THEME: DISASTER RISK MANAGEMENT: HOW PREPARED IS NIGERIA?

SUB THEME: MANAGEMENT OF ECOLOGICAL RISK AND DISASTER

TOPIC: DEGRADATION AND DEPLETION OF FOREST RESOURCES

CASE STUDY: OYO STATE, NIGERIA.

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Abstract

Occurrences of disasters in the last two decades have increased drastically around the world and left some noticeable ecological imbalances in the environment caused either by nature or human activities. Disaster can be traced to the dynamics of natural hazards, global climate change, rise in sea level, but more often than not, its causal factor is largely human impact on the environment. Over the years, human activities have resulted in local extinction of most species of plants and animals, and other microbial populations (Hobbs R.J. et al, 2006:2). Forest covers helps to protect the land surface from erosion and keep the soil compact, serves as wind break and also shelter belts for agricultural purposes and the depletion of these forest covers has implication for Global warming. To avoid the total "disruption" of the ecological balance however, ecological management and conservation needs to be employed.

This paper therefore aims to study the changes in the forest cover in Oyo State, the trend in the depletion of forest vegetal cover over time, and to suggest ways on how to manage forest resources to ensure sustainability in the use of forest resources. To understand the rate of forest cover depletion in the state, an analysis of the vegetation satellite images between 1986 – 2010 was carried out using unsupervised classification with ERDAS IMAGINE. In this study, the evidence of encroachment into the forest and imbalance in its vegetation was articulated and ways to achieve management and sustainability of forest for future generation suggested.

Key words: **Deforestation, Normalized Difference Vegetation Index (NDVI), ERDAS IMAGINE, ArcGIS.**

1.0 INTRODUCTION

A disaster is a serious disruption of the functioning of a community or society causing widespread human, material, economic or environmental losses, which exceed the ability of affected community or society to cope, using its own resources. A disaster is a function of risk process. It results from the combination of hazard, condition of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk (ISDR, 2004). A disaster is an extremely sad event, both foreseen and unprecedented, that being about widespread, devastating and catastrophic, ecological, economic, social, political and humanitarian crisis. It represents the impact of a natural or manmade event that negatively affects life, property, livelihood or industry often resulting in permanent changes to human societies, ecosystems, and environment (Ojo, 2013).

Depending upon their factors, disasters can be categorized as being natural, man-made or human-natural in nature and for all kinds of disasters; two main types of effects ensue after the occurrence of such disaster; the direct and the indirect effects. Direct effects impact on human populations causing injury and deaths as well as physical and animal stocks damage and destruction. The Indirect effects affect the interrelation between physical structures and between people. These two types of effects bring about losses to society's stocks and flows.

Direct Causes include harvesting of timber, fuel wood, or games above the capacity of the forest ecosystem to replace the quantities extracted; excessive selectivity of species, size and form cut; overgrazing; air pollution; pollution of forest watercourses; soil erosion within the forest; anthropogenic fires; depletion of biodiversity; introduced disease or pest species; And the Indirect or the Underlying Causes include; national policies; failures of policy or planning; insecurity of tenure; absence of alternative sources of forest goods and services or substitutes for them; failures of regulation or control; land speculation; the temptation of a profitable market; absence of employment; land hunger; displacement of populations, farming failure; improved accessibility; displacement of Populations by other land uses; greed and corruption and also unwise intensification of land use.

In Nigeria, the total value of both the wood and non-wood forest product as well as their environmental functions is enormous though not completely quantifiable (Moormann et al. 1975). Mostly, the forest is underestimated in value within the National reckoning. Nigerian forest and woody vegetation resources include the high Forest, woodland, bush lands, plantations and trees on farms. Each of these various resources contributes to production, protection and conservation functions. Studies have shown that forest reserves occupy about 10 million ha in Nigeria, which accounts for about 10% of a land area of approximately 96.2 million ha (NFP, 2006). Over the years however, the land area identified as forest land shave been decreasing steadily due to industrial and social development which competes for the same pieces of land upon which the forest stands (Alamu, L. O. and Agbeja, B. O., 2011)

Annually, more than 7.000.000 hectares of forests, jungle and scrubs are destroyed annually through forest fire and between the factors that favour this phenomenon are the high temperatures, the strong and dry droughts and great lack of humidity and winds that contribute to the dispersion of the fire. What begins being a spark, quickly becomes a fire center that advances and it is not easy to be stopped nor be controlled (Encarta, 2009).

Due to poor economies, people resort to clearing the forest and planting crops in order to survive. While there have been effective efforts to stop deforestation directly through boycotts of multinational corporations responsible for exploitative logging, the most effective conservation policies have been efforts to relieve poverty and expand access to education and health care.

In 2005 the Food and Agriculture Organization of the United Nations issued a major report, titled "Global Forest Resources Assessment 2005," on the status of the world's forests. Based on a five-year study, the report found that forested areas throughout the world were continuing to decline at a rate of about 7.3 million hectares (18 million acres) per year, an area equivalent in size to Panama or Sierra Leone. However, the rate of decline had slowed in comparison with the period from 1990 to 2000, when the world lost about 8.9 million hectares (22 million acres) of forested area per year. Africa and South America continued to have the largest net loss of forests, while forest loss also continued in North and Central America and the Pacific Islands (Encarta, 2009).

These loses are majorly due to Weak policy formulation and enforcement; Political factors manifested through, for example, the practice of giving patches of forest to supporters of politicians for political patronage; Macro-economic policies, such as increasing cash crop farming for exports; Structural adjustment; Population pressures; and Trade liberalization (Lynette O. and Wangwe J.B., 1999).

2.0 THE STUDY AREA

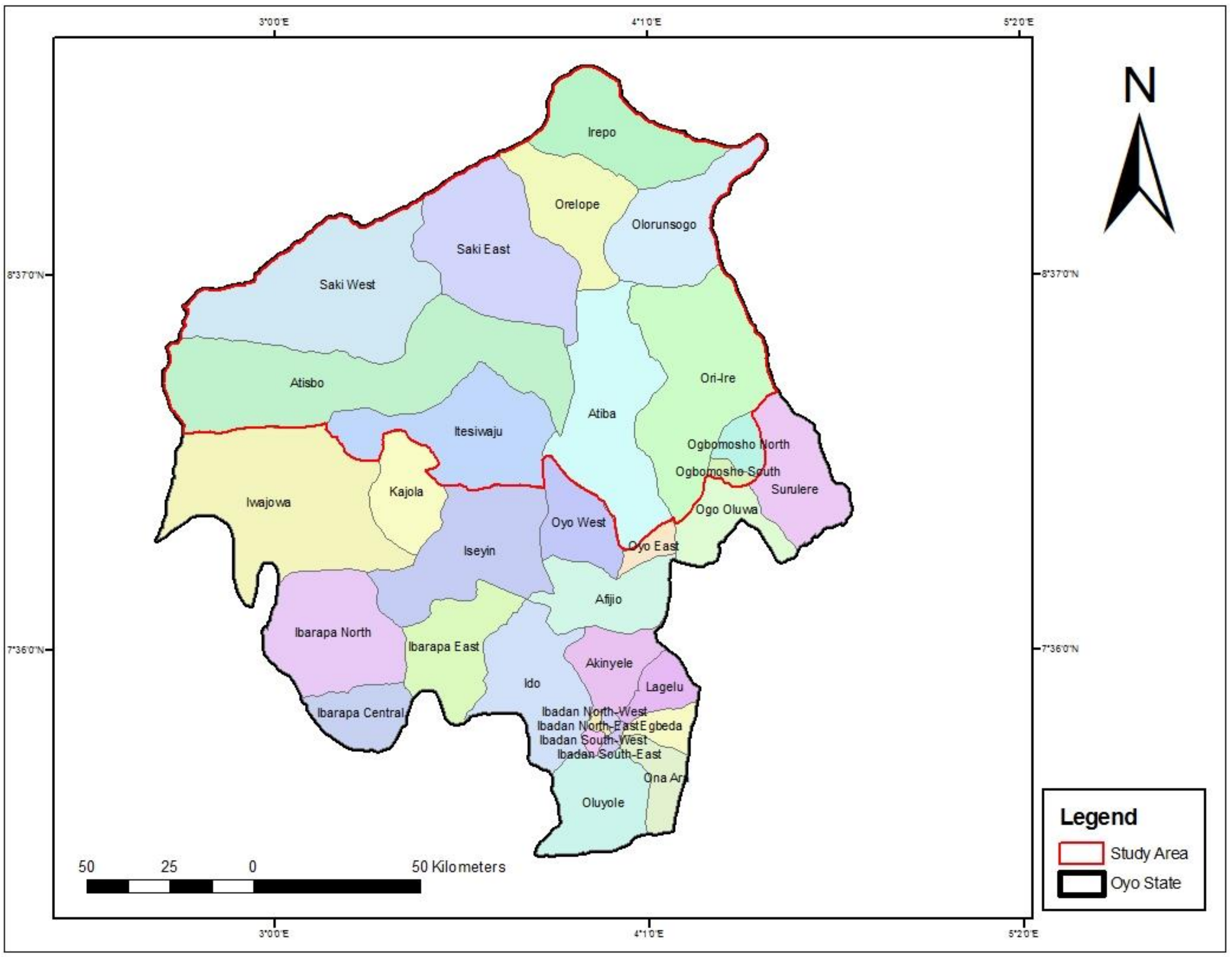

Figure 1: Map of Oyo State.

Source: Ministry of Lands and Survey (updated by Author, 2013).

Oyo is an inland state in the south western Nigeria, with its capital at Ibadan. It is bounded in the north by Kwara State, in the east by Osun State, in the south by Ogun State and in the west partly by Ogun state and Republic of Benin. The area is defined by latitude 8.00N 4.00W and longitude 8.000N 4.000E. The state covers approximately an area of 28,454 8q km and is ranked 14th by size amongst the state in Nigeria with a population of 5,591,589 according to 2006 Census, (NPC, 2006).

The climate is equatorial, notably with dry and wet seasons with relatively high humidity. The state is home to NTA Ibadan the first television station in Africa, Obafemi Awolowo Stadium, first sky scrapper in Africa (cocoa home), the first Nigerian university (UI), and first teaching hospital (UCH). The state is an agricultural centre because of its fertile agric hinterland. The state was created in 1976v and is the largest indigenous African city south of the Sahara

2.1 FOREST RESOURCES IN OYO STATE

The Forestry Ordinance of 1916 in Nigeria states three major methods of forest conservation which are to teach the natives the methods of intensive cultivation, to create forest reserves and partially to protect unreserved forest areas. And in a bid to manage Forest Resources in Nigeria for Agriculture as well as for Export, certain objectives were carved out and these includes;

- To mitigate shifting cultivation and secure favourable conditions for intensive agricultural activities.
- To continuously supply forest produce not only for public requirements but also for domestic and foreign markets. Public needs included revenue generation and railway construction while the need of the native population included the materials for buildings, canoes, agricultural implements, firewood, fibre etc
- To conserve water for domestic, commercial and industrial purposes, irrigation, and power generation from waterfalls.
- To rest the soil in order to improve its fertility for cultivation.
- To increase the atmospheric humidity of the forest environs and consequently, heir rainfall for the purpose of promoting the growth of their trees and crops.
- To control runoff from the hill slopes and minimize the danger of flood on adjoining lowlands and in river valleys.

- To control soil erosion and landslips on hill slopes and the silting of the adjoining lowlands and river valleys.
- To conserve wildlife. (Obateru, 2010)

Some of the forest reserves created then are the Alalubosa Forest reserve in 1916, Ogunpa Forest reserve in 1931, the Oke- Aremo forest reserve in 1932, and the Eleyele Forest Reserve in 1941, all in Ibadan.

Advancements in the principles and methods of forest conservation came as a result of the widespread destruction of the forests of the country taking place then, arising from the farming practice of shifting cultivation that was rampart in the 19^{th} century.

A field investigation carried out in 2000 however revealed that these forest reserves in have not been managed properly and have been greatly abused such as

- Misuse of forest reserves for religious activities
- The Ogunpa forest reserve was used for the establishment of Oba Akinbiyi High Schools 1 and 2.
- Quarrying of earth, sand and gravel in the forest reserve.
- Illegal farming in the forest reserves
- Illegal hunting in all the forest reserves
- Misuse of forest reserves for burying the dead
- Dumping of waste by the public in the forest reserves
- Misuse of forest reserves as hideouts by criminals and armed robbers
- Non availability of forest guards or patrol staff to police the forest reserves against illegal entry and abuse
- Lack of funds for their proper management, especially for the provision of perimeter fences and forest guards (Obateru, 2010)

Others include weak policy formulation and enforcement; Political factors manifested through, for example, the practice of giving patches of forest to supporters of politicians for political patronage; Macro-economic policies, such as increasing cash crop farming for exports; Structural adjustment; Population pressures; and Trade liberalization.

All these problems portray the depth of environmental insolvency in the management of our forest resources and the lack of proper management.

3.0 METHODOLOGY

Data for this study were gotten from two different sources that is primary and secondary data. The primary sources include three sets of satellite imagery for Oyo State covering the study area (Local Government in Question) for 1990, 2000 and 2005. The images for 2000, 2005 are enhancing Thematic Mapper while that of 1990 is Thematic Mapper. All the images were downloaded from the global land cover facility.

Band 4, 3 and 2 was stacked together using ERDAS IMAGINE. The stacked image was used to develop a false colour Composite for the all images to be considered. Sample set were created in ILWIS and five classes of land uses were created on the images, they are: Agricultural Land, Built-up Area, Vegetation, Bare Surface/ Degraded Land and Water Body. All the three images were subjected to a supervised classification in ILWIS software (Integrated Land Water Information System).

Table: 3.1 Satellite Image Data Information

Year of Landsat Imagery	Date of acquisition	Resolution	Path and Row	Column	Row
Landsat TM 1990	1990-12-06	28.5m	P191R054	7703	7329
Landsat ETM+ 2000	2000-02-06	28.5m	P191R054	8597	7548
Landsat ETM+ 2005	2005-11-18	30m	P191R054	8061	7081

Source: Satellite Image Metadata Files

The secondary sources of data include published and unpublished journals from the internet; and other related materials obtained from the Oyo State Urban and Regional Planning Board.

3.1 Normalize Differential Vegetation Index (NDVI)

Normalize Differential Vegetation Index **(**NDVI) of the study areas was calculated from the visible band (band 3) and near-infrared band (band 4) reflected by vegetation. Healthy vegetation absorbs most of the incoming visible light, and reflects a large portion (about 25%) of the near infrared (NIR) light, but a low portion in the red band (RED). Unhealthy or sparse vegetation reflects more visible light and less NIR light. Normalize Density Vegetation Index **(**NDVI) data provide an opportunity to assess quantitatively and qualitatively the vegetation cover status in the past and present, to determine trends, and to predict the ecosystem processes (Nemani et al., 1997).

To calculate NDVI (Normalized Difference Vegetation Index) values, you can use the Map Calculate function NDVI (*a, b*). This function requires 2 satellite bands (one with visible or red values and the other near-infra red values). The function performs the calculation:

$(b - a) / (a + b)$

When using the NDVI (*a*, *b*) function, *a* is replaced with the band with visible or red reflectance, and *b* with the band with near-infrared reflectance.

4.0 RESULTS AND DISCUSSIONS

The classified images are analyzed and they show changes in area of all land use/ land cover types during the period under study (1990-2005).

Table: 4.1 Land cover in the Study Areas (1990,2000 and 2005)

Sample Set	1990 (SqKm)	%	2000 (SqKm)	%	2005 Sq/Km	%
Agricultural Land	15092.847	71.541	17588.498	83.382	12370.459	56.267
Bare surface/ Degraded Land	76.264	0.362	414.689	1.966	678.145	3.085
Built-up Area	436.459	2.069	693.802	3.289	843.206	3.835
Vegetation	5488.689	26.019	2349.144	11.137	7556.902	34.373
Water Body	2.402	0.011	47.669	0.226	536.503	2.440
Total	21096.661	100	21093.803	100	21985.215	100

Source: Author, 2013.

Figure 2 shows the characteristic of the classified image of 1990, Agricultural land is represented in colour yellow and covers 71.541%, bare surface/ degraded land is represented in cyan colour with a landcover of 0.362%, built-up area is represented in colour red and covers 2.069%, vegetation is covers 26.019% of the total land coverage and is represented in light green colour. Water body is represented in colour blue and covers 0.011% (Table 4.1). Figure 4 shows the image characteristic of the study area in 2000. Built-up area covers 3.289% and is represented in red colour. Degraded land/bare surface is represented in cyan colour and covers an area of 1.966%. Agriculture land is represented in yellow colour and has an area of 83.382%. Water body is represented in blue colour and covers an area of 0.226% and Vegetation covers an area of 11.137%. And it is represented in light green colour.(Table 4.1) The characteristics of the classified image of 2005 is shown in Figure Agricultural land covers 56.267%, Bare surface/ degraded land covers 3.085% and it is represented in colour yellow and Cyan respectively. Built-up area covers 3.835% and it is respresnted in colour. Vegetation is reprensented in light green and it covers 34.373%. water body has the least coverage of the total land area with 2.440% and it is represented in colour blue.(Table 4.1)

Table: 4.2 Magnitude and percentage of change in Land cover between 1990 and 2000.

Sample Set	1990 (A)	2000 (B)	Magnitude of Change (B-A)abs	Annual frequency change C/10	Percentage of change C/A x100
Agricultural Land	15092.847	17588.498	2495.651	249.565	16.535
Bare surface/ Degraded Land	76.264	414.689	338.425	33.842	443.755
Built-up Area	436.459	693.802	257.343	25.734	58.962
Vegetation	5488.689	2349.144	-3139.545	-313.954	-57.200
Water Body	2.402	47.669	45.267	4.528	1885.555
Total	21096.661	21093.803	-2.859	-0.285	2347.607

Source: Author, 2013.

Table: 4.3 Magnitude and percentage of change in Land cover between 2000 and 2005

Sample Set	2000 (A)	2005 (B)	Magnitude of Change (B-A)abs	Annual frequency change C/5	Percentage of change C/A x100
Agricultural	17588.498	12370.459	-5218.039	-1043.607	-29.667

Land					
Bare surface/ Degraded Land	414.689	678.145	263.456	52.691	63.531
Built-up Area	693.802	843.206	149.404	29.881	21.534
Vegetation	2349.144	7556.902	5507.758	1041.552	234.458
Water Body	47.669	536.503	488.834	97.767	10.255
Total	21093.803	21985.215	1191.413	178.284	300.111

Source: Author, 2013.

The magnitude of change (Table 4.2) for 1990-2000 is calculated by subtracting the area of each Landcover type for the year 1990 from 2000 that is, (B-A) absolute. The percentage of change (E) is calculated by dividing the magnitude of change C of each Land cover category by the figure of the base year that is, 1990 then multiplying the result by 100. The same is done for the periods 2000 to 2005(Table 4.3) where 2000 is the reference year. Annual frequency of change is gotten by dividing the magnitude of change of each Landcover category by the number of years between the period that is 10 years for 1990 -2000 and 5 years for 2000 – 2005. The results of the analysis unveil a tremendous change in the Landcover of the study areas during the period of study (15 years). It can be noticed that the percentage change in the proportions of some Landcover sample sets increased while others decreased.

Table 4.2 show an increase in bare surface and degraded land in the year 2000 with a magnitude of change of 338.425 square kilometers. These changes can be attributed to human activities such as deforestation and sand mining. The built-up areas also increased in year 2000 with a magnitude of change of 257.343 square kilometers and an annual frequency of change of 25.734. Due to the increase in population growth and other developmental activities the vegetation of the study areas reduced by -3139.545 square kilometers with an annual frequency of change and percentage of change of -313.954 square kilometers and -57.200 square kilometers respectively. Agricultural activities also increased in the year 2000 with a land coverage of 2495.651 square kilometers in the study areas.

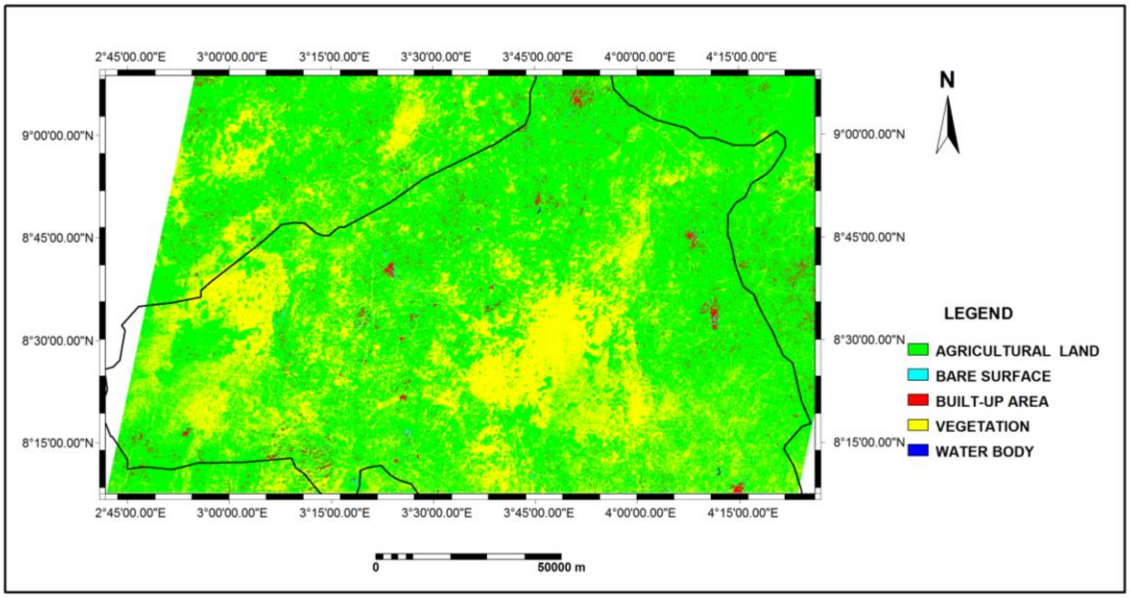

Figure 2: Classified Image of the Study Area, 1990.

Source: Author, 2013.

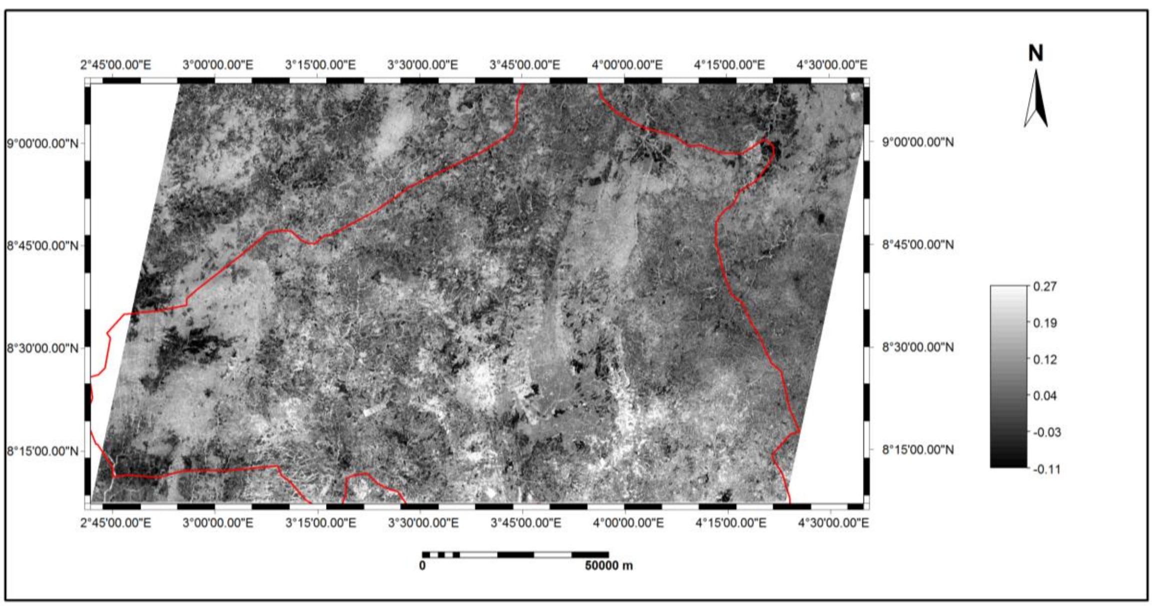

Figure 3: NDVI (Normalized Difference Vegetation Index) of the Study Area,1990

Source: Author, 2013.

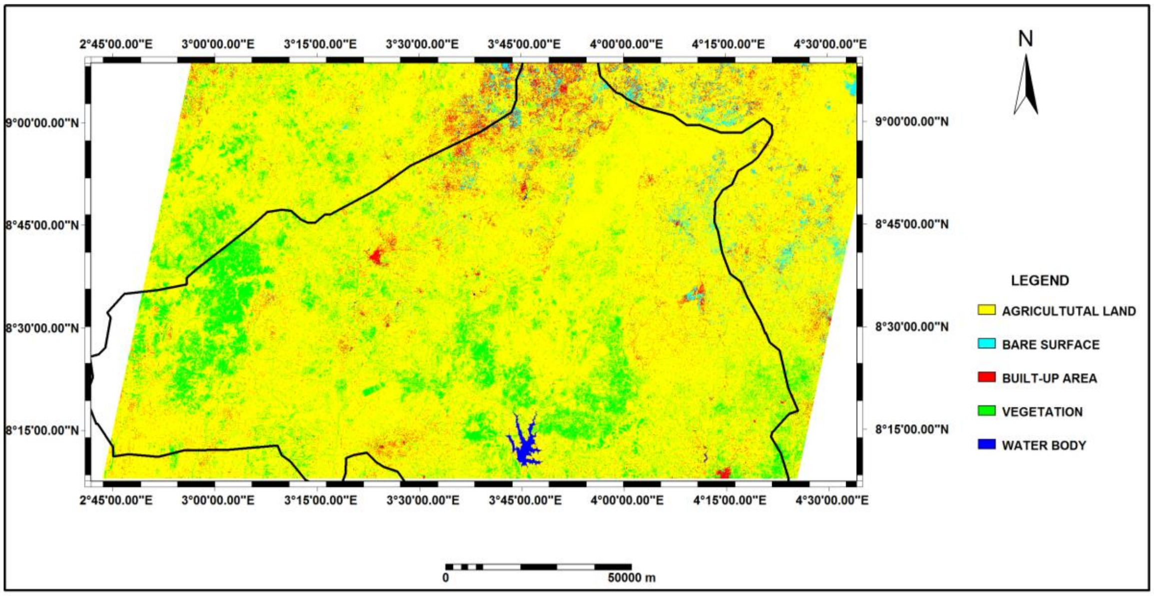

Figure 4: Classified Image of the Study Area, 2000.

Source: Author, 2013.

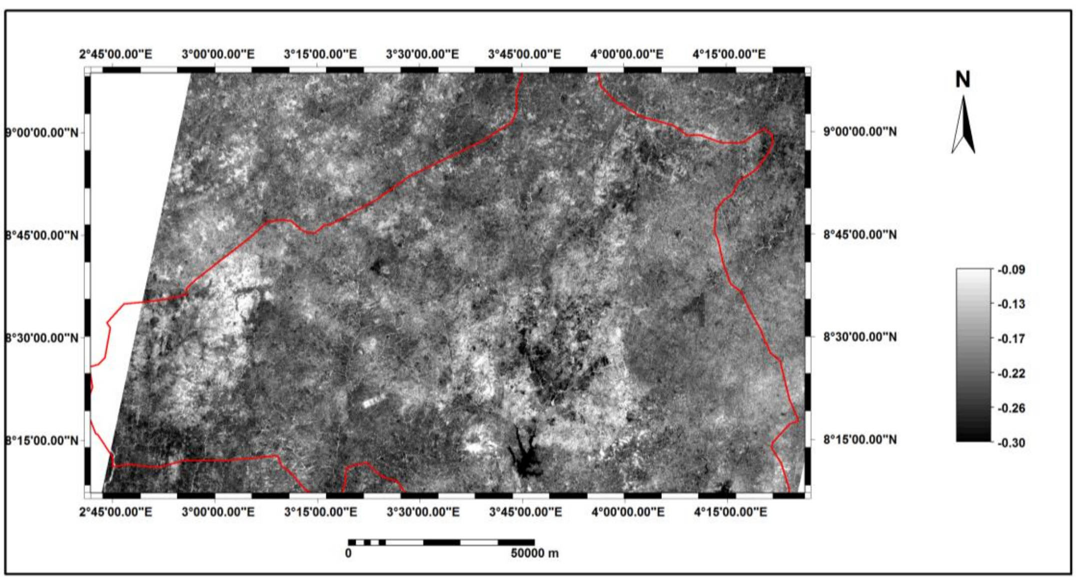

Figure 5: NDVI (Normalized Difference Vegetation Index) of the Study Area,2000

Source: Author, 2013.

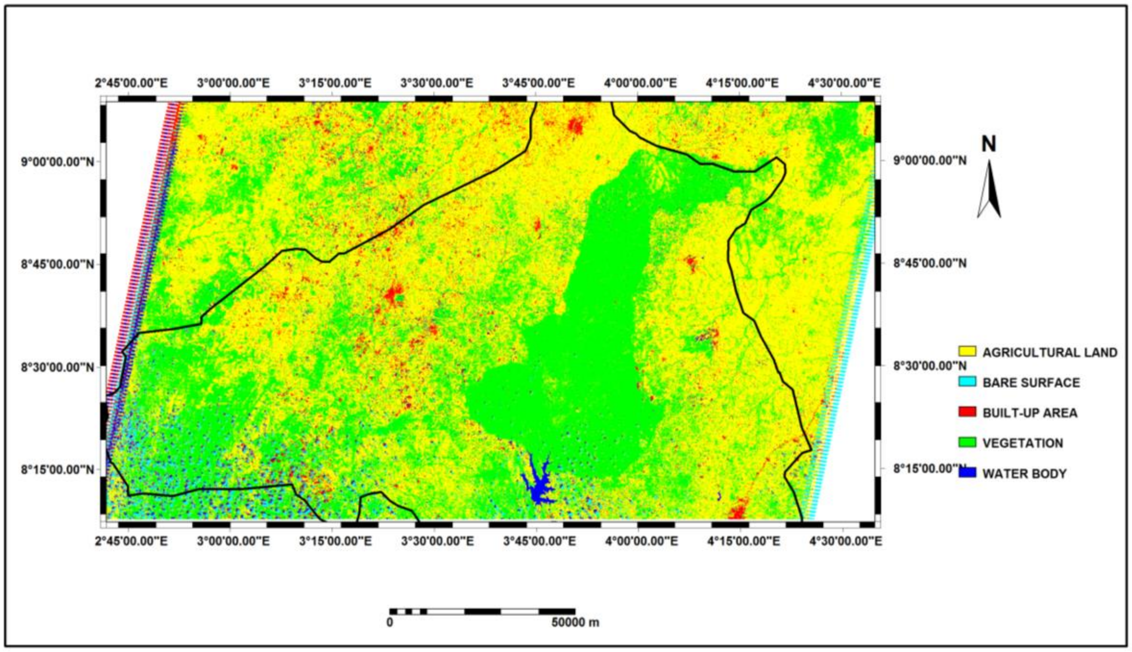

Figure 6: Classified Image of the Study Areas 2005.

Source: Author, 2013.

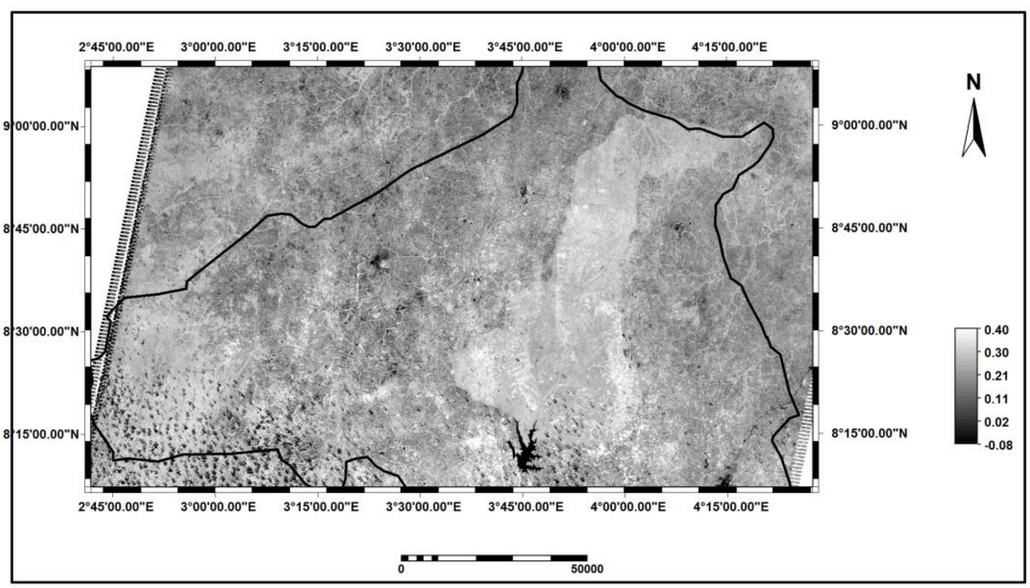

Figure 7: NDVI (Normalized Difference Vegetation Index) of the Study Area, 2005.

Source: Author, 2013.

The period of 2000-2005 shows an increase in bare surface/ degraded land with a percentage change of 63.531 square kilometer this could be as a result of bush burning, deforestation and conversion of land cover into other uses. The magnitude of change within the period of 2000 – 2005 shows an increased by 149.404 square kilometers with an annual frequency change of 29.881 square kilometers in the study area. The vegetated areas increase in 2005 with a magnitude of change of 5507.758 square kilometers. This increase could be attributed to the time the image was taken (that is, immediately after the rainy season). Due to the increase in the degraded land/ bare surface, agricultural land reduced in the study areas with a change in magnitude of -5218.039 square kilometers and an annual frequency change of -1043.607.(as shown in Table 4.3)

Analysis of vegetation and detection of changes in vegetation patterns are keys to natural resources assessment and Monitoring. Thus it comes as no surprise that the detection and quantitative assessment of green vegetation is one of the major applications of remote sensing for environmental resource management and decision making. NDVI measurement has the desirable property ranging from -1 to +1 with 0 representing the approximate value of no vegetation. Thus negative values represent non-vegetated surfaces. (Musa et al, 2011). In 1990, non-vegetated surfaces of the study areas ranges between -0.78 to -0.01, while the vegetated surfaces ranges from 0.01 to 0.96 (Figure 3) indicating substantial level greenness in the study areas for this period. However, there was declined in 2000 (Ten years period). The result of the analysis shows that the vegetated surfaces ranges from 0.01 to 0.15 (Figure 5) and the non vegetated area ranges from -0.50 to -0.01 indicating a decrease in vegetated surface of the study areas. The decrease in vegetation can be attributed to deforestation of forested area for fuel. In 2005 there was also a substantial level of greenness in the study areas because image used was acquired immediately after the rainy season. The vegetated surface ranges from 0.01to 0.99 and the non-vegetated area ranges from -0.01 to -1.0 (Figure7). The non-vegetated surface is the reflection of the increase in the degraded land/ bare surface in the study areas.

5.0 CONCLUSION

This study was carried out with the aid of Landsat false colour composite satellite imageries taken in 1990 (TM), 2000 (ETM+) and 2005 (ETM+). The following observations were made:

- The degraded land/ bare surface are increasing in an alarming rate. The magnitude of changes in 2000 and 2005 are 338.425sqkms and 263.456sqkms respectively. Looking at the magnitude of change in 2005 the degraded land is likely to increase to 3951.840sqkms in 2015 if the human activities are not properly checked, it could lead to loss of bio-diversity in plants and animals.
- The rate of change of natural vegetation between 1990 and 2000 was -313.954sqkms per annum while that of 2000 and 2005 was 1041.552sqkms per annum.
- The built-areas increased with a percentage change of 21.534 in 2005 and land coverage of 843.206sqkms as against 693.802sqkms in 2000.
- There was a serious decline in vegetation in 2000 and the non vegetated area ranges from -0.50 to -0.01. Loss of naturally vegetated areas in the study areas is mainly as a result of urban growth and expansion, farming, bush burning and deforestation.

6.0 RECOMMENDATIONS

- The Government research institute should source and develop alternative source of energy, especially for domestic use such as: Cooking and Electricity. The alternative source of energy could include, wind, solar, Biomass and Water.
- The State Governor should enforce forestry laws in the State in order to put a stop to wanton bush burning and illegal felling of tress.
- The State Government should promote public awareness on dangers of deforestation in all local government to curb the rate of forest related disasters.
- Forest Conservation and Reserve should be encouraged so as to preserve plant and animal bio-diversity
- GIS technique for monitoring changes in the forested areas should be employed and embraced at every Local Government Land use Department in the State..

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