation.

4.6 Change analysis in percentage of Landsat 4 TM and Landsat 7ETM as at 2001.

Table 6: Change Analysis in percentage as at 2001

S/NO	LAND USE CHANGES	PERCENTAGE
1	Unchanged Vegetation	44.4%
2	Built up areas changed to vegetation	21.0%
3	Vegetation changed to built up areas	20.6%
4	Unchanged built up areas	14.0%

Table 6 shows the change analysis in landuse landcover in percentage as at December 2001.

CHAPTER FIVE

5.0 DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

5.1.1 COLOUR COMPOSITE.

The true colour composite of the image attempted to given an idea of the spatial features on the specific area of concern. fig 1 shows the true colour composite of Landsat 4TM imagery of Dec 21st 1987 while figure 2 shows the true colour composite of Landsat 7ETM of 27th Dec. 2001 they were all given the spatial features of the same area at different time.

5.1.2 LAND USE LAND COVER CLASSIFICATION

Land use land cover classification is usually conducted to obtain information on the different ways and extent that land was put to use depending on the factors relevant to the study. In this research only two factors were consider for observation, these are vegetation and built up area. The vegetation represents all classes of vegetation present within the study area while the built up area include the road network, bare soil and building structures within the study area.

5.1.3 LAND USE LAND COVER CLASSIFICATION LANDSAT 4TM 1987

In 1987 the land use land cover of the study area indicated that 18807.4 HA was covered with vegetation while a total of 8474.5 HA was built up area, this shows that 68.9% of the total land area was covered by vegetation while the 31.1% of the total land area was covered by built up area.

5.1.4 LAND USE LAND COVER CLASSIFICATION LANDSAT 7 ETM 2001

In 2001 the land use land cover of the study area indicated that vegetation covered 18611.9 HA which is 68.2% of the study area while the built up area covers 8670.0 HA which 31.8% of the total land is.

5.1.5 LAND USE LAND COVER CHANGE ANALYSIS BETWEEN 1987 – 2001

The land use land cover of the study area covers a total area of 27281.9 HA, the change that took place between December 1987 to December 2001 clearly indicated that in 1987, the vegetal cover of the study area stand at 18807.4 HA represents 68.98% while as at 2001 vegetation cover have changed to 18611.9 HA representing 68.02% as a result of different land use but 12,115 HA remain unchanged by any land use built up area in 1987 covers 8474.5HA representing 31.1% of the total land cover of the study area but in 2001 it has been increased to 8670.0 HA representing 31.8% of the study area while 3826.1 HA remain uncharged.

5.2 SUMMARY,

Vegetation provides woods, food, medicinal product as well as habitat for plant and man.

Forest regulate the global and local atmospheric cycles that makes biological life possible on earth. Remote sensing was used to detect changes on vegetation cover in the Federal Capital City phase 1 Abuja. In this research two (2) basic factors were considered, the first was vegetation the second was built up area. Time series satellite images of 1987and 2001 was used to detect the changes that occurred within the period of fourteen (14) years. To achieve this aim some specific objective were set up as follows. To come up with a database that will ascertain current status of areas that are covered by vegetation and area that are built up, this includes the road network houses and bare ground. To determine the extent and rate of changes in the two factors, to examine on the basis of 1&2 above and recommend a sustainable manner of land use.

The analysis indicates that in 1987 vegetation covered 68.9% of the total land cover built up area covered 31.1%, but in 2001 vegetation decreased to 68.2% while built up areas increased to 31.8%.

5.3 CONCLUSION

In conclusion of this research finding that covered a total area of 27281.9 HA, indicated that vegetation cover have decreased by 0.7% equivalent to 195.5HA, while built up areas have increased by 0.7% also equivalent to 195.5HA. this high impact of land uses is causing the disappearance of thick vegetation which is a gradual process of land degradation and if not control the resultant effect will include urban heat, environmental pollution as a result of uncontrolled pollution which could be a predispose factors of decreases out break. The destroying of vegetation can expose soil to erosion which will make agriculture unprofitable, it also facilitate wind storm which eventually result to damaging of surface structure and above al it contribution to climate change.

5.4 RECOMMENDATION

This research was conducted to ass how vegetation was destroyed as a result of rapid urban development.

From the result of the research and ground true thing conducted by the research its clearly indicated, that people neglected the important of vegetation to environment, in view of this the following recommendation have been made:

- There should be control on land use.
- Any protected zone such as buffer zone should not be tempered with.
- A forestation should be given emphasis in order to replace the natural ones lost.
- Improved agricultural farming system most be adapted.
- There is the need for continuous education on the negative impact of destroying vegetation, such as erosion, wind, storm, climate change etc.
- There should be a strong legislation that each house should plant at least a tree.

For further research, planning a sustainable habitat with particular reference

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